INTRODUCTION

SEEING THE CAGE? THE EMERGENCE OF CRITICAL MATHEMATICS EDUCATION

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The grounds for this book may be stated simply. Critical mathematics educators: have concerns about mathematics education as they observe it taking place in multiple contexts; believe that those concerns cannot be met by changes internal to mathematics education but must be addressed in sociopolitical contexts; accept the responsibility of making value judgments, while subjecting these judgments to perpetual critique; desire to promote change in accordance with those value judgments, envisaging alternatives to what is generally the case. These concerns, political consciousness, acceptance of responsibility, and desire and work for change generate the central theme of the book, namely critical agency as a synthesis of reflection and action directed towards the inherently political nature of mathematics education.

CRITIQUE OF MATHEMATICS EDUCATION

A cluster of related words, including “crisis”, “criticism”, and “critique”, all derive from the Greek verb krínein, meaning “to decide” or “to judge”. “Crisis” can mean, in general, “a time of intense difficulty or danger” or, more specifically in a medical context, “the turning point of a disease when an important change takes place indicating either recovery or death”. Likewise, “criticism” has the general meaning of “the expression of disapproval of someone or something based on perceived faults or mistakes” and the more specific meaning of “the critical assessment of a literary or artistic work”. “Critique” means “a detailed analysis and assessment”. The medical meaning of “crisis” also carries the implication of a turning-point where alternative actions are possible. Thus, the diverse connotations of “crisis” refer to dangerous situations and analysis, diagnostic analysis, turning-points, and the opportunity for action. Accordingly, we think of “critique” in terms of “critical agency”, signifying that critique refers to both reflection and action, integrating the various aforementioned connotations.

Within the period during which we have been working in mathematics education, there have been major developments in the directions advocated in this book – at least within certain active, albeit marginalized, pockets of mathematics educators. The emergence of this social, cultural, political approach has been well summarized by Vithal (2003, Chapter 1). Among the important pioneering
publications during the period 1973–1988 (several of which were written in languages other than English) are the following:

- Claudia Zaslavsky, particularly in her 1973 book, *Africa Counts*, was one of the first to valorise the diversity of non-academic mathematical practices of non-Western cultures.
- Peter Damerow, Ulla Elwitz, Christine Keitel, and Jürgen Zimmer (1974), provided a sociopolitical perspective on elementary mathematics education.
- Dieter Volk (1975) formulated a mathematics education from an emancipatory perspective and later (Volk, 1979), provided a panoramic view of the wide range of critical approaches to mathematics education that had been developed at that point.
- Stieg Mellin-Olsen (1977) contributed to a pioneering analysis of the sociopolitical analyses of mathematics education, which he developed further in *The Politics of Mathematics Education* (1987).
- Munir Fasheh (1982) raised many penetrating questions about the politics of mathematics education, such as the following:
  
  Is it possible to teach mathematics effectively – that is, to enhance a critical attitude of one’s self, society, and culture; to be an instrument in changing attitudes, convictions, and perspectives; to improve the ability of students to interpret the events of their immediate community, and to serve its needs better – without being attacked by existing authorities whether they are educational, scientific, political, religious, or any other form?

- Marilyn Frankenstein (1983) recognized the relevance of Paulo Freire’s praxis to mathematics education and showed how Freirean principles could be adapted in teaching mathematics for social justice.
- Ubiratan D’Ambrosio delivered a plenary talk on *Socio-Cultural Bases for Mathematical Education* (D’Ambrosio, 1984) at the International Congress on Mathematical Education in Adelaide, to which an extra day had been added on the theme *Mathematics, Education, and Society*. A year later, he introduced the concept of ethnomathematics (D’Ambrosio, 1985).
- Alan Bishop (1988) authored a key early work casting mathematics as an activity practiced in sophisticated ways in all cultures.

Not all the development of critical mathematics education was within the protected world of academe. In South Africa, a movement was created called “People’s mathematics” (Vithal, 2003, pp. 27–35) that was part of the People’s Education movement during the anti-Apartheid struggle. Vithal (p. 29) takes as a starting point the presentation of politically charged curricular materials by Chris Breen (1986) at the white-dominated Mathematics Association of South Africa’s annual conference. Other important stands were taken by, amongst many others, Jill Adler (1988) and Cyril Julie. The latter presented a paper at the first of three conferences on *Political Dimensions of Mathematics Education*, succeeded by the
ongoing biennial conferences on *Mathematics Education and Society*. The theme of that first conference (Noss, Brown, Dowling, Drake, Harris, Hoyles, and Mellin-Olsen, 1990) was *Action and Critique*.

In the course of these developments, we may say that the critique of mathematics education has emerged from the restraint of being directed *internally*, that is to say concerned primarily with how mathematics is learned and taught, to being also *external*, concerned with the embeddedness of mathematics education and mathematics within historical, cultural, social, and political contexts, and the implications and ramifications thereof.

The inspiring influence of Freire as a central figure in the development of critical education continues to be recognized (e.g., Apple, Au, & Gandin, 2011b, Part IV) and is pervasive throughout this book. Nowhere is there a clearer statement than the following:

This is a great discovery, education is politics! After that, when a teacher discovers that he or she is a politician, too, the teacher has to ask, What kind of politics am I doing in the classroom? That is, in favor of whom am I being a teacher? By asking in favor of whom am I educating, the teacher must also ask against whom am I educating. Of course, the teacher who asks in favor of whom I am educating and against whom, must also be teaching in favor of something and against something. This “something” is just the political project, the political profile of society, the political “dream”. (Freire, 1987, p. 46)

Freire did not write explicitly about mathematics education. Indeed, in a conversation with D’Ambrosio, he commented that:

In my generation of Brazilians from the North-East, when we referred to mathematicians, we were referring to something suited for gods or for geniuses. There was a concession for the genius individual who might do Mathematics without being a god. As a consequence, how many critical intelligences, how much curiosity, how many enquirers, how many capacities that were abstract to become concrete, have we lost? (Freire, D’Ambrosio, & Mendonça, 1997, p. 8)

Nevertheless, and in the spirit of Freire’s insistence that his pedagogy be not copied, but *reinvented in context*, the relevance of his work and philosophy to mathematics education has been demonstrated and put into practice, notably by Frankenstein (1983, 1989), and more recently Gutstein (2006; Chapter 1, this volume).

The field of mathematics education, in general, has considerably matured, as reflected in the diversification of influential disciplines and related methodologies – broadly speaking, the balancing of technical disciplines by human disciplines such as sociology, sociolinguistics, anthropology, psychoanalysis, and of formal statistical methods by interpretative methods of research and analysis. Within the field, there is heightened cultural and historical awareness, both within and beyond academic mathematics, and an increased acknowledgment of the
ubiquity and importance of “mathematics in action” and the implications for mathematics education, including more curricular prominence for probability, data handling, modelling, and applications. In relation to the political nature of the enterprise, there is greater attention to the relationships between knowledge, education, and power. Important concomitant developments that have both been influenced by, and have impacted, developments in mathematics education include the emphasis on cognition as both situated and cultural. The philosophical realm has been burst open by postmodern questionings of the assumptions of progress, notions of truth and objectivity, and transparency of language. A new philosophy of mathematics (e.g. Ernest, 2009) reflects historical changes in views of the ontology of mathematics and its relations to forms of life.

Much of the above historical sketch may be seen as manifesting the humanization (a word frequently used by Freire) of mathematics and mathematics education, encapsulated in the phrase “mathematics as a human activity”. This phrase rejects the Platonic view of mathematics as existing independently of its creators and users, as does the conception of ethnomathematics as “the mathematics which is practised among identifiable cultural groups, such as national-tribal societies, labor groups, children of a certain age bracket, professional classes, and so on” (D’Ambrosio, 1985, p. 45).

In relation to mathematics education, it is reflected in the understanding that teaching/learning is not a purely intellectual activity – students are not “cognitive angels”.

Furthermore, (re)humanizing mathematics and mathematics education are inextricably political activities. The political nature of mathematics education follows from the recognition that improving (mathematics) education is a human problem, not a technical problem (Kilpatrick, 1981). Of profound political importance is the challenge to mathematicians and mathematics educators to accept ethical responsibilities, in particular as posed by D’Ambrosio (2010, p. 51): “It is clear that mathematics provides the foundation of the technological, industrial, military, economic and political systems and that in turn mathematics relies on these systems for the material bases of its continuing progress. It is important to question the role of mathematics and mathematics education in arriving at the present global predicaments of humankind.”

The globalisation of mathematics education is clearly illustrated in this book, albeit not in a comprehensive manner (which would be impossible). The authors collectively represent considerable diversity (including amongst those based in universities in the USA). The first languages of the authors also are diverse, which prompts acknowledgment of the fact that the book is written in English. Thus, we agree with the sentiment expressed in similar circumstances by Apple et al., (2011a, p. 15): “Inevitably a book such as this, no matter how large, partly centers dominant voices even in its attempt to be conscious of that centering … Given the geopolitics of publishing and academic writing … and the role of English as an imperial project, right now we can but note this as part of a constitutive dilemma.”

One aspect of this hegemony is that pioneering works in critical mathematics
education written in languages other than English (some of which were cited earlier) receive limited attention in Anglophone circles.

In an extremely deep and powerful analysis, Edward Said (1994) showed how culture, particularly literature, both reflected and reinforced unexamined assumptions of the peoples of colonizing and colonized countries, and also how resistance to imperialism developed in literature. To our knowledge, no analysis of comparable depth exists for mathematics; however there have been important acknowledgements of the role of mathematics in the imperial/colonial enterprise (e.g. Bishop, 1990; Urton, 1997), the old forms of which continue to affect ideology of former colonies, and new forms of which are rampant under the name of globalisation. These forms are primarily economic, in particular disaster capitalism (Klein, 2007). The roles of mathematics in these geopolitical movements deserve deeper scrutiny, for example, the claims by Milton Friedman and others of the Chicago school that their theory of economics has a sound mathematical foundation (Klein, 2007, pp. 61–62).

POLITICS OF MATHEMATICS EDUCATION

Critical education is situated within local, national, and global politics. What Michael Apple terms “conservative modernization” is currently the dominant ideology within education in the USA and controlled or aligned countries, a situation exacerbated under President Obama. As described by Apple et al., (2011a, p. 10), “conservative modernization” is an alliance (by no means free of internal contradictions) among neoliberals, neoconservatives, authoritarian populist religious conservatives, and the professional and managerial middle class. As with politics in general, what goes for the USA also applies in other industrialized countries, and to a greater or lesser extent, to many parts of the world. (Although it might be considered that we are disproportionately referring in our discussion to the situation in the USA as opposed to the rest of the world, the current political reality is that much of what applies in the USA applies widely beyond, albeit with variations.)

Historically and contemporarily, there are strong links between mathematics and war (which might be characterized as the ultimate example of attempting to solve human problems by technical means). A great deal of the world’s intellectual talent in mathematics (and science) is used in the creation of better ways of killing, subjugating, or surveilling and controlling people, of which current deployment of flightless aircraft, “drones”, provides a chilling example (Skovsmose, 2010). By contrast with the vision of D’Ambrosio cited above, that mathematicians and mathematics educators should be concerned with the critical problems facing humankind, mathematics education is typically laced with nationalism. (By way of example, think of the reactions in media and political circles in participating countries when results of international comparative studies of school performance in mathematics are announced.)

