Ethnomathematics and the challenges of racism in mathematics education

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The *Adamastor* episode as metaphor for racial and political dimension of ethnomathematics

In 1572, the Portuguese adventurer and writer, Luís Vaz de Camões (1524-1580) published his epic poem, *Os Lusíadas (The Sons of Lusus, that is, the Portuguese*), which has come to be known as the Portuguese national epic. *Os Lusíadas* praises the Portuguese leaders of the past and celebrates the heroic accomplishments of the Portuguese nation, the glories of the Portuguese over the enemies of Christianity, while telling the story of Vasco da Gama's extraordinary voyage around Africa and across the Indian Ocean to India, the first ever from Europe. The poem is divided into ten parts, called *Cantos*. In the Fifth Canto, sometimes called the *Adamastor* Episode, Camões describes that after circumnavigating the continent, da Gama's small fleet anchors in the harbor of the East African port of Melindi, where the navigator recounts to the Muslim Sultan the events of the voyage to date. Our specific interest in this part of the epic is the episode in which Camões tells us that Vasco da Gama's fleet is about to double the storm-wracked southern cape of Africa, known today as the Cape of Good Hope and then to the Portuguese as (in the words Bartolomeu Dias) "*Cabo Tormentoso*," the Cape of Storms. On the one hand, the *Adamastor* Episode can be read as a tale of the victorious struggle of the Portuguese against the forces of nature. One the other hand, against an imperial backdrop, we can read the episode as a dramatic scene in a colonial narrative that commemorates Portugal's "glorious," expansionist launch and projects a "rightful" subjugation of Africa and other Eastern regions by Portuguese other European powers.

In the second half of the Fifth Canto, as Vasco da Gama and his fleet approach the Cape of Storms, *Adamastor*, represented as a hideous phantom; a dark, ominous cloud; an anthropomorphic spirit of storms of the Cape, appears overhead and reproaches the Portuguese voyagers for venturing into the seas. This "black African monster," sternly warns the frightened mariners and prophesizes that disaster will befall anyone who dares to round the Cape. At this moment, he represents both a threat and a challenge to European cognition. He symbolizes Africa full of traditions, know-how, and secrets. Temporarily, he inflicts a paralysis on European knowledge and judgment. This is resolved in the dialogue that follows his materialization. *Adamastor* speaks first, prophesying doom to the Portuguese adventurers and their many successors, who have been hubristically transgressing boundaries, penetrating secrets, and intruding on forbidden domains. Not only does he correctly prophesize the destruction of

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future seafarers in the stormy passage around the Cape, but he also anticipates other forms of destruction to be visited on Europeans for moving out of their proper place (Crewe, 1997, p. 30).

Eventually, da Gama effectively challenges *Adamastor*. The fact that *Adamastor* either does not know himself, or is dissimulating his animus, is exposed when da Gama interrupts his diatribe. Despite everything *Adamastor* has said, da Gama still wonderingly asks, “Who art thou,…?” (stanza 49). This psychological question that is both unexpected and penetrating is a question of being and elicits from *Adamastor* a pathetic admission of feeling isolated and violated “roud out Africa’s extremity…Which your audacity has deeply wronged” (stanza 50). Da Gama’s question also elicits *Adamastor*’s history of defeat as a titan, his envy of the mobility of the Portuguese explorers, and, above all, his almost inconceivably “displaced” desire for the classical Thetis, a white sea nymph. He tells how, for presumptuously fondling Thetis, he has undergone punitive metamorphosis “into hard clay” (stanza 59). And overcome with sorrow and self-pity, *Adamastor* finishing telling “his tale, and weeping wild” (stanza 60) vanishes from before da Gama, who then prays to God to withhold the “evils *Adamastor* had foretold” (stanza 60). It is not the Portuguese but the African who is thus doomed and immobilized for tabooed desire for the “white” woman. He is emasculated and considered abject. Vasco da Gama thus circumnavigates *Adamastor* resistance to Portuguese expansion. In so doing, the Portuguese conquering hero appropriates *Adamastor*’s titanic stature and, thereby, guarantees the future of the European colonial project.

The poem of Camões, particularly the *Adamastor* Episode, speaks to many issues in the colonial literature and its interpretation of history. What strikes us is that if we see *Adamastor* as representative of the colonized and Vaso da Gama as the colonizer a mainstream, multicultural reading is that da Gama was interested in *Adamastor*, someone from another culture, by asking who he is and listening attentively to him. A critical reading can view da Gama’s question as a subtle psychological strategy for conquest, resulting in disarming *Adamastor* and using African navigational knowledge that allowed da Gama to double the Cape and continue with the colonial project.