A major common thread discernible in the strategic alliance described above is what might be called the ideology of certainty. The constituents of that alliance
have apparently unshakable convictions in such disparate belief systems as the
derpower of the market, the inherent superiority of certain civilizations, various
religions, social values, the power of technical and managerial techniques to solve
problems and regulate people’s lives. The desire for certainty seems to be a natural
human yearning, often expressed through religion, or through positivist logic.
Bertrand Russell, for example, sought certainty in logic only to reach, ultimately,
the conclusion that “all human knowledge is uncertain, inexact, and partial”
(Russell, 1992, p. 527). As Russell found, mathematics can offer a tantalizing
illusion of certainty. As far as mathematicians are concerned, this mindset becomes
seriously dangerous when they seek to project the certainty that they find internally
within mathematics onto its applications (Skovsmose, 2005, p. 48), an attitude that
is typically inculcated within mathematics classrooms. Such an attitude is also
manifest in a search for procedures, rules, algorithms, that allow people to abdicate
the responsibility of making judgments in complex social situations. People and
institutions within mainstream mathematics education too often collude with the
political establishment by wilfully remaining oblivious of the social and political
contexts outside their self-constructed cage:

It is unfortunate but true that there is not a long tradition within the
mainstream of mathematics education of both critically and rigorously
examining the connections between mathematics as an area of study and the
larger relations of unequal economic, political, and cultural power. (Apple,
2000, p. 243)

At the core of our work in exposing mathematics education as an inherently
political enterprise is the dialectic between reflection and action, that again is a
Freirean theme, since “reflection – true reflection – leads to action. On the other
hand, when the situation calls for action, that action will constitute an authentic
praxis only if its consequences become the object of critical reflection” (Freire,
1997, p. 48). We use the term “critical agency” to express the dialectic between
reflection and action. Through this term we also acknowledge that politics and
critique of mathematics education are integrated. The notion of critical agency
can be seen as a generalization of the notion of mathematical agency
(e.g., Stemhagen, 2009). While mathematical agency is discussed largely in
terms of students in school mathematics, it also is applicable to teachers,
researchers, and, in the most general way, people dealing in their lives with
mathematics in action. Our adoption of the term “critical agency” signals that we
regard critique as not only reflective and contemplative, but also implying the
goal of trying to make changes. Critical agency for students implies that students
come to speak for themselves; that they become able to read and write the world,
in Freire’s metaphor, that has been taken up and applied to mathematics
education by Gutstein (2006; Chapter 1, this volume). Critical agency for
educators means searching out spaces, such as alternative schools and classroom
environments, in which students become capable of, and have a disposition
towards, critical analysis, in particular with mathematical tools, to address issues
of importance to them personally, to their communities, and to humankind in
general (Mukhopadhyay & Greer, 2001). It also includes the exploration of the possibilities of making changes, large or small, in daily classroom routines despite all the regulations and demands that restrict diversity of practice and content. A first step in any exploration of what is possible is to imagine that something in what is the case could be different, or that a state of affairs perceived as necessary is actually contingent. Thus, a pedagogical imagination forms part of a critical agency.

Critical agency refers to the whole socio-political context of education, including attempts to influence policy. De Corte, Greer, and Verschaffel (1996, p. 534) commented that “perhaps the enlightenment of political decision-makers, and other groups such as parents, administrators, and the public in general … is the biggest educational challenge.” This statement is a direct expression of the political dimension of this agency.

Critical agency also implies openness to self-critique.

OUTLINE OF THE BOOK

The organization of the book into four parts was one of many possibilities; many chapters could sit equally aptly in different sections; themes interweave across the linear organization.

Part I: Mathematics education is politics

The title given to this section, of course, echoes Freire, as quoted earlier. The situatedness of mathematics education within historical, cultural, social, and political contexts is reflected in this section, and, indeed, throughout the book. Some manifestations of the global and national apparatus relating to education are obvious, such as the formulation and control by states of curricula, testing, teacher education requirements, statements of policy, and all the paraphernalia of educational systems. However, digging into the ideological substrates of such tangible external manifestations is complex and contentious. Even more complex and contentious is trying to lay bare the relationships, in relation to mathematics and mathematics education, among knowledge, power, hegemony, racism, inequity, social injustice.

Freire’s conceptualisation of education as “a weapon in the struggle” forms part of the title of Chapter 1, by Eric Gutstein. Critical agency can be nurtured on a local level, in a particular situation (as Freire did). The situation in which Gutstein works includes the political activity of a community demanding a school promised to them, to the point of carrying out a hunger strike. Gutstein’s praxis transcends the aim of working for equity within mathematics education to enacting a vision of equity through mathematics education, by teaching content and raising political consciousness together, as Freire did when teaching literacy. In his chapter in this volume, Gutstein further elaborates his reinvention of Freire’s praxis within the context of teaching mathematics that is already clear in the title of his 2006 book Reading and writing the world with mathematics. In this chapter, he describes how
the content for the class he taught was co-developed with the students in the form of generative themes: elections, displacement (gentrification, foreclosures, and immigration/deportation), HIV/AIDS, criminalisation, and sexism. This work is taking place in the national US context of neoliberal efforts to privatise education, which have, if anything, accelerated under President Obama. As Gutstein says, “there are always spaces in which to act”.

In Chapter 2, Alexandre Pais surveys the very extensive body of recent literature addressing equity in mathematics education (and see Atweh, Graven, Secada, & Valero, 2011) to form the basis for a very profound critique of mathematics education as a field. A central point of this critique is that, for the bulk of the literature on equity, the authors acknowledge that the problems being discussed are inextricably political, yet then generally proceed as if the solution can be found through changes internal to mathematics education. Drawing on Žižek’s work, Pais argues trenchantly that this search for a solution within the system rather than changing the whole system is chimerical because inequity is an inherent feature of capitalist education. The fine-sounding slogan “mathematics for all” falls apart because of the same structural contradictions (and see Gutstein, 2009). Much research on equity focuses on what are called “achievement gaps” and how to “close” them; few think to interrogate the nature of the gaps (materialized as differences in scores on tests which are themselves in need of interrogation) or to ask the more important question “Why are the gaps there?” Thus, the verdict reached by Pais on a very considerable body of research is that it is almost all looking for the lost object where it is easiest to look (“pseudo-activity”, to use Žižek’s term), not where it is most likely to be found. Pais takes as his task the raising of awareness necessary to acknowledge and understand this fundamental mischaracterization of the “problem”.

Munir Fasheh considers the macro-effects of mathematically influenced worldviews and conceptions of humankind on his native Palestine, part of the global effect of neoliberal economic theory (Klein, 2007). In an earlier paper, Fasheh (1997) commented on the fact that he had lived through four very different political regimes in Palestine, yet throughout those changes, mathematics did not change. Having learnt and taught academic mathematics, he was brought to awareness by coming to see the complexity of the mathematics of his mother as a dressmaker, bringing to mind the statement by Freire that “the intellectual activity of those without power is always characterized as non-intellectual” (Freire & Macedo, 1987, p. 122). Through the insight offered by this experience, he came to see himself, a scholar versed in Western mathematics, as a collaborator in cultural imperialism, the process whereby long-standing viable, place-based modes of living, and of education aligned with that living, are being destroyed. As he points out, this process was already clear to the Palestinian educator Khalil Sakakini at the end of the 19th century. In particular, Fasheh points to the dehumanisation that comes with grading and credentialing people (echoing a major theme in the chapter by Pais) that he characterizes as a form of cultural violence. He now works to develop education that is tied to the culture, the land, and sustainable local economy.
In Chapter 4, Brian Greer examines an overtly political exercise called the National Mathematics Advisory Panel set up by President George Bush. This project was remarkable in that it all but ignored the entire academic field of mathematics education. This disappearance was achieved, in particular, through the composition of the panel, and through the adoption of rigid criteria for what constitutes research. As a result, there is very little of what we would recognize as mainstream mathematics education research in the document, let alone anything remotely resembling critical mathematics education. The simplest way to characterize the whole exercise is as the endorsement by the Bush administration of one side in the ideological dispute commonly known in the USA as the “Math Wars”. There is also a very strong nationalistic tone and warning of crisis in the framing of the panel’s brief and in the report that resulted (one member in the final meeting commended his fellow-members on their patriotism); the workings of the military-industrial-academic complex can also be seen at various points. Of particular concern is that, with some honourable exceptions, and in particular an issue of Educational Research (December, 2008) devoted to the topic, in which strong criticisms were voiced, there was limited resistance on behalf of the mathematics education community, including the small number of mathematics educators that were on the panel. Thanks to the excellent conventions and laws in the USA about making information available, there is a vast amount of public-domain information relating to NMAP, and it offers a rich topic for a sociological analysis of the intersection of politics and education.

Part II: Borderland positions

Arising from geopolitical developments, military conflicts, popular uprisings, economic hegemony, population movements, the rising voices of subalterns, post-colonial resistance, and so on, the contemporary world reflects hybridity and diversity. These inherent characteristics of humankind relate not only to ethnicity, but also to culture, educational, economic, and political systems, mathematical practices, worldviews. As Skovsmose (Chapter 16, this volume) argues, mathematics education as a field has largely failed to reflect the diversity of situations within which mathematics is learnt and taught in schools and elsewhere, as illustrated by the chapters in this section and elsewhere in this book. In this respect, the simplistic of the slogan “mathematics for all” becomes evident (see Pais, Chapter 2, this volume). To unpack it, we need to ask many questions, including: Does inclusion imply assimilation without accommodation? Whose mathematics and for what purposes? Is it really necessary for all? If access is granted, at what cost in cultural violence?

In Chapter 5, Marta Civil provides a survey of research on the mathematical education of immigrant children. Although, as she points out, immigrants constitute only 3% of the world’s population, there is considerable political tension relating to them, particularly in the USA and Europe. As she points out, the circumstances of immigrant students raise in sharp focus issues of assimilation versus multiculturalism.
(which apply also to non-immigrant populations such as indigenous groups). Specifically with respect to mathematics, this tension relates to school mathematics versus the mathematics of the students and their communities, which naturally impacts interpersonal relationships between teachers and students. Again, the perception of mathematics as being “the same for everyone” makes it easier to avoid responsibility for mathematic teachers to educate themselves about the mathematical practices of other cultures. Further, pressure for linguistic assimilation interacts in complex ways with the teaching of mathematics – again an issue by no means only for immigrant children (Setati & Planas, Chapter 7, this volume).

Concretising Civil’s survey, Sikunder Ali Baber offers a detailed case study of a student in a specific context, exemplifying Skovsmose’s (2005) exhortation to consider not just the “background” of an individual, but also the “foreground”, i.e. subjective perceptions of the future possibilities and opportunities open to her/him. In this chapter, Ali Baber first describes in detail the circumstances of a particular immigrant community, namely Pakistanis in Barcelona. As discussed in the chapter by Setati and Planas, the situation is further complicated by the politics of languages – in this case, Catalan and Spanish (and, increasingly, English). The complexity of the case study that follows illustrates not just diversity but also hybridity, and puts into sharp relief the nature of much research in mathematics education wherein the complexity of an individual is reduced to half a dozen values of often simplistically defined variables (e.g. socio-economic status). Baber concludes by making recommendations on the basis of his analysis for how teachers, schools, and policy-makers could better serve the needs of immigrant children in the kind of multicultural context that is becoming common in many parts of the world.

In both chapters just outlined, the importance of language in learning mathematics is clear. In Chapter 7, Mamokgethi Setati and Núria Planas consider the question of use of languages in mathematics classrooms in which the children speak two or more languages. They do so in two contrasting contexts, South Africa and Catalonia, the latter showing that English is not the only dominant language in such circumstances (though English is also making inroads in Catalonia). As the examples make strikingly clear, the choices of policies in such circumstances regarding language of teaching and learning are highly political. What happens in mathematics classrooms accordingly needs to be analysed, not simply in terms of the implications of the language of learning and instruction for development of mathematical cognition, but also in relation to sociopolitical aspects and power relationships. Extensive research on teachers’ and students’ perspectives illuminates these issues. It is clear from the research in South Africa that the dominance of English as the source of cultural capital is well established, and this takes precedence over questions of language as a cognitive tool and over questions of language and cultural identity; similar comments apply to the dominance of Catalan. These cases vividly exemplify the tension that occurs between acknowledging cultural diversity and trying to afford educational and economic opportunities through mastery of the dominant discourse.
In Chapter 8, Gelsa Knijnik and Fernanda Wanderer consider two examples of sets of mathematical practices in Brazilian communities deriving from what Wittgenstein termed “forms of life”, integrating culture, world-view, and language. As with the contributions by Gutstein and Fasheh, they thus illustrate the teaching/learning/doing of mathematics in specific situations. The first example relates to a community of German settlers in Brazil in the mid-20th century compelled to adopt the Portuguese language. The second relates to the more recent Landless Movement that incorporates out-of-school mathematics embedded in the political situation of the landless peasants. In both cases, Knijnik and Wanderer describe how the state, in the pursuit of political unity and cultural homogeneity, forced these communities to conform to the norms of school mathematics by absorbing them into the state system “so that they will have access to the knowledge imparted to all people”. Knijnik and Wanderer examine the cultural violence done thereby through what Hardt and Negri (2003) term the mechanism of “differential inclusion”.

In Chapter 9, Danny Martin and Maisie Gholson present their reflections on what it means to be critical Black scholars in mathematics education in the USA. Most, if not all, of what they describe applies to Black scholars in general, but there are several ways in which the fact that their field is mathematics education brings certain issues into particular focus. The “ideology of no ideology” that supports the fiction of academics as ethically and politically neutral is particularly easy to project in relation to mathematics. Given the prominence of mathematics in testing, mathematics affords fertile ground for those who, indirectly or indirectly, continue to advance claims of intellectual inferiority of Black children – in particular, claims that black (and poor) children lack the capacity to engage in abstraction and formal mathematical thinking. And mathematics is an intellectual area with a particularly strongly entrenched epistemology, which needs to be challenged by alternative epistemologies. Above all, through both the form and the content of their chapter, Martin and Gholson remind us that the children who are studied and the scholars that do the research are individuals that deserve to be considered as more than a handful of statistically manipulable values of variables.

Intermezzo: Totakahini (The Tale of the Parrot)

Rabindranath Tagore (1861–1941) was a Bengali poet, writer, painter, musician, philosopher, and educator who made fundamental contributions to education, including the establishment of a school at Santiniketan and a university at Visva Bharati at Bosepur, near Kolkata (Calcutta). His parable, Totakahini: The Tale of the Parrot stands as one of the great satirical attacks on repressive education (see Fasheh, Chapter 3, this volume). A play based on Totakahini is performed by children in India. The translation presented here, from her native Bengali, is by Swapna Mukhopadhyay.
Like Freire, Tagore projected a vision of education as emancipatory. As Sen (2005, p. 98) put it “For Tagore it was of the highest importance that people be able to live, and reason, in freedom”, quoting a poem from Tagore’s work *Gitanjali*, for which he won the Nobel Prize for Literature in 1913:

Where the mind is without fear and the head is held high;  
Where knowledge is free;  
Where the world has not been broken up into fragments by narrow domestic walls; ...  
Where the clear stream of reason has not lost its way into the dreary desert sand of dead habit; ...  
Into that heaven of freedom, my Father, let my country awake.  

(This poem first appeared in Naivedya, July 1901, in Bengali. The English translation, by Tagore himself, first appeared in 1912 in *Gitanjali*).

**Part III: Mathematics and power**

It is arguable that one of the greatest shortcomings of mathematics education is that – at all levels, including tertiary – scant attention is paid to the societal effects of activities in which mathematics is instrumental. To a very limited extent, this deficiency has been ameliorated by increasing emphasis in some curricular programs on mathematical modelling and data handling. However, much of the work that is done on mathematical modelling fails to go beyond what Verschaffel and Greer (2007) termed “explicit modelling”, namely the case-by-case modelling of specific situations, to “critical modelling”, which includes both the critique of particular models, but also more general consideration of the roles played by mathematics in action in our societies, and the limitations of applying technical solutions to human problems. In particular, it is a scandal that such issues are minimally treated at the university level.

Technology has greatly facilitated the extension of mathematical modelling to format more and more aspects of our lives; in D’Ambrosio’s phrase, it has produced both “miracles” and “horrors”. A particularly pernicious effect is the dehumanisation that can take many forms ranging from the glaringly obvious to the extremely subtle. Moreover, above and beyond particular mechanisms and devices there is often a disposition to dehumanise, strikingly and literally exemplified by the time and motion studies of Taylor (Frankenstein, 2009; Skovsmose, 2011). Viewing the human body as a machine (or the brain as a computer) can be useful and appropriate, but it can also be profoundly dehumanising. The same comment applies to viewing (mathematics) teaching as a technical enterprise or as a business.

In Chapter 10, Brian Greer and Swapna Mukhopadhyay examine aspects of the relationship between mathematics and power in relation to three contexts of hegemony. The first context of hegemony discussed is the role of mathematics in cultural imperialism (Bishop, 1990), which includes the dominance until relatively recently of a Eurocentric narrative for the history of academic
mathematics. In this context, there are striking parallels between the hegemony of mathematics and the description by Macedo, Dendrinos, and Gounari (2003) of the hegemony of English (Greer & Mukhopadhyay, in press). Secondly, the role of mathematics in action in society is discussed in relation to how mathematics can be used to intimidate, a phenomenon that is exacerbated by the lack of societal support for critical mathematical agency. Thirdly, hegemonic aspects of mathematics education include the use of mathematics education within education in general as a means of cultural oppression. The “Math Wars” in the USA are considered as a prime example of hegemonic struggle, and the slogan “mathematics for all” is picked apart, since it is meaningless without clarification of the basic question “What is mathematics education for?” As with the final chapter of Said’s (1994) *Culture and Imperialism*, forms of resistance that are developing in each of the three arenas are considered.

In Chapter 11, Keiko Yasukawa and Tony Brown “dig where they stand”, that is to say, as mathematics educators they excavate buried models within their own context as university staff in Australia. They begin by pointing out that, while adult numeracy is considered highly important in relation to employment, it is directed towards the increase of human capital rather than towards the kind of critical mathematics that would empower workers to critique their economic circumstances. They present a case study in which they worked in their immediate milieu to uncover and explicate opaque and flawed models governing pay of untenured university staff. As they illustrate, the strength of the exercise derived from combining “statistics and stories”, i.e. the integration of the analysis of mathematical models and data with the collective lived experiences of the staff. This integration proved necessary in order to mobilize for action. The example also shows how the agency that derives from having mathematical tools to critique may exist at the level of the collective, through individuals mediating as statistical or modelling experts. In the spirit of Pais (Chapter 2, this volume) it could be argued that this local action should be followed by a more global analysis of the circumstances that gave rise to the situation, namely the increasing commodification and privatization of university education, a global phenomenon.

In Chapter 12 in this section, Keiko Yasukawa, Ole Skovsmose, and Ole Ravn consider mathematics interpreted as a form of technology, and suggest that insights and theoretical tools from the field of Science and Technology Studies may be usefully adapted in the quest to get a better understanding of, and control over, mathematics in action. They discuss two examples, one being the case study of Yasukawa and Brown described in the previous chapter, and the other from the field of cryptography. Mathematics is ubiquitously used as “a technology of rationality”, a tool for making and justifying decisions. It is, indeed, a powerful tool, that meshes easily with a range of particular economic and political interests. What is essential is to retain control over that tool (i.e. preserve critical agency), otherwise technologies can become autonomous and beyond control. Finally, it can be observed that social theorizing, in general, does not pay any particular attention to mathematics. Thus, the discussion of the social formation of technology,
including mathematics, needs to be combined with a discussion of how the social becomes formed to a substantial extent through mathematics as a tool for rationality.

Part IV: Searching for possibilities

By “socially relevant mathematics education” we mean mathematics education that connects with the present and future forms of life of the students, and with the issues of importance to them, their families and communities, and humankind in general. It is an education that recognizes the important of critical agency in general. The search for a socially relevant mathematics education concerns all forms of mathematics education: in schools and out of schools, in all possible socio-political and economic contexts, and at all levels of education. Thus, it also concerns the education of future experts, including researchers in mathematics and technical disciplines. It is essential that expertise be combined with social responsibility (e.g., see Skovsmose, Valero, & Ravn Christensen, 2009). To search for a socially relevant mathematics education means to consider what could be in the interest of humankind in general. Clearly, such ideas align with the humanization of mathematics education as described above, with the aspirations of a “mathematics education for social justice”, with many forms of ethnomathematical approaches, and with critical mathematics education in general.

In this section, a number of approaches that search for such an education are described and evaluated. (Gutstein’s work is a very important example, and his contribution in Part I could equally well have been included here.) In Chapter 13, Eva Jablonka and Uwe Gellert, within a framework of how mainstream and resistant curricular positions are formed, review a number of curricular conceptions in relation to access to tertiary education. They raise the tension between trying to make mathematics education socially relevant while not closing gates to educational and economic opportunities, a discussion that recurs at many points in this book. This tension is embodied in the framework that they introduce, in particular the contrast between tactical resistance (playing the game) and deconstruction (changing the game) in positions that challenge the mainstream. Having commented on four orientations, namely Inquiry-based Mathematics Education, Ethnomathematics, Mathematical Modelling, and Critical Mathematics Literacy, they put forward another perspective, that they term “Radical Conservative Pedagogy” informed by the work of Basil Bernstein and his followers, that might be characterized as “making explicit for the students the rules of the game”, in particular the differences between the discourses of formal mathematical knowledge and practices and of non-academic mathematical knowledge and practices.

As discussed by Jablonka and Gellert, Bernstein and his successors have been influential in problematising contextualisations in mathematics education (Greer, Verschaffel, Van Dooren, & Mukhopadhyay, 2009), the focus of Chapter 14 by Annica Andersson and Ole Ravn. In the Swedish context that they address, they report that mathematics is rarely taught/learnt with social relevance. They argue that this state of affairs represents an unbalanced ideological conception of the
INTRODUCTION

nature of mathematics as abstract, existing independently of the human concerns of its users and those who are impacted by mathematics in action. Such a position is aligned with the later Wittgenstein’s characterization of mathematics as a network of language games. In their first case study, Andersson and Ravn pick apart a number of textbook problems and their use in an upper secondary class. Thereby, they demonstrate the clear gap between a mission statement from the Ministry of Education about socially relevant mathematics education and what happens in schools in the form of a mathematics language game that is dysfunctional in a multitude of ways (Verschaffel, Greer, & De Corte, 2000). In the second case study, they present examples of students studying more complex and realistic issues, with more personal input, over a longer period of time. As with Jablonka and Gellert, they argue for transparency towards the students as to the nature of formal mathematics, applications of mathematics, and the relationships between them, within which framework ethical values can be naturally situated and addressed.