Ethnomathematics, a discipline that emerged from an engaged multicultural perspective on mathematics and mathematics education and poststructural theorizing, symbolizes the return of *Adamastor*. It is a resurrection of an African Titan to correct the history of mathematics for African and other formerly colonized peoples who were disempowered by the violent and avaricious European colonial process and who continue to be threatened and plummeted by the current imperial project euphemistically called globalization. D’Ambrosio (1985, 1987, 1988, 1990, 2001) mathematician and educational theorist, initiated theorization about ethnomathematics. In his recent book, Etnomatemática: *Elo entre as tradições e a modernidade* [Ethnomathematics:

Link between tradition and modernity], D'Ambrosio (2001) articulates his viewpoint on the political nature of the discipline:

> Ethnomathematics is the mathematics practiced by cultural groups such as urban and rural communities, labor groups, professional classes, children of a certain age bracket, indigenous societies, and many other groups that identify themselves through objects and traditions common to the groups.[1]
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> Beside this anthropological character, ethnomathematics has an indisputable political focus. Ethnomathematics is imbued with ethics, focused on the recuperation of cultural dignity of human beings.
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> The dignity of the individual is violated by social exclusion that often causes one not to pass discriminatory barriers established by the dominate society, including and, principally, in schools (p. 9, my translation[2]).

Ethnomathematics represents a break with attributes of Enlightenment thinking. In particular, it departs from a binary mode of thought and a universal conception of mathematical knowledge that privileges European, male, heterosexual, racist, and capitalistic interests and values. A metaphorical goal of the ethnomathematics program is to reconstitute *Adamastor*: As D'Ambrosio (2001) states it

> Ethnomathematics encompasses in this reflection on decolonialization and in the search for real possibilities of access for the subaltern, for the marginalized e for the excluded. The most promising strategy for education, in societies that are in transition from subordination to autonomy, is to reestablish the dignity of its individuals, recognizing and respecting their roots. To recognize and respect the

[1] A conceptually fruitful consequence of defining ethnomathematics as specific mathematical practices constituted by cultural groups is the scope of such activities. One can theorize that in ethnomathematics, the prefix "ethno" not only refers to a specific ethnic, national, or racial group, gender, or even professional group but also to a cultural group defined by a philosophical and ideological perspective. The social and intellectual relations of individuals to nature or the world and to such mind-dependent, cultural objects as productive forces influence products of the mind that are labeled mathematical ideas. Dirk J. Struik (1948 reprinted in 1997), an eminent mathematician and historian of mathematics, indicates how a particular perspective—dialectical materialism—decisively influenced Marx's theoretical ideas on the foundation of the calculus. The calculus of Marx (1983) represents the ethnomathematical production of a specific cultural group. For a popular account of Marx's calculus, see Gerdes (1985).

[2] Etnomatemática é a matemática praticada por grupos culturais, tais como comunidades urbanas e rurais, grupos de trabalhadores, classes profissionais, crianças de uma certa faixa etária, sociedades indígenas, e tantos outros grupos que se identificam por objetivos e tradições comuns aos grupos.

Além desse carácter antropológico, a etnomatemática tem um indiscutível foco político. A etnomatemática é embebida de ética, focalizada na recuperação da dignidade cultural do ser humano.

A dignidade do indivíduo é violentada pela exclusão social, que se dá muitas vezes por não passar pelas barreiras discriminatórias estabelecidas pela sociedade dominante, inclusive e, principalmente, no sistema escolar (p. 9).

> roots of an individual does not mean to ignore and reject the roots of the other, but, in a process of synthesis, to reinforce ones own roots (p. 42, my translation[3]).

In my vision, reconstituting *Adamastor* is metaphoric for the political dimension of ethnomathematics as a research program. As D'Ambrosio (2001) notes there are other dimensions including conceptual, historical, cognitive, epistemological, and educational. In addition, some researchers (Barton, 1995) are attempting to establish a philosophical dimension to ethnomathematics.