In Chapter 15, Bill Atweh, who has a wealth of experience teaching mathematics within a socially relevant approach, takes up the theme of ethics, in particular in relation to the roles of mathematics in preparing students for democratic participation. He cites Skovsmose and Valero (2001) on the need to subject that highly complex and contested concept to unceasing critique. His analysis of the impossibility of finding a unique set of principles to define democracy echoes the position argued by Sen (2009), in relation to justice, that it is necessary to accommodate a plurality of divergent, but reasonable, points of view, and to transcend narrow views of nationality and identity. Agreeing with Skovsmose on the need for “critique without foundation” he appeals to the idea of responsibility, and echoes the position of the philosopher Anderson in his paper Ethical rights as ethical fictions presented in the play Professional Foul by Tom Stoppard (1978) that: “There is a sense of right and wrong which precedes utterance. It is individually experienced and it concerns one person’s dealings with another person”. The notion of social justice is equally contested, full of tensions and even contradictions; nevertheless, the lack of an absolute foundation for ethical behaviour in no way absolves us from action, within and through mathematics education as everywhere else. Atweh hails the reappearance of ethics at the centre of philosophy, particularly due to the work of Emmanuel Levinas, and proposes that a conception of ethics is implicated in any critique of the relationship between mathematics and democratic participation. The conception of ethics that he advocates is based on responsibility to/for the other. From feminist critical theory, he takes the distinction between responsibility and “response-ability”, the ability to respond with agency on one’s own behalf and with responsibility on behalf of the other. From these considerations follow recommendations for the curriculum, and for pedagogy.

In Chapter 16, Ole Skovsmose points towards a critical mathematics education research programme by addressing three salient features of critical mathematics education. The first concerns the diversity of the situations in which mathematics is taught and learned. In previous chapters, authors have discussed what it is like
to teach and learn mathematics for diverse people in diverse settings, such as a school in Chicago explicitly identified with teaching/learning for social justice, a Pakistani student in Barcelona, landless peasants in Brazil, and many more. None of these fit the “prototypical mathematics classroom” that dominates published research in mathematics education. To challenge this bias forms part of critical mathematics education. The second feature concerns the forms of mathematics in action. Mathematics operates as part of very many different work practices and technical settings. Often mathematics is integrated in work practices in a form that is not transparent to people involved in the professional practice. It is, however, important to address such variety of practices to provide a critical investigation of how mathematics might function, and it is important to investigate possible relationships between out-of-school mathematical practices and how mathematics might be contextualised in a school setting. The third feature concerns the exploration of educational possibilities, which can be mediated by notions like empowerment, social justice, and mathemacy. All of these features appeal to explosive and contested concepts, as they are not confinable within strict definitions. Any critical mathematics education research program, accordingly, comes to reflect a deep uncertainty.

Finally, in Chapter 17, we return to the notion of critique and to the impossibility of founding critique on an unassailable logical, epistemological, or political foundation. Emphatically, this position does not imply that action is impossible, but the grounds for that action are value systems and judgments. Collectively, the authors of this book do not at all expect that readers will agree with us on everything. Indeed, we do not always agree with each other, and may even face internal personal contradictions, doubts, and changes of mind. We regard such reactions as healthy, better by far than the illusion of certainty and the dogmatism that accompanies it. What we do ask for is intellectual openness to examining unexamined assumptions, and to the consideration of alternatives.

The cover of the book shows Ole’s painting of a parrot, as an illustration of Tagore’s powerful parable that stands as a condemnation of education as the construction of an intellectual cage.

NOTE

1 The definitions cited are from the Concise Oxford English Dictionary. This cluster of words and their complex ramifications in philosophy and critical theory, including critical theory of mathematics education, has been extensively analysed by Skovsmose (e.g., 2005, pp. 38–47), and further reflections on this pivotal concern will be found in Chapter 17.

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PART I

MATHEMATICS EDUCATION IS POLITICS
CHAPTER 1

MATHEMATICS AS A WEAPON IN THE STRUGGLE

ERIC (RICO) GUTSTEIN

In one of several “spoken-word” books that Paulo Freire wrote with friends and collaborators – this one with Chilean philosopher Antonio Faundez – the two discussed models of reality, the role of intellectuals in popular struggles, and the reinvention of others’ work. The following is from their conversation:

Antonio: … what is wrongly called your “method” … a lot of people think that your method is basically a model. I don’t think you ever considered your method to be a model.

Paulo: No, never.

Antonio: A method for you is a series of principles which must be constantly reformulated, in that different, constantly changing situations demand that the principles be interpreted in a different way. And thereby enriched. And thus basically your method is a sort of challenge to intellectuals and to reality to reformulate that method in order to translate its principles as the situation demands and thus be a response to different concrete situations. What do you think of that?

Paulo: I am in complete agreement. That is exactly why I always say that the only way anyone has of applying in their situation any of the propositions I have made is precisely by redoing what I have done, that is, by not following me. In order to follow me it is essential not to follow me! [emphasis added] (Freire & Faundez, 1992, p. 30).

Instead of “following”, Freire (Freire & Macedo, 1987) urged reinvention, which he wrote, “demands the historical, cultural, political, social, and economic comprehension of the practice and proposals to be reinvented” (p. 133). He continued “I have to challenge other educators…to take my practice and my reflections as the object of their own reflections and analyse their context so they can begin to reinvent them in practice” (p. 135). To reinvent and apply a set of principles from another’s context to one’s own, and to move social struggles forward, one needs to comprehend how others see their own lives and the objective conditions of their realities – as well as the dialectical connections of these two – all in relation to understanding the same within one’s own contexts.

This spirit of reinvention guides my approach to what Freire (1994) called reading [understanding] and writing [acting on and changing] the world – in a mathematics class in a Chicago public high school. I call this using mathematics as a weapon in...
Although I still describe my work as teaching “mathematics for social justice” or “critical mathematics”, I have adopted this more radical phrasing because, in 2007, then-President Bush travelled to South America and claimed that the U.S. was promoting “social justice” there. When I heard that, I remembered that others can appropriate our language, and so I starting using words that resist easy co-optation. Briefly, I mean by this that, “students need to be prepared through their mathematics education to investigate and critique injustice, and to challenge, in words and actions, oppressive structures and acts” (Gutstein, 2006, p. 4).

In this chapter, I examine, theorize, and problematise how Freire’s concept of generative themes (defined below) figured into an attempt to enact liberatory education in a neighbourhood Chicago public school. The school is in a culturally and spiritually strong, but economically battered, Black (African American) and Brown (Latina/o) community. I analyse practices within a 12th-grade mathematics class (2008–09) that focused entirely on students investigating their lived realities using mathematics, through which they learned college-preparatory math. Students and teacher (myself) together decided which contexts to study, and when, either based on students’ generative themes that they proposed, or on themes I suggested that they accepted. Together, we co-constructed a classroom embracing a pedagogy of questions, connections, critique, and challenge. Students engaged in the complexities of reading their world with mathematics and, to write the world with mathematics, they shared what they learned with their community and others in public presentations and through actions. As a contribution to this present volume on the politics of mathematics education, I analyse how we reinvented and lived out in the praxis of our class – with its many challenges and contradictions – Freire’s notion that “education is politics” (Shor & Freire, 1987, p. 46).

CONTEXT MATTERS

The history of social movements attempting to upend unequal power relations shows that transformational processes can be neither exported nor imported. The internal conditions within the particular locale must exist for genuine change to occur, from the bottom up and inside out. As Amilcar Cabral (1979), leader of the victorious independence struggles of Cape Verde and Guineau-Bissau against almost 500 years of Portuguese colonialism, said:

We also know that on the political level – however fine and attractive the reality of others may be – we can only truly transform our own reality, on the basis of detailed knowledge of it and our own efforts and sacrifices... however great the similarity between our cases and however identical our enemies, unfortunately or fortunately, national liberation and social revolution are not exportable commodities – more or less influenced by (favourable and unfavourable) external factors, but essentially determined and conditioned by the historical reality of each people. (p. 122)

This is entirely consistent with Freire’s contention that others reinvent his praxis to (re)make their own history.
In other words, context matters – foundationally. Freire’s contexts were literacy and post-literacy campaigns, explicitly and radically political, which often took place through culture circles – qualitatively different from schools: “Instead of a teacher, we had a coordinator; instead of lectures, dialogue; instead of pupils, group participants; instead of alienating syllabi, compact programs that were ‘broken down’ and ‘codified’ into learning units” (Freire, 1973, p. 42). He worked primarily with adult farmers, fisherfolk, peasants, and workers. They wanted to learn to read, on their own volition. Furthermore, there were no tests (let alone high-stakes assessments), passing grades, in-grade retention, or more to the point – educational failure. In Freire’s settings, “performance standards” would have been nonsense, and neoliberal ideas of privatising public education, parents as educational consumers in a marketplace, and profits being extracted from school would have been downright retrograde. He worked mainly in rural areas, and the economically developing countries with which he collaborated were in the Global South, including Brazil, Chile, Guinea-Bissau, Cape Verde, Nicaragua, Grenada, and El Salvador. Except for his two and a half years as Secretary of Education in São Paulo (Brazil’s largest city), he had little power over those with whom he worked on educational campaigns. Culture circle facilitators created curriculum (in the broad sense) from learners’ lived realities and held after-work sessions in the community. No bells rang to signal the period’s end. The school to prison pipeline was unknown – and the purpose of education was for liberation and humanization.

Contrast this to urban, U.S. public schools, particularly middle/high school mathematics classrooms, my focus. Similar to Freire’s contexts, most students are low-income (in Chicago public schools, 85%) and of colour (92%). But the similarities end there. Here, education is compulsory, to age 16 or 17, so whether or not learners want to attend school (of course many do, although as children age, their enthusiasm fades for many reasons), they have little choice. The mathematics “literacy campaign”, so to speak, of U.S. public education emphasizes technological innovation for U.S. economic competitiveness, global market supremacy, capital accumulation, and increased productivity – all to benefit the wealthiest (Gutstein, 2009). This campaign’s politics are reactionary and racist in that they serve and enrich U.S. capital and corporate/financial elites primarily at the expense of low-income and working-class people and people of colour within the U.S. (Gutstein, 2009), while, externally, the policies bolster U.S. supremacy over the Global South through “the control of new technologies, natural resources, flows of financial capital, communications and information, and weapons of mass destruction” (Amin, 2008, p. 15). Unlike Freirean culture circles, U.S. mathematics classes do have “teachers”, “lectures” (often didactic, despite the mathematics reforms), “pupils”, and “alienating syllabi” (in that they rarely touch upon or come from young people’s lives). Students’ school experiences, and those of teachers and administrators, are driven by high-stakes, punitive, (often) multiple-choice, exams, with profound consequences – for students wanting access to college and scholarships, and for communities whose schools can be closed or turned-around and made ready for “new” residents in gentrified spaces (Lipman, 2011). In the most recent model of top-down educational power in the U.S.,
mayors appoint district officials, who have power over principals, who have power over teachers, who have power over students. District, state, and national standards serve the larger agenda and influence curricula and textbooks, with little (or no) responsiveness to local needs or desires (Gutstein, 2010b). Schooling’s regimentation instills labour discipline – school bells, discipline codes, rule books, tardy passes, detentions, suspensions, expulsions – and greases the skids from school to prison, the military, gangs, street life, and early graves (all of which youth often critique). Macedo (1994) aptly described this as “literacy for stupidification”.

In short, one would have trouble finding two more diametrically opposed educational contexts – Freirean culture circles supporting radical political democracy and U.S. mathematics classrooms in urban schools. How then to reinvent Freire in this foreign space of a Chicago public high school math class?

GENERATIVE THEMES

A key way to address this question is to use generative themes, which are essentially key social contradictions in people’s lives. A theme can become “…the starting point for a political-pedagogical project [which] must be precisely at the level of the people’s aspirations and dreams, their understanding of reality, and their forms of action and struggle” (Freire & Faundez, 1992, p. 27). Based on generative themes of students and their communities – as they understand and articulate them – one can attempt to create liberatory education. Curriculum, then, is not imported, but is particularized to students’ lived realities, corresponding to Cabral’s (1979) assertions that “we can only truly transform our own reality, on the basis of detailed knowledge of it” and that the path is “essentially determined and conditioned by the historical reality of each people” (p. 122). This reality is embedded within the generative themes that people experience and express, and it forms the basis for transformative curriculum (Camangian, 2006).

However, generative themes encompass more than social problems, and Freire considered them in relation to how people perceive their existence and act in response. While a social contradiction might constitute the basis of the theme itself, one cannot fully comprehend it apart from how people understand and interact with it. As he wrote, “I must re-emphasize that the generative theme cannot be found in people, divorced from reality; nor yet in reality, divorced from people…. It can only be apprehended in the human-world relationship” (1970/1998, p. 87). He continued and critiqued the position that:

…presupposes that themes exist, in their original objective purity, outside people – as if themes were things. Actually, themes exist in people in the relations with the world, with reference to concrete facts. The same objective fact could evoke different complexes of generative themes in different epochal sub-units. There is, therefore, a relation between the given objective fact, the perception women and men have of this fact, and the generative themes. (p. 87)
Freire viewed themes as interacting with and influencing each other in various ways. For example, he saw them in relationship to their negation, or opposite: “I consider the fundamental theme of our epoch to be that of domination” (p. 84), and he added that this theme simultaneously “implies its opposite, the theme of liberation, as the objective to be achieved” (p. 84). He also thought about the generality and specificity of themes: “Generative themes can be located in concentric circles, moving from the general to the particular” (p. 84). For him, the overall consideration was that people develop an understanding of, and act to change, the conditions of their lives as expressed in their generative themes.

Complexities in using generative themes

Previously, I examined various difficulties in building on generative themes in mathematics classes (Gutstein, 2006, 2007). My perspective was that three types of interrelated, yet distinct, knowledges relate to “reading and writing the world with mathematics” (that is, using mathematics to understand or “read” reality (Frankenstein, 1998), and to change or “write” it). These ideas are not novel, but in general, have been under-elaborated in mathematics education. The three types are community, classical, and critical knowledges, which all have mathematical components. Briefly, community knowledge refers to what some call popular or informal knowledge – knowledge of one’s life circumstances and perspectives on reality. Classical knowledge refers to “traditional” academic knowledge, and critical knowledge means critiques and analyses of relations of power and issues of (in)justice. Developing (and acting upon) critical mathematical knowledge is akin to reading (and writing) the world with mathematics. I use Freire’s (Freire & Macedo, 1987) notion of “reading the world” and extend it to mathematics to be synonymous to developing classical mathematical knowledge. Knowledge of generative themes might be considered part of community knowledge, but can include aspects of critical and classical knowledge as well.

My argument then was that one way to enact critical mathematics pedagogy was to build on students’ community knowledge to support the simultaneous, interwoven development of their classical and critical mathematical knowledges. That is, build on generative themes and move outward from there. But the mathematics education literature contains few sustained examples of these practices. Certainly, educators have tried and studied these ideas. For example, the Algebra Project (Moses & Cobb, 2001) and the Funds of Knowledge work in mathematics education (Civil, 2006) connected community and classical mathematical knowledge, and culturally relevant mathematics pedagogy attempts this also (Gutstein, Lipman, Hernández, & de los Reyes, 1997; Ladson-Billings 1995; Tate, 1995). But, in practice, these efforts have under-emphasized critical mathematical knowledge. Other educators have connected critical and classical knowledges in mathematics (Brantlinger, 2006; Frankenstein, 1983; Gutstein, 2006), but did not fully proceed from student-articulated generative themes (community knowledge). Turner’s (2003) dissertation based in a 6th grade mathematics class and Varley Gutiérrez’s (2009) work in an after-school setting
are notable exceptions of attempts to build upon urban students’ community knowledge to develop both critical and classical mathematical knowledge. In Brazil (not coincidentally, Freire’s home), urban school systems develop curriculum based on students’ and adults’ community knowledge (O’Cadiz, Wong, & Torres, 1998; Gandin, 2002), but I know of no detailed research on sustained efforts to create and teach mathematics curriculum based on generative themes. In sum, this territory is insufficiently explored, practiced, and theorized. Below, I examine an attempt to use generative themes to teach critical mathematics and describe and theorize some difficulties, complexities, and contradictions.

GENERATIVE THEMES IN READING AND WRITING THE WORLD WITH MATHEMATICS

In the 2008–2009 school year, I taught a 12th grade mathematics class at Chicago’s Greater Lawndale/Little Village School for Social Justice (known as Sojo). (I am a university faculty member and occasionally teach in Chicago public schools.) Sojo was born out of struggle through a 19-day hunger strike by residents of Chicago’s Little Village community, a Mexican immigrant neighbourhood. Community members had demanded a new neighbourhood high school for years (the existing one was overcrowded), and when the district allocated funds (in 1998) but then reneged and built two selective, magnet high schools in wealthier, whiter communities, residents intensified the battle. This campaign culminated in the victorious hunger strike in 2001. A new building was built in which four small, neighbourhood schools opened in 2005 (Russo, 2003; Stovall, 2005), of which Sojo was one. I joined Sojo’s Design Team in 2003 and have worked with the school since its opening, participating in mathematics classes and collaborating with students and teachers to develop, teach, and study social justice mathematics.

The schools are roughly 70% Latina/o (mainly Mexican from Little Village, also known as South Lawndale) and 30% African-American students, who live in adjacent North Lawndale. Almost all students are low-income (96%), and any Lawndale student can attend any of the four schools. Each school is independent of the others, but they share common space (auditorium, gyms, lunchroom). Each has about 375 students, and as of this writing (June 2011), they have just finished their sixth year. Sojo’s mean 2009 ACT score was 16.8, about the district average for neighbourhood schools and well below the national mean of 21.0 (American College Testing Program, 2010), but the school’s first two classes (June 2009) graduated about 70% of entering 9th graders, well above Chicago’s average of roughly 50% (Swanson, 2008).

Sojo uses IMP, the Interactive Mathematics Program (Fendel, Resek, Alper, & Fraser, 1998), as its basic curriculum, although we also incorporate several critical mathematics projects (Gutstein, 2007, 2010a) each year. IMP is considered one of the mathematics “reform” curricula and emphasizes student conceptual understanding. Students take four years of mathematics, and, in spring 2008, the 11th grade class selected their senior math class from the “math for social justice” class, year four of IMP, or pre-calculus. This was the only time juniors had this option, as
I only taught the math for social justice class in 2008–09 to 21 seniors (6 Black and 15 Latina/o; 6 male and 15 female). Previously, Sojo teachers and I surveyed and asked students about topics they wanted to study. They mentioned HIV/AIDS, neighbourhood displacement (gentrification), and immigration. That spring (2008), I met with the students twice and had several informal conversations to discuss our 12th grade units. During the conversations, a student proposed studying the criminalisation of youth of colour/people of colour, and I proposed two topics. One was sexism, because my reading of the literature suggests that K-12 classes rarely study it, and because the class was almost three fourths female, I wanted it to build on, support, and be relevant to students’ identities. I also suggested that we study some statistical anomalies, suggesting possible fraud, in the 2004 presidential election that I believed (correctly, it turned out) students would not want to reoccur in the upcoming 2008 presidential election. Through dialogue, we collectively agreed on five topics: elections, displacement (gentrification, foreclosures, and immigration/deportation), HIV/AIDS, criminalisation, and sexism. Students expressed why they wanted to study these (personal connections, experiences, specific knowledge, observations, general concern, localness of the contexts, and interest). The three themes students proposed – displacement, HIV-AIDS, and criminalisation – were particularly meaningful and concerned many in the class. Several students had experienced themselves, family members, or friends struggling to save their homes from foreclosure or losing them altogether. HIV-AIDS in North Lawndale was a serious problem and some students knew people living with AIDS. And criminalisation of people of colour affected virtually the whole class as many students had family members involved, one way or the other, in the criminal justice system, Indeed, North Lawndale has an extremely high rate of criminalisation, with one estimate of up to 57% of its adults having had contact with the prison system (McKean & Raphael, 2002). Through the discussions and throughout the whole next year, I better understood how the themes related to students’ lives and what was happening in their neighbourhoods.

I believe it is important to clarify some issues about generative themes as I understand them and as they played out in our class. First, teaching critical mathematics based on generative themes expressed by low-income, urban students of colour should not be interpreted to mean that none of these youth love or want to study mathematics. There were students in my class (and throughout Sojo) who were mathematically strong and gravitated to and enjoyed the abstractions, patterns, and intellectual stimulation of mathematics. One of my students was even occasionally impatient when we stayed too long (for him) on sociopolitical contexts and spent insufficient time on mathematics.

Second, using generative themes is not a motivational gimmick to entice students to learn more mathematics. Rather, the purpose is to develop what Freire (1970/1998) called a problem posing pedagogy that starts from “…the present, existential, concrete situation, reflecting the aspirations of the people” (p. 76) and that…”does not and cannot serve the interests of the oppressor” (p. 67). Such pedagogy is inherently dangerous to the power structure because questioning, critiquing, challenging, and ultimately taking action to transform an unjust society.
are the goals of using generative themes. Of course, learning mathematics for marginalized students is definitely important for their personal life and education opportunities, and for economic survival for their families, communities, and themselves. Moreover, learning to read the mathematical word (developing classical mathematical knowledge) is necessary to read and write the world with mathematics (developing and acting upon critical mathematical knowledge).

Third, using generative themes is not a panacea – students’ lives are too complicated and the pain from harsh conditions of oppression does not stay outside the schoolhouse walls. Furthermore, the profoundly racist *miseducation* (Woodson, 1933/1990) of low-income youth of colour in the U.S. ensures that many have under-developed mathematical knowledge. Though some of my students were both conceptually and procedurally strong in mathematics, others – deeply intelligent, inquisitive, insightful, and resilient youth – had very weak comprehension of mathematics and rarely had the opportunity to make genuine meaning, for themselves, of symbols, procedures, and concepts. Although documentation exists that student engagement in K-12 critical mathematics tends to outstrip that in reform or traditional mathematics (Brantlinger, 2006; Gutstein, 2006; Turner, 2003) – and engagement is clearly related to learning – one should not infer that critical mathematics, with or without using generative themes, necessarily or miraculously transforms mathematics learning.

**Complexities in using generative themes: HIV/AIDS in our communities**

Beyond these broad observations about generative themes lie other issues, because having a meaningful theme is just a starting point. This statement may be obvious, but the theme, by itself, does not tell how to teach it. When teaching students to read and write the world with mathematics, the challenges are both mathematical and political. I examine the HIV/AIDS unit to illustrate specific complications in teaching with generative themes, how we tried to resolve them, and what we learned.

**Mathematical complexities** There were two key challenges related to mathematics in this unit – one, to create curriculum that helped students better understand the HIV/AIDS epidemic in their communities and Chicago, and two, for students to learn the difficult mathematics that this required. To create the unit meant comprehending how scientists, public health workers, community organizers, epidemiologists, and AIDS activists studied and used mathematics to understand HIV-AIDS. I, and two of the graduate students helping develop curriculum frameworks, contacted health professionals and researched medical journals to understand the spread, prevention, and treatment of the disease. We learned that epidemiologists study disease transmission with differential equations (beyond my students’ knowledge) and that the mathematical models for HIV/AIDS are complex.