Ethnomathematics, race, and mathematics education

The ethnomathematics researchers (Knijnik, 1998; Powell and Frankenstein, 1997; among others) recognize that power struggles around who knowledge counts that have constituted interactions among European cultural groups and nations and, for instance, African cultural groups and nations also constitute internal relations among African cultural groups and nations. For example, the mathematics presented in extant mathematical papyri from ancient Egypt most probably has preserved the mathematical ideas of an African elite. Nevertheless, mainstream, Eurocentric historians of mathematics have largely discounted these ideas. Consider the following statement of a famous author of books on topology, differential equations and the calculus as well as on the history of mathematics:

> In all history, nothings is so astonishing as the sudden appearance of intellectual civilization in Greece. Many of the other components of civilization—art, religion, complex societies capable of organizing and carrying out enormous projects—had already existed for hundreds or thousands of years, in Egypt, in Mesopotamia, and in China. No one has ever surpassed the Egyptians or Babylonians in monumental stone sculpture, or the Chinese in the production of incomparable works of art in bronze and ceramics. And even today we stand in awe of the organized effort that built the Great Pyramid of Egypt and the Great Wall of China. But what the Greeks achieved in the realm of the intellect is greater still: they invented mathematics, science, and philosophy (Simons, 1972, p. 3).

As the above quote indicates, the importance of Africa's contribution to mathematics and the central role of that contribution to the mathematics studied in schools have not received the attention and understanding that befit them. As an example, documentary evidence of insightful and critical algebraic ideas developed in ancient Egypt exists, but little of this information has been made available to students studying mathematics, at any level. Through my own

[3] A etnomatemática se encaixa nessa reflexão sobre a descolonização e na procura de reais possibilidades de acesso para o subordinado, para a marginalizado e para o excluído. A estratégia mais promissora para a educação, nas sociedades que estão em transição da subordinação para a autonomia, é restaurar a dignidade de seus indivíduos, reconhecendo e respeitando suas raízes. Reconhecer e respeitar as raízes de um indivíduo não significa ignorar e rejeitar as raízes do outro, mas, num processo de síntese, reforçar suas próprias raízes. (p. 42)

research and development of a course module, I am attempting to contribute to redressing this lack of scholarship in school algebra courses by incorporating mathematical ideas from what some researchers call the *Ahmose Mathematical Papyrus* (Diop, 1985; Joseph, 1991; Lumpkin, 1985; Zaslavsky, 1999).

Although the ravages of more than three millennia of time, conquest, plunder, and colonialism have destroyed many African documents and other artifacts of historical and scientific significance, a few Egyptian papyri have managed to survive. In the Egyptian period, before the Greek conquest of the Egyptian state in –332 (or 332 BC), the scribe Ahmose wrote what in Eurocentric historiography is known as the *Rhind Mathematical Papyrus*, the most extensive papyrus of a mathematical nature and dated approximately –1650 (Chace, Manning, & Archibald, 1927, 1929; Gillings, 1982; Robins & Shute, 1987). It and another Egyptian mathematical papyrus, now lodged in the Moscow Museum of Fine Arts, are humanity's oldest extant mathematical document. According to Robins and Shute (1987), the papyrus roll written by Ahmose was found in the ruins of a small building close to the mortuary temple of Ramesses II at Thebes and, in 1858, purchased in Luxor along with other Egyptian antiquities by Alexander Henry Rhind. After his death in 1963, the Ahmose papyrus roll, "together with another mathematical document known as the Leather Roll (BM 10250), was purchased from his executor in two pieces (BM 10057-58) by the British Museum in 1865"(p. 9). Since Ahmose wrote the mathematical text, as with any other text, his papyrus roll ought be called the *Ahmose Mathematical Papyrus*, after him, the author. A little more than one foot high and nineteen feet long, written hieratic form, Ahmose's papyrus contains numerical tables for calculations as well as arithmetic, geometric, and algebraic problems, 85 in all, together with explanations of methods and worked out solutions (Chace et al., 1927; Gillings, 1982) and provides us with considerable information about ancient Egyptian mathematics. The algebraic techniques of Problems 28 and 29 are the subject of my course module.

Western scholars of the history of mathematics have markedly different interpretations of the significance and mathematical ideas expressed in Problems 28 and 29. On the one side, Chace (Chace et al., 1927) considers these problems to belong to a category of *aha* or "quantity" problems (p. 67-71). Such problems, according to Chace, "nearly all begin with the word *aha* and use this word to denote the result of their calculations" (p. 25). Interestingly, upon close examination of the photographic plates of Problems 28 and 29 of Ahmose's papyrus contained in Chace's second volume (Chace et al., 1929, Photograph XII and Plate 51), one can see that these two problems neither begin with nor even contain the word *aha*. Possibly due to Chace's incorrect assessment of the nature of Problems 28 and 29, he opines that Ahmose seems not to have provided a complete solution to Problem 28.

On the other side, Gillings (Gillings, 1961; 1982) interprets differently the meaning and mathematical ideas exemplified in Problems 28 and 29. He considers that these two problems are in a category of nine others that explore "methods of solving equations in one unknown of the first degree" (1982, p. 154). For these eleven problems, he divides them into three subcategories based on their difficulty and method of solution. Problems 24 to 27, different from 28 and 29, illustrate a method known as "false position," and belong to his first subcategory (1982, p. 154). Problems 28 and 29 belong to Gillings's second subcategory, which he described as "think of a number problems (1982, p. 158) about which he considers as the earliest examples on record (1982, p. 181). Interpreting Problems 28 and 29 from this perspective, one finds that the problems and their solutions are indeed complete and that their solutions offer an interesting and insightful approach to solving equations in one unknown of the first degree. The differing scholarship of Chace and of Gillings, leads one to wonder about what differences in their theoretical orientation or analytic method lead them to substantially different interpretations of the mathematical ideas of ancient Egyptian scientists as evidenced in the papyrus of Ahmose.

The curricular module that incorporates scholarship on African mathematics into the curriculum of school algebra is based on insights of Ahmose (circa –1650) and work of Hoffman and Powell (1988; 1991). It engages students in learning a set of algebraic techniques from ancient Africa in order to enable students to develop insight and facility in solving a large class of algebraic equations. The curricular module has manifold, convergent meanings of mathematical, pedagogical, and political significance. First, students study the history of the *Ahmose Mathematical Papyrus* as well as the differing scholarly interpretations of the meaning of Problems 28 and 29. Second, students learn algebraic techniques from ancient Egypt with which to solve single-variable, first- and second-degree equations, the only two classes of equations that at present are part of most school algebra curricula. Far beyond this, students learn to generalize these techniques to enable them to solve a wider array and more complex algebraic equations. Specifically, they learn to solve n-degree equations, where n is rational and $n > 2$, such as radical equations expressed in exponential form. Third, far from trivializing or folklorizing Africa or its mathematical contributions, the inclusion of African algebraic techniques will help students develop more sophisticated mathematical insights and abilities. Fourth, since *all* students have a common biological heritage rooted in Africa (Diop, 1974; Tattersall, 1997), they gain an increased appreciation for the mathematical accomplishments of their ancestors as well as for the diverse cultural manifestations of mathematical ideas (Gerdes, 1999; Powell & Frankenstein, 1997). Finally and importantly, students reflect on the politics of knowledge and power. They discuss essentially how the intellectual subject positions of African and African American as well as other oppressed groups are constituted though experience with school curricula that are themselves largely expressions of the intersubjectivity of dominant discourses. These discourses express a supposed intellectual hierarchy to differentiate its valuation of the products of the oppressed as practical in contrast to their own ‘theoretical’ products. Diop (1991) discusses a number of other cases in which eurocentric scholars use this practical-theoretical hierarchy to deny the sophisticated mathematical knowledge of the ancient Egyptians.

In spite of scholarship on the Egyptian mathematical writings, the Eurocentric myth persists and effects school curricula. Ethnomathematics challenges the particular ways in which Eurocentrism permeates mathematics education: that the ‘academic’ mathematics taught in schools world-wide was created solely by the European males and diffused to the Periphery; that mathematical knowledge exists outside of and unaffected by culture; and that only a narrow part of human activity is mathematical and, moreover, worthy of serious contemplation as ‘legitimate’ mathematics. Many ethnomathematicians view themselves not as neutral academics, but as activist academics, committed to finding ways to contribute to struggles for justice through our educational work. They not just interested, for example, in the mathematics of Angolan sand drawings but also in the politics of imperialism that arrested the development of this cultural tradition, and in the politics of cultural imperialism that discounts the mathematical activity involved in creating Angolan sand drawings. Further, they are alert for ways that this contextualized mathematical knowledge can be used in educational settings to contribute to greater social justice.

The significance of the *Adamastor* Episode connects most particularly with an aspect of ethnomathematics—the ′unfreezing′ or uncovering of ′hidden′ or stolen mathematical knowledge. Camões epic poem and Vasco da Gama′s voyage serve to justify and encourage past and future plunder of the material resources and intellectual wealth of the peoples of Africa India, and more generally, Asia, and Latin America.