However, my initial (naïve and erroneous) thinking was that we could develop a working HIV/AIDS model of Greater Lawndale and then project the impact of certain policies on the disease’s spread. As I wrote in my journal:

…I want students to have/create math models of AIDS transmission, and then think about tweaking them based on more (for example) gender equity so as to
reduce “survival sex”\textsuperscript{6}, or better/more accessible HIV testing or full free access to condoms everywhere. The idea would be for us to make a mathematical argument that we’d have less deaths if we did one or more of these things. Of course, this is a bit contrived because we are just playing with numbers here and we cannot know how to change the parameters to affect the number of deaths…and that should be part of the discussion as well. (3/19/09).

As we progressed through the unit, it became obvious that creating the model for Lawndale was impossible. First, developing a model for HIV/AIDS was more difficult than I had anticipated. Hyman, Li, and Stanley (2003) capture some reasons for this: “Because the transmission dynamics [of HIV/AIDS] form a complex non-linear dynamical system, the behaviour of the epidemic is a highly non-linear function of the parameter values and levels of intervention strategies” (p. 18). Second, good data are scarce. We could not get reliable figures on HIV/AIDS in the community. And third, while mathematically modelling diseases has life-saving potential (but only if political will exists!), the models rely on many difficult-to-make assumptions. How does one account for individual choices? The number of partners one has? Access to prevention programs? The probability that unprotected sex results in disease transmission? Whether HIV-positive individuals inform potential sexual partners? Such uncertainties pervade the modelling of complex social phenomena. Typically, little is done in school mathematics to give students a sense of the unavoidable uncertainty in the interpretation of the output from such models. Indeed, the overall effect of school mathematics may be to inculcate an implicit belief that mathematical models map aspects of the real world unproblematically on to mathematical equations that can then be manipulated to yield precise results.

Beyond the challenges for me to create the unit, students had to do quite difficult mathematics. To model HIV/AIDS, we used \textit{discrete dynamical systems} (DDS) to represent change over time (Sandefur, 1993). We built on the work from the previous unit (displacement) in which students used DDS to study mortgages (Gutstein, 2012). A sociologist/biostatistician who teaches doctors about epidemic modelling graciously sent me her materials (Morris, Goodreau, & Cassels, 2008), which I adapted for class. Students built simulations, first drawing cubes from a bag, and then graphed the results on their calculators. To give a sense of their mathematical challenges, I reproduce a graph and an assignment from the unit.

What made the mathematics for the HIV/AIDS unit so much harder than for the displacement unit is that one needs a DDS of two interacting equations to model a mortgage but four or six to model disease transmission. This assignment required students to derive and program into their calculators the four equations below (I did not give students the equations below). After the assignment, we analysed why the graph was shaped as it was. These equations describe much simpler disease transmission dynamics than those of HIV-AIDS.

\begin{align*}
u(n) &= u(n-1) + .0001v(n-1)u(n-1) \quad [u(n) \text{ means number of infected at time } n] \\
u(1) &= 1 \\
v(n) &= v(n-1) - .0001u(n-1)v(n-1) \quad [v(n) \text{ means number of susceptible at time } n] \\
v(1) &= 999
1. Suppose you had 1 infected and 999 susceptible people. Answer a–f below based on these numbers. This is too hard to do with cubes, so we can use our yellows [our TI-84 calculators].

   a. How could you find the number of interactions in a day using I and S for the number of infecteds and susceptibles? (Think about what you did to answer this w/ the chart).
   
   b. What is the minimum number of interactions in one day that you could have?
   
   c. What is the maximum number of interactions in one day that you could have?
   
   d. Suppose there is a probability of .01% (or .0001) that an interaction occurs between an infected and susceptible person and the susceptible is infected. What is the maximum number of infections that can occur in any one day?
   
   e. A dynamical system would tell us “the number of infected at the start of day \( n \) is equal to the number at the start of day \( n-1 \) plus the newly infected that day”. What is that as a difference equation? And what is the starting equation for the system?
   
   f. Create the dynamical system (the difference equation and starting equation) for the number of susceptibles.

2. Graph both systems on your yellow (think about your window variables!). When does your system hit equilibrium and what are the equilibrium values?

3. Experiment with different values for the probability, changing it slightly. Record your results for the probability value and number of days until equilibrium. What happens?
**Political complexities** The mathematical issues of the HIV/AIDS unit were complex – and the political ones were no less so. A principal challenge was to support students in developing sociopolitical explanations for the data. Shortly before the unit began, I asked students how we should spend the rest of our year (roughly three months). We had planned to complete three more units (HIV/AIDS, criminalisation, and sexism) but that seemed impossible. Students collectively decided to embed sexism in the other two units, and we started on HIV/AIDS. Carmen, a Black female student, had proposed the unit, and we were focusing on the impact on women, with Black women being the most disproportionately impacted demographic group in Chicago. I assembled and showed a short PowerPoint on Chicago data. As I wrote in my journal:

> We then moved to the slide that showed that 80% of the female diagnoses in 2006 [in Chicago] were of African Americans. That really blew people away. Carmen sat straight up and said, “damn!” Since we knew that African Americans made up only about 35% of the population, this was really out of line. (3/25/09)

This raises another key issue in using generative themes. Teachers and curriculum creators need to develop what Freire (1998) called “political clarity” on the themes. If a teacher uses a controversial topic with such powerful potential to stigmatise those most affected (e.g., Black women with HIV/AIDS), then the teacher herself has to read the world and deeply understand the sociopolitical genesis of the injustice. Then one can provide students access to various perspectives that differ from dominant narratives so they can critique and develop their own. Though this might involve mathematical issues, it is fundamentally a political question. I wanted to ensure that students did not leave class demonising Black women for their HIV/AIDS rate. Initially, I was not totally clear how to explain these data, but I knew that Black women were not the cause of the problem.

I found a book deconstructing various HIV/AIDS myths including that of “dangerous behavior” (Irwin, Millen, & Fallows, 2003). The authors argued that sociopolitical forces strongly constrained individuals’ choices. The chapter on dangerous behaviour recounted several tales: a young woman in India pressured to have unprotected sex by social mores and by her HIV-positive, much older, and unfaithful, husband who subsequently infected her; a young man in Puerto Rico pressured by his family to earn more money, who turned to dealing drugs and eventually contacted AIDS; and other stories. The chapter’s point was not to absolve individual responsibility or excuse poor choices, but to help readers contextualise and understand why people sometimes acted self-destructively.

We spent three (50-minute) periods in groups reading the chapter and making large posters to present the ideas. A central one was of “survival sex”, which meant that women (and men) sometimes had sex because of economic pressures. This led into engaged debate about women, HIV/AIDS, sexism, gender, racism, power, prostitution, “sugar daddies”, (a term the book used) and more. From my journal:

> Even though students know that there are real issues here, they have trouble getting past the discourse, the very powerful discourse of individual
responsibility. Jenny [a Black female], in particular, wants to look at the individual and said that she felt the book was making excuses for people. (3/23/09).

Later in that journal, I wrote about more complexities:

I drew Calvin and Antoine into the conversation about survival sex because their portion of the chapter was on gender discrimination. I think they have different views. Calvin seems to think that females who have sugar daddies do so because they want things, whereas I heard Antoine talk about needs. How do we approach this and distinguish? Jenny also talked about a woman she knows (I assume a Black woman) who knows her partner has HIV but sleeps with him anyhow, unprotected. We didn’t ask, but one question might be if she has the power to demand condoms. Or not. Such a complicated situation. And if a woman acquiesces, even knowing the risk, is she weak? Roxanne pointed out that women stay in abusive relationships even when they should know better, often times because of economic insecurity. Is that also survival sex? Lots of really good questions emerged today… (3/23/09)

We never totally settled this matter at the time, which is not necessarily a problem in my view. One should not expect that youth (or adults!) easily resolve so complicated an issue, and critical (mathematics) pedagogy should allow for ambiguity, open questions, and contradiction. As Freire (Freire & Macedo, 1987) wrote, “A pedagogy will be that much more critical and radical the more investigative and less certain of ‘certainties’ it is. The more ‘unquiet’ a pedagogy, the more critical it will become” (p. 54). As I wrote in my journal:

So something that is really interesting to me is this: in the elections unit, as we’ve talked about (me, Anita, Patty [doctoral-student co-researchers studying the class]), we’ve said that was a unit in which you had to do a mathematical analysis of a political situation to understand whether or not the election was stolen. Here, you have to do a political analysis of a mathematical situation (i.e., the data) to understand the data, the question of “why is there the disproportionality?” It’s the flip side. (4/21/09)

I return to the “dangerous behavior” myth below when I discuss the related themes of race, class, and gender.

Mathematical-political complexities The above leads into what could be called the mathematical-political complexity of using generative themes in critical mathematics. One needs clarity on constraints and possibilities within both the mathematical and the political spheres – and their dialectical interactions – when creating and teaching curriculum based on the themes students and their communities bring. Since my general framework was to have context, not content, drive the curriculum, I tried to ensure that students wanted to learn mathematics to answer their own questions. This occurred in the elections unit during which students themselves reached the point of wanting to understand if the 2004 presidential election was “stolen” (a term used by Freeman and Bleifuss, 2006),
because of the then-upcoming 2008 Obama election. After all, we were in Chicago (Obama’s town), several students were 18 and preparing to vote for the first time, and some had helped monitor elections or participated in voter registration drives. The only way to answer the central question and be prepared for possible fraud in 2008 was to study binomial and normal distributions so students could make appropriate mathematical arguments about whether – or not – the irregularities were just coincidence (Gutstein, 2012). But the HIV/AIDS unit was different. I had trouble linking the mathematics of the DDS to students’ questions about HIV/AIDS. My journal:

After class, Anita contrasted what we’re doing in the AIDS unit with what we did in the Elections unit. Students are not clear about why we’re doing what we’re doing! And that’s my responsibility. I’m not even super sure…but she pointed out that we need to one, frame it more clearly in terms of the sociopolitical and economic context, and two, make it clear what we’re doing mathematically that relates to the sociopolitical context. So I will work on this! (3/19/09)

That is, students did not need to model HIV/AIDS to understand the disease, grasp the disproportionate impact on certain populations, or not blame Black women. There was no focus question that motivated learning mathematics in the same way as in the elections unit (“what really happened in the 2004 election?”) or displacement unit (“what were the sociopolitical forces displacing people from Lawndale and whose community was it?”). I felt committed to the challenging mathematics of DDS and was reluctant to give it up because I wanted students to have broad mathematics experiences and to learn serious, college-preparatory mathematics. I did not want students only to analyse data, as important as quantitative literacy is. But the difficulties of creating an HIV/AIDS model for Lawndale that students could learn from, along with my not-quite-rational proposition to students that they needed one, demonstrate the complexities of interweaving mathematical and sociopolitical aspects when using students’ generative themes to teach critical mathematics. My journal:

At times, we use mathematics to explain social things (like the election being stolen), at other times, we use social analysis to explain mathematics (like high AIDS rates). The point here is, I think, that you cannot easily explain one without the other. (3/23/09)

GENERATIVE, “RELATED” THEMES: INTERCONNECTIONS OF RACE, CLASS, AND GENDER

I have tried to illustrate some constraints and affordances of using generative themes in critical mathematics as a way to reinvent, but not follow, Freire. But the challenges of using themes from students’ lives also extend to themes that I call “related”. These were bound to, and both encompassed and were encompassed within, the situational themes that drove the units (e.g., displacement, HIV-AIDS). Given who my students were – low-income youth of colour from Lawndale – these
related themes included race, class, and gender. These were specifically involved in four of our five units – displacement, HIV/AIDS, criminalisation of youth of colour/people of colour, and sexism. These themes interconnected and were central to the class as a whole. They also related to the mathematics students learned. Below, I explain how these related themes manifested themselves differently in two of our units and some possibilities and challenges that emerged. I also provide more context for how they connected to what Freire (1970/1998) called the fundamental themes of our epoch: domination and liberation.