I now want to turn my attention to the question of who is learning and who is not even present in the classroom. To begin addressing this question, I would like to present to you a brief segment of an interview with a high school student conducted by a researcher, a colleague of mine. The student participated in a research study that explored mathematical ideas in precalculus that develop into sophisticated conceptual notions in an advance placement calculus course. For now, I would like you think about the interactions of cultures—researcher vs. student and white male professor vs. male student of color. Did the researcher get at whether Ankur was learning the mathematics? In the research, we often use individual, clinical interviews as a tool for assessing student understanding. What can one reasonable say about the student’s knowledge of a specific domain of high school mathematics— polynomial, trigonometric, and exponential functions?

Ankur, the student interviewed in the video, worked in a small-group setting during the course of thirty hours in a technology-rich environment, exploring ideas of exponential growth, velocity, and acceleration and representing these ideas in polar and rectangular coordinates. Now, away from the immediacy of the Ankur’s interview, in the context of peer or small-group learning let’s examine the question: Who is learning and who is not even present in the classroom? By the way, peer or small-group learning is the most widely implemented and the most researched pedagogical innovation in the last twenty to thirty years of educational research. Even though mathematics education resisted this pedagogy initially, for the past decade it has become more and more implemented from kindergarten to university mathematics classrooms. Now, even the Principles and Standards for School Mathematics of The National Council of Teachers of Mathematics (2000) encourages small-group learning and everybody studies its effect. However, there are serious challenges that we must face.

From among the reams of findings, various studies have shown that the composition of a group affects participation rates in those cognitive activities strongly associated with achievement. And we know that race and gender can affect how individuals interact in groups. Many students from groups that have been disempowered by institutional oppressions such as racism and sexism develop a low sense of status and self-esteem. When working in small-groups, students with low status and self-esteem may have unequal opportunities to participate in verbalizations related to the task. And such inequalities tend to be directly proportional to the difficulty of the task. In many studies, since they are considered difficult, mathematics and science learning are investigated. In groups with unequal access to cognitive opportunities, not only may small-group learning fail to produce positive effects for most participants but also may serve further to affect negatively the self-esteem of some group members (O'Donnell and O'Kelly, 1994, p. 339). Power and prestige structures of the society emerge in the context of group interactions. Individuals with presumed status of power and prestige because, for instance, of their race or gender are often assumed to have the ability to accomplish the group’s task. Individuals with so-called high status, such as white males, therefore, often acquire greater opportunities to verbalize and, therefore, to engage in cognitive elaboration. Their race and gender are assumed to be indicators of competence, and consequently, they are asked more often for help, have the opportunity to ignore requests, and exert more influence in the group. And what we know is that, in the setting of small-group learning, an individual’s amount and kind of verbalization relate to consequent achievement.

Progressive educators as well as innovative pedagogical procedures can wittingly or unwittingly disempower women and students of color. We shall see that the more complicated interactions of various institutional oppressions are reflected even in well-intentioned research. O’Donnell and O’Kelly (1994) in their synthesis of literature on cooperative and collaborative learning discuss benefits and limitations of using unstructured, collaborative groups in an approach to learning that emphasizes cognitive elaboration. They argue that the benefits of interactions among students result from their active processing of information. Students elaborate their cognitive structures. Such elaboration may entail restructuring of existing cognitive structures or adding new information to existing structures. The key here is that while working in small groups students' verbalizations are critical to their learning. In providing elaborated responses, students rehearse, reconsider, re-present, reflect, and reorganize their ideas. Through these cognitive acts, students can restructure and deepen their understanding (pp. 338-339).

Discussing limitations to this perspective on cooperative and collaborative learning, O'Donnell and O'Kelly point out important ways in which individuals may not benefit from such small-group learning. As I discussed above, for instance, they indicate that students with low status in a group may have unequal opportunities to participate in the verbalizations related to the group's task. Moreover, groups in which individuals have unequal access to cognitive opportunities may not only fail to produce positive effects but may also serve to affect negatively the self-esteem of those individuals.

Their analysis up to this point is correct. However, how do they explain the reasons why individuals are negatively affected? Who acquires status in a group and why? How is agency attributed or not to different gender and racial groups? Examining how the societal and assumed status of gender and of race associate with the frequency and amount of verbalization within groups, O'Donnell and O'Kelly write the following:

> When girls outnumber boys in a group, they tend to defer to the boys. When boys outnumber girls, they tend to ignore the girls…Inequalities in participation rates by girls and boys in unbalanced groups may perpetuate problems experienced by girls with respect to some academic subjects. Balanced groups with equal number of male and female participants seem to provide the best opportunity for equal participation… Race and ethnicity are additional characteristics of students that can distinguish students from one another. In a number of studies, Cohen (1972, 1982) has shown that minority students in groups are often ignored or fail to participate (p. 341).

For us, engaged educators, what is particularly noteworthy is the differential analysis of how girls and minority students respond to their perceived status. This differential explanation may reveal fundamental, bedrock notions of our society that are reflected in the discourse and, therefore, thoughts of even progressive educators. O'Donnell and O'Kelly tell us that girls have agency. On the one hand, when boys do not ignore them, they defer to them. In the case of minority students, when white students are not ignoring them, according to O'Donnell and O'Kelly, minority students simply fail to elaborate, fail to engage in cognitive structuring or restructuring. To fail to elaborate is do nothing, to be incapable of intellectual action. Intellectual agency, you see, is denied to minority students in the theory and analysis of some progressive educational practice. Moreover, the nature of the diffuse (societal and assumed) status is covered up. Clearly, it is sexism and racism, respectively, that contributes mightily to both the negative self-esteem of girls and minority students and the superiority complex of white students. Without naming the problem, it is impossible to create appropriate and efficacious solutions.

Before leaving the O'Donnell and O'Kelly quote, let's notice one other interesting attribute of their discussion. As progressive educators and mathematicians, it is worth noticing how much commentary they give to reporting on the issue of gender as opposed to the same issue in terms of race. The discussion of race warranted only a sentence whereas the discussion of gender is longer and more nuanced.

Another important issue related to progressive educational theory and practice concerns the effect size when women, African Americans, and Latinas/os students participate in small-group learning. (And now we'll give emphasis to students of color.) Some of the data and data analyses are contradictory and run counter our notions of the benefits of diversity. Springer, Stanne, and Donovan published in 1999 a meta-analytic synthesis of literature on small-group learning. Their article, published in the *Review of Educational Research*, is titled "Effects of small-group learning on undergraduates in science, mathematics, engineering, and technology: A meta-analysis." The conclusions of their quantitative analyses contradict the findings of O'Donnell and O'Kelly (1994). Moreover, for educators, Springer, Stanne, and Donovan give unsettling findings concerning the effect size of small-group learning for women, African Americans, and Latinas/os students.

As O'Donnell and O'Kelly (1994) point out, some researchers suggest that status differentiation causes women and minority students to have unequal opportunities to engage in verbal elaboration when working in mixed gender and multiracial small-group settings. Contrastingly, Springer, Stanne, and Donovan (1999) assert that women and "underrepresented groups have greater opportunities to be heard and learn by participating in more collaborative and democratic teaching and learning process" (p. 277). We can presume that they mean to "underrepresented groups" working in multiracial settings. However, contradicting their own assertion, Springer, Stanne, and Donovan's meta-analysis found that achievement effects of small-group learning were significantly greater for, in their words, "groups composed primarily or exclusively of African Americans and Latinas/os (d = 0.76) compared with predominantly white (d = 0.46) and relatively heterogeneous (d = 0.42) groups" (p. 282). These research findings seem to contradict their earlier statement concerning greater opportunities for verbal elaboration, which O'Donnell and O'Kelly suggest is not even true. Equally as interesting and more unsettling for proponents of multiculturalism and diversity, Springer, Stanne, and Donovan findings suggest that racially segregated small groups are more favorable for the academic achievement of African Americans and Latinas/os students than when they work in racially mixed small groups.

On this last point, Springer, Stanne, and Donovan found that small-group learning had significantly greater effect on achievement for groups composed primarily or exclusively of African American and Latinas/os as compare with predominately white or racial mixed. These findings corroborate the higher rate of attendance to graduate and professional schools of African Americans who study at historically black colleges and universities compared with those who attend predominately white colleges and universities.