Race, class, and gender – and the displacement unit

The displacement of low-income communities of colour in Chicago demonstrates these themes’ interconnections. Displacement takes multiple forms, but in Lawndale, it takes shape in three main ways – gentrification (North Lawndale), deportation (Little Village), and foreclosures (both communities). North Lawndale’s gentrification is part of Chicago’s attempt to become a “global city” with “command centers” of the global economy (Demissie, 2006, Lipman, 2004). To become global, cities need to attract knowledge workers and develop the commensurate amenities to satisfy them. This includes schools for their children and up-scale housing (and culture and social opportunities, low-skill services, etc.) that this stratum demands. The confluence of housing and education is particularly interlinked in Chicago, and a key component is urban gentrification along with school closings and openings – rebranding of the “new” (transformed) neighbourhoods, along with the euphemistically termed “rebirthing” of “new” schools (Lipman, 2011).

Gentrification in Chicago overwhelmingly affects Black, Brown, and low-income areas. Whole swaths of the city’s Black community have been wiped off the map, partially due to the destruction of public housing and its subsequent replacement with “mixed-income” communities that effectively exclude most original residents (Lipman & Haines, 2007). Since 2004, the school board shut about 70 neighbourhood schools and opened approximately 100 new “renaissance” schools that are publicly funded, but mostly privately run by management corporations (i.e., charter or contract schools) (Chicago Public Schools, 2010). Administrators of these schools use implicit and often subtle mechanisms to restrict enrolment to students whom they consider “desirable” and to remove “undesirable” ones (Karp, 2010; Lutton, 2010). In the process, low-income students of colour and their families are forced out.

Women are particularly impacted by displacement. In general, they disproportionately head low-income and working-class families – North Lawndale’s 2000 rate of female-headed households was about two and a half times greater than Chicago’s as a whole (Census 2000) – and this is particularly true for public housing residents. In 2000, North Lawndale was about 60% female (Census 2000). When I asked a Black male Sojo student to explain this, he answered, “Cuz all the brothers [Black males] are locked up or in the ground”, reflecting the confluence of racism (with respect to criminalisation), sexism
(women bearing the burdens of life and family by themselves), and class (lack of meaningful job and educational opportunities for low-income Black males). This exclusion and removal devastates people’s communities and histories. A mural in one gentrifying neighbourhood captures this well: “Gentrification = Ethnic Cleaning!”

While gentrification assaults North Lawndale, Little Village is relatively unscathed (so far). This is probably due both to geography (North Lawndale is closer to downtown with better transportation) and housing stock (North Lawndale has the most architecturally desirable greystones of any Chicago community). Little Village’s displacement nemesis is deportation. It is common knowledge in the neighbourhood that thousands of undocumented migrants (including many public school students) live in Little Village – the largest Mexican migrant community in the U.S. outside of East Los Angeles. Many are economic refugees from Mexico where poverty forces people off rural lands to Mexican cities and maquiladora areas along the U.S.-Mexico border, and often, eventually, north to the U.S. and Chicago where they live in fear of discovery and deportation (Bacon, 2008; Bigelow, 2006; Oxfam, 2003). Their jobs are disproportionately low-wage, non-union, difficult and dangerous, in the agriculture, low-skill service (e.g., gardening, maintenance, custodial), fast food, and construction (e.g., day labour) sectors (Bacon, 2008; Mehta, Theodore, Mora, & Wade, 2002).

Besides class issues, the experiences of Mexicans in Little Village and throughout the U.S. are highly racialised. A recently passed (April 2010) State of Arizona law exemplifies anti-Mexican racism. The legislation states that any Arizona law enforcement officer can demand identification documents from anyone they think is unauthorized in the U.S., effectively sanctioning racial profiling (although mass protests and resistance immediately erupted). Furthermore, the predicament of economic migrants is often gendered as well. Most from Mexico are males seeking jobs in the new land while their wives and children stay behind. These women often head families by themselves, hoping for remittances from their husbands up north. Men have to deal with alienation, loneliness, and exploitation, but women often experience these and the extra burdens of being single parents.

Like gentrification and deportation, home foreclosures have racialised, gendered, and classed aspects. Home foreclosures strongly correlate with race in Chicago, and the communities with the most numerically and the highest rates are overwhelmingly African American (National People’s Action, 2010). I started the displacement unit by telling a story about Carmen’s family, after receiving permission to share it. Her retired grandmother lived in North Lawndale for decades and paid off her modest home where she raised Carmen’s family, after receiving permission to share it. Her retired grandmother lived in North Lawndale for decades and paid off her modest home where she raised Carmen’s mother and aunt. When her property taxes increased (common in gentrifying communities when property values go up), she took out an adjustable-rate home equity loan and borrowed extra cash. When the loan reset and increased, she could not make the payments, lost her house, and moved in with Carmen’s aunt – a typical story in Chicago and across the nation. And although low-income and
working-class Black communities had the highest rate of foreclosures in Chicago, Latina/o neighbourhoods were close behind. The families of two Latinas in our class were also struggling to keep their homes. In both Lawndales, foreclosures more than tripled from 2005 to 2008 (Woodstock Institute, 2010).

Here, too, women often bear the brunt because women and female-headed families are overall poorer than men and male-headed families, and poverty generally correlates with foreclosure rates. In recent years, predatory lenders targeted low-income women of colour (Fishbein & Woodall, 2006), showing the interconnections of race, class, and gender. Even though women in 2005 had slightly better average credit scores than men, they were more likely to receive subprime (financially unsound and typically more expensive) loans than men within their income range. This disparity increased as incomes increased – upper-income Black women were five times as likely to have a subprime loan as upper-income white men – and overall, Black women and Latinas have the highest rates of subprime borrowing (Fishbein & Woodall).

Thus, the generative theme of displacement and its related themes of race, class, and gender were salient in our class. In particular, this unit provided the best opportunity for students to use mathematics to understand that despite racial and cultural differences (and sometimes antagonisms) between the two Lawndales, the political commonalities outweighed the differences. I provide student perspectives on this point when I return to it below.

Race, class, and gender – and the HIV/AIDS unit

Similarly to the displacement unit, the HIV/AIDS unit also embodied the related themes of race, class, and gender, but raised different challenges. Since students decided to embed sexism within this unit (and criminalisation), the theme of gender was particularly present. As I mention above, this took shape as we analysed HIV/AIDS rates for Black and Latina women and the myth of dangerous behaviour. But the data surprised us, in more ways than one. We discovered that in the U.S., people of colour disproportionately have HIV/AIDS, but Chicago had some anomalous data. Eighty percent of its newly diagnosed female HIV cases in 2006 were of Black women, while the city was only 37% African American. During the same time, Latinas/os made up 26% of the population, but Latinas accounted for only 16% of the new diagnoses (AIDS Foundation of Chicago, 2008). Whites were also under-represented.

Students drew on their out-of-school knowledge in discussing HIV/AIDS, and implicitly and explicitly linked racism, poverty, and sexism. When we read the chapter on dangerous behaviour, Jenny and Gregory reported on the story of the young Indian woman whose husband infected her. Jenny said that “she [the woman in the story] is obligated to have sex with him…she doesn’t have a choice, she’s a woman”. Marisol, in a very matter-of-fact voice, added that “when you get married, you have an obligation to have sex with your husband”. I asked “So where does the power reside in the relationship?” Several students simultaneously
responded, “with the man”. Students were clear that the text was making the point that women often lack power to demand protected sex.

Students then discussed survival sex, and one read aloud a poster, titled “Women and AIDS”. A line read, “Survival sex is necessary for women in poor [economically] situations.” When Renee asked, “does survival sex mean prostitution”, as I mention above, some students defined it as being about economic need but distinguished it from women having sugar daddies. That, they claimed, was about low-income women meeting their wants. Roxanne complicated this by stating that some economically dependent women who were not prostitutes stay in abusive relationships to feed their kids, and Ann added, “there are different forms of survival sex”.

As we continued to discuss the chapter, contradictions emerged. Sometimes students contradicted themselves. Several accepted the book’s argument that economics influenced people’s decisions, and they used this to explain why women of colour had disproportionately high rates of HIV/AIDS. However, the class was perplexed when we confronted the Chicago data ofLatinas having disproportionately low rates of infection in 2006. From my journal:

So we established that Blacks were disproportionately [over-] affected by HIV/AIDS. But then Roxanne or Gema or Ann asked “but what about Latinas/os?” since they were 16% of the new [female] cases in 2006. I told them that Latinas/os were about 26% or so of the Chicago population. I also told them that whites were also about 35%, like African Americans. That led to a really interesting discussion. Roxanne said, “then we’re not right, because we said that poverty was really related to AIDS, but then how can Latinas/os have a lower rate than they’re in Chicago?” This prompted Ann, who said, “Then Jenny and I were right.” Jenny said, “What do you mean?” And Ann responded, “then it is about promiscuous behavior, not poverty”. What a complicated issue! I asked Roxanne what she made of all that, but she could not answer this. But what we did establish is that in Chicago, both Latinas/os and whites are under-represented in the 2006 HIV diagnoses, while African Americans are clearly over-represented. (3/25/2009)

Again, we did not try to definitively resolve this. In retrospect, I believe I made some mistakes at this point. I do not recall the details, and we have no audio or video of that day. Also, my journal makes no mention that I tried to support students in trying to make sense of the strange data. While I believe, in general, that students have to learn to handle ambiguity as part of learning how to remake the world, this oversight was a missed opportunity. Embracing uncertainty is part of the epistemological, ideological, and political standpoint of problem-posing pedagogies, as Freire’s (Freire & Macedo, 1987) earlier quote about “uncertain” and “unquiet” education makes clear. But although that is my general pedagogical stance, in this instance my analysis is that I should have done things differently. At the very least, a teacher in this situation could have had students examine whether
this was a trend/pattern and asked them how might they investigate this further and what else did they need to know.

All the themes and their interconnections, complexities, and contradictions

Race, class, and gender were inextricably linked in both the HIV/AIDS and displacement units but differed in how they connected to the generative themes framing each unit. In the HIV/AIDS unit, the intersections of race, class, and gender shed less light on political commonalities and more on analytical ambiguities. The unanswered question of why Latinas were under-represented in Chicago’s new HIV cases in 2006 complicated students’ understandings. They argued that because poverty was associated with higher levels of HIV/AIDS (though they could not fully explain why) and people of colour tended to be poorer, that the overall poverty of people of colour was a factor in their disproportionately high rates of HIV/AIDS. But Latinas’ under-representation confounded that analysis.

My goal was that students develop a relatively coherent political understanding of specific mathematical data – Black women’s drastically high rate of HIV/AIDS. I do not think that happened to the extent I wanted. Some Black female students argued that social factors did not absolve individual choices, but they could not explain why other Black women made what they considered to be bad decisions. In general, several students remained ambivalent in their views about the relationship of sociopolitical forces to individual choices. Some argued that promiscuity was the leading factor, then changed their minds to say it was poverty, but then could not explain why poor Latinas were under-represented in Chicago, and Black women over-represented. Overall, my analysis of classroom data suggests that most students left the unit understanding that racism, sexism, and poverty all contributed to Black women’s high rates – even if the exact mechanisms and connections remained unclear. Students left with open questions, to continue to think about in the future, but with more unclarity than I had wanted on this particular issue.

However, in contrast to the HIV-AIDS unit, in the displacement unit, race, class, and gender’s interrelationships provided contexts for students to more clearly examine how their lives were touched by gentrification, foreclosure, and deportation and to better understand the political connections between the two communities. In late May 2009, near the end of the school year, the whole class presented what they had learned to their two communities (on consecutive nights). The group of students speaking on gentrification provided a mathematical analysis showing that families with median wages in both Little Village and North Lawndale could not afford new homes in the neighbourhood. And to end the section on the displacement unit, and the whole 81-slide power point presentation (created entirely by students), Erika presented the following slide that drew together both communities and captured well our work for the year:
Monica echoed these sentiments of unity in her end-of-unit project for the displacement unit. Her response was typical of what students wrote and said about this unit:

Some connections that I see between these two parts [gentrification/foreclosure and immigration/deportation] of the unit are that in both communities, people are being forced out their homes. Of course, it’s different situations, but similar causes. African Americans are being forced out their homes because they can’t pay for their homes. The taxes go up so much that they can’t afford to keep living in those communities, so they are forced to look for another place to live. For Mexican people, the problem is that they don’t have jobs in Mexico because corn isn’t being sold, because it’s cheaper to import subsidized US corn than to grow their own. That forces Mexicans to leave their family and homes to come to the US to look for a job. This is how the unit connects…. People are being forced out of their community through gentrification. Latinos (especially Mexicans) are being forced out their countries by not having a good paying job. Also, the house mortgages don’t only affect one community, but both. They are sometimes the target of bad loans that only make banks richer!

I want the people in my community to know that we are really similar with these situations. That there is more that makes us similar, less that makes us different. If we want to fight the bigger people out there, the best way is to unite. Fighting each other is not going to take us anywhere. I think this is something very important our community should know.

Finally, there is the question of a white teacher and low-income students of colour. What did it mean to the students (and to me) that I, a white male professional, taught them to use mathematics to study these issues? Students and I talked openly about the differences between us, and I shared some of my experiences that were
similar to theirs. I asked them their views in an open-ended survey at year’s end (June 2009). Question #11 was:

I am 56-year old white male, not from your community and don’t experience what you do – and I’m the person teaching you to use math to understand racism, sexism, criminalization of youth of color, etc. What do you think?

Students’ responses were interesting and varied. Some demonstrated a broad perspective on race and difference. Julie wrote: “You don’t have to be from our community or our color to understand that things that are going on in our world are not balanced”, and Calvin added: “Even if you don’t experience it you hear it from the students…”. Others seemed relatively unfazed. Gregory wrote: “I think nothing of it because you ask questions so that you don’t put your opinion too much into the units”, and Roxanne added: “When I read this question I just realized that I don’t think it’s a problem.”

Others mentioned personal relationships, like Ann, who was broadminded and teased me as well: “I like it. I feel like you are one of us. Being born a certain thing isn’t only what makes you, you. You are like a more experienced slightly older friend. Lol 😊.” Antoine, in his usual succinct way, wrote, “Understand us. So you fit well in this class.” Although none expressed a problem with my whiteness, Ellen wrote that “…it’s weird how a white male is teaching us this instead of someone that looks like us”, and Carmen, commenting on my having grown up in an inner-city Black and Brown community, also thought it weird: “About you being white, I have always thought that this was weird but it is accepted because you come from a similar background as some of us. You have struggled with us and the stuff you went through is encouragement for us to do things.” And Daphne’s response was particularly interesting because it reconfirms that students pay close attention to who their teachers are as people: “If I didn’t know you so well I wouldn’t listen to you. I would think of you as just someone trying to tell me what’s right and wrong and criticize…”

I take from these responses and others, as well as other data, that students made relatively little of my race, age, etc. Sojo staff are fairly diverse in race, ethnicity, gender, and sexuality, so students were used to teachers from different backgrounds. I also think that, overall, my sharing power and having students co-determine what and when we would study; my continual pushing for questions, critique, challenge, collaboration, and communication; and our explicitly political relationships and the political framing of everything we did all mattered. Using generative themes demands these attributes from teachers, and while I made many mistakes and was not always able to be such a teacher, that was a conscious, explicit goal that I communicated regularly to students. This disposition may have mitigated the real power differentials of race, class, age, culture, language, and experience between my students and me.

CONCLUSION

My argument here is that teachers can use student/community generative themes to create and teach mathematics curriculum that supports young people in learning to
read and write the world with mathematics – that is, to use mathematics as a weapon in the struggle for justice. This approach was an attempt to reinvent and apply Freire’s principles to an urban U.S. context. I conclude with some key ideas, as I understand them.

The details of classroom interactions here should not obscure some larger points. First, I am clear on the difficulty of this work within the high-stakes, accountability-driven madness enveloping U.S. schools, exacerbated by the Duncan/Obama *Race to the Top* and neoliberal, education privatisation efforts. I recognize that district, school, and state mandates constrain teachers. This reality contributes to why relatively few teachers use students’ generative themes to develop critical mathematics education. But understanding the roots of existing constraints helps us overcome barriers through collective agency. There are always spaces in which to act, even in modest ways. Teachers wanting to teach mathematics for social justice can start small, politicise simple situations, and share and collaborate with others.

Second, navigating what we call the “dance” between teaching social justice contexts and teaching mathematics is complicated, fluid, and challenging. At times (infrequently), my mathematics class resembled a social studies class devoid of mathematics; at times (also infrequently), it looked like a more-or-less reform mathematics class lacking sociopolitical contexts; and at other, more fortuitous times, my classroom genuinely and visibly integrated reading and writing the world with mathematics and reading the mathematical word. And everything in between. There is a continuum here, and one should not expect it to look neat and clean. Teachers need the patience to realize that this is a developmental process. It takes time and experience – for both teachers and students – to create a pedagogy of questioning and to co-create a classroom that supports teaching and learning critical mathematics. At its most fundamental level, the task asks teachers to have a political stance and the commitment to stand in solidarity with students in the struggles of their communities for justice (Freire, 1998; Gutstein, 2008; Ladson-Billings, 1994).

Third, there is the obvious distinction between developing curriculum and teaching it. The literature is clear that even veteran teachers have to learn to teach reform curriculum like IMP (Stein, Remillard, & Smith, 2007). Social justice curriculum is no different, and, in fact, has added challenges as I illustrate here. And there is the inherent contradiction between developing curriculum based on generative themes in one locale and then others using it in different settings. Yes, curricula may be adaptable, but teachers have to make that happen, partnering with their students to concretise and study their own specific contexts. There are no shortcuts here.

Fourth, there are no blueprints either. We make this road while walking and will not find answers in a book. We can build on existing learnings, but we also have to collaborate to produce new knowledge in this field. We can draw on the research on mathematics teaching and learning, which I do – the math reforms definitely inform my critical mathematics teaching and curriculum development – but while this is necessary, it is in no way sufficient. Generic “critical thinking” in mathematics is fundamentally different from critical literacy in mathematics (Apple, 1992).
Furthermore, the mainstream mathematics education community overlooks these questions, and the reforms, by themselves, can even exacerbate inequality (Martin, 2003; Secada, 1996). The political nature of this work demands reinvention.

Fifth, using generative themes in the classroom not only demands genuine democracy but also helps create it. This was central in Freire’s writings about resolving what he called the “teacher-student contradiction”. When teachers elicit generative themes from students and use them to develop liberatory curriculum, they instigate a dialectical process that opens a space for deep student engagement. And when students take this up, as they did in our class, they help make democracy be a cornerstone of the setting and participate in remaking education as “the practice of freedom” (Freire, 1973).

Finally, the purpose of reading and writing the world (with or without mathematics) is for sociopolitical change, to end oppression, exploitation, and exclusion, and for full humanization and liberation. As I write this (January 2012), the revolutions in Tunisia and Egypt are one year old, the Arab Spring has sprung, the Occupy Movement has 2600 encampments around the world, and the 99 percent/1 percent divide is on ordinary people’s lips and minds, as well as on those of activists. The gap between rich and poor has never been wider and continues to grow, and vast global resources serve to enrich a tiny minority. The present path is not ecologically, economically, or spiritually sustainable.

In my view, the struggle of the world’s people needs to be against our present political and economic system that is the root of racism, sexism, homophobia, and other discriminations that cause so much pain to my students and countless others. These young people need to take their rightful place in history as subjects, not objects, in the words of Paulo Freire (1970/1998). In the last book he wrote before he died, Freire (1998) wrote:

> I am a teacher who favors the perman ent struggle against every form of bigotry and against the economic domination of individuals and social classes. I am a teacher who rejects the present system of capitalism, responsible for the aberration of misery in the midst of plenty. I am a teacher full of the spirit of hope, in spite of all signs to the contrary. (p. 94)

This spirit of hope, Freire (1994) reminded us, comes with the fight for a brighter future based on new relations between people. He wrote that without hope, the struggle dissipates and withers – but without the struggle, hope is meaningless and does not change reality. They need each other. To build on what others have done, to reinvent, and to use the knowledge of generative themes that students and their communities bring as a source for developing and teaching critical mathematics curriculum is a contribution we can make – that is, to make K-12, urban, U.S. mathematics be a weapon in the struggle for social justice, peace, and a better world. As Antoine wrote when I asked him, impromptu, to write what reading and writing the world with mathematics meant to him, and why our class did it:

> Reading and writing the world with mathematics for me is interpreting and making our judgment of the social and political reality of our community and
the world we live in. At the same [time] I learned how to make connections with mathematics and the real world. We do it because it helps us understand and combat against oppression and injustice in our communities and in the world. But more importantly, we do it to be educated in knowing what we are fighting against.

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NOTES

1 A neighborhood school in Chicago is one that any student living within the school’s attendance boundaries can attend.
2 In Chicago, many use Black and Brown to refer to African Americans and Latinas/os respectively, and interchangeably, which I follow here.
3 This refers to the way students are forced out of school and eventually wind up in prison.
4 Chicago school turnaround means firing all adults and bringing in new administration and staff, though a small portion of teachers return.
5 Each school on the campus has its own theme. One is a multicultural arts school, one a math/science/technology school, and one a “world languages” school. Sojo is the only social justice school.
6 We read in class from a book that defined survival sex as people having to have sex for various forms of survival.
7 Gentrification has also become part of neoliberal economic development as cities as metropolitan regions compete on a global scale for capital investment. This activity is to compensate, in part, for federal budget cuts to urban areas in the U.S. as part of neoliberal restructuring that began in the 1970s and 1980s (Harvey, 2003).
8 Buildings characteristic of many Chicago communities.
9 Data for the year includes video from 41 classes, audio of classes, field notes and teacher journals from most classes, student surveys, audiotaped focus-group interviews, video of public student presentations, most of the student work, and more.
10 Her real name, because it was a public presentation. All other student names are pseudonyms.
Although I do not have room to describe it, we also studied the impact of NAFTA (North American Free Trade Agreement) on displacement – from Mexico, as Monica alludes to here, and from Lawndale through its deindustrialization via the global race to the bottom.

REFERENCES


A WEAPON IN THE STRUGGLE


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