Conclusion

In the United States, in spite of the progress in racial relations and legislation that seeks to redress historical and institutional racism, many African Americans continue to experience differential treatment in schools. Martin (2000) provides ethnographic evidence of this view. He studied how African American students and parents invoke their agency in response to forces of racism. A parent, a participant in his study, states the following concerning the quality of education that her daughter receives:

> Oh! I hate the schools. I really do. She's going to high school next year and there's not one, here in Richmond I want to send her to. Actually, I'm hoping she would go back to Louisiana and stay with my mom and go to high school thee. Actually, her principal, he's prejudiced. That's all you can say. These schools, they're not teaching these kids and they don't have nothing for them to do. The kids are just bad. I just hate these schools. They're horrible. (p. 53).

As Martin argues, this parent's oppositional stance was based on her belief that status of African Americans, that is, their subject position within dominant discourses, determined the treatment they receive from teachers and school officials. This is only part of the story. Martin's study indicate three important features of the

> Mathematics learning, achievement, and persistence among African-Americans must be examined within their broader contexts—sociohistorical, socioeconomic, community, family, school, classroom, curricular and peer group.
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> The experience that characterize mathematics socialization and affect mathematics identity among African-Americans provide n important interpretive framework with which to understand outcomes in mathematics achievement and persistence.
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> African-American parents and adolescents are not passive in their mathematics socializations but exhibit a wide range of agency-related behaviors that affect their success or failure. (Martin, 2000, p. 170).

Schools are simply one several contexts in which African-American subjectivity is constituted and their subject position is constructed in relation to mathematics. There are multiple contexts in which African-Americans form their socialized mathematically and form their mathematics identity. On the one hand, ethnographic research suggests that "successful students can respond effectively to [racist discourses] by adopting strong personal, academic, and mathematics identities and by engaging in self-definition in the direction of success by resisting and opposing what they perceive as negative or as obstacles that stand in the way of their goals" (Martin, 2000, p. 187).

On the other hand, the general empowerment through critical ethnomathematical knowledge is, we feel, a very important part of the struggle to overcome a colonized mentality. Samora Machel (1978) argues that

> colonialism is the greatest destroyer of culture that humanity has ever known. African society and its culture were crushed, and when they survived they were co-opted so that they could be more easily emptied of their content. This was done in two distinct ways. One was the utilization of institutions in order to support colonial exploitation…The other was the 'folklorising' of culture, its reduction to more or less picturesque habits and customs, to impose in their place the values of colonialism (p. 400).

The connections between educational action and liberatory social change are the least developed aspects of research activities in ethnomathematics. On this point, the work of Knijnik (1996, 1997, 1998, 1999) with the landless in Brazil is a notable exception, an example of a mathematics education researcher working with the *Movemento Sem Terra* (Landless People Movement) toward a shared goal of transforming the political economy of Brazil.[4] Our practice confirms that ethnomathematical knowledge increases student's self-confidence and opens up areas of critical insight in their understanding of the nature of knowledge. But there is no confirmation that this knowledge results in action against oppression and domination. In the current historical context of an advanced capitalist society, it may be that the most critical collective change that a pedagogy of the oppressed can bring about is a subtle shift in ideological climate that will encourage action for a just socialist economic and political restructuring.

This is not insignificant. Nteta (1987) argues that "revolutionary self-consciousness [is] an objective force within the process of liberation" (p. 55). He shows how the aim of Steve Biko's theories and the Black Consciousness Movement in South Africa was "to demystify power relations so that blacks would come to view their status as neither natural, inevitable nor part of the eternal social order…created conditions that have irreversibly transfigured South Africa's political landscape" (pp. 60-61). We argue that as we more clearly understand the limits of our educational practice, we will increase the radical possibilities of our educational action for liberatory change. Thus, we feel the most important area for ethnomathematical research to pursue is the

[4] In a different context, Powell (see Baldassarre, Broccoli, Jusinski, & Powell, 1993) worked with students who acted on their critiques of educational materials, resulting in the banning of the distribution of those offensive materials. This points to differences in the terrain of political struggles in the United States and Brazil, one lacking a strong, conscious oppositional political movement.

dialectics between knowledge and action for change.[5] Fasheh (1982) points the way to the direction of investigation by hypothesizing that

> teaching math through cultural relevance and personal experiences helps the learners know more about reality, culture, society and themselves. That will, in turn, help them become more aware, more critical, more appreciative, and more self-confident. It will help them build new perspectives and syntheses, and seek new alternatives, and, hopefully will help them transform some existing structures and relations (p. 8).

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[5] To this end, John Volmink and the authors have organized a Criticalmathematics Educators Group. Contact the authors for a copy of the group’s newsletter.

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