# *Emancipatory and Social Justice Perspectives in Mathematics Education*

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CRITICAL NOTICE of *Reading and Writing the World with Mathematics: Toward a Pedagogy for Social Justice*, by Eric Gutstein, 2006. New York: Routledge, 257 pages; and, *Mathematicians as Enquirers*, by Leone Burton, 2004. Dordrecht, NL: Kluwer Academic Publishers, 246 pages.

Mathematics has historically served as the gatekeeper to numerous other areas of study. For instance the hard sciences, schools of engineering and business typically rely on the Calculus sequence as a way to filter out students unable to fulfill program pre-requisites. In numerous countries around the world, particularly in Asia, entry to government subsidized programs in engineering and the sciences is highly competitive and require students to score in the top one percentile in entrance exams in which mathematics is a major component. The situation is not so different in North America as evidenced in the importance of standardized tests like SAT or ACT to gain entry into college programs. It is also not uncommon to hear politicians use schools' performance on mathematics assessments as a reference point to criticize public school programs and teachers (e.g., the passing of the *No Child Left Behind Act* in the United States). Therefore one can say that mathematics education has everything to do with today's socio-cultural, political and economic scenario (Sriraman, 2007). In particular, mathematics education has much more to do with politics, in its broad sense, than with mathematics, in its inner sense (D'Ambrosio, 1990, 1998, 1999).

Mathematics seen in its entirety can be viewed as a means of empowerment as well as a means to oppress at the other end of the spectrum. For instance, Schoenfeld (2004) in his survey of the state of mathematics education in the United States, wrote "Is mathematics for

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the elite or for the masses? Are there tensions between 'excellence' and 'equity'? Should mathematics be seen as a democratizing force or as a vehicle for maintaining the status quo?" (p. 253). Although, these questions have been the subject of some mathematics education research, the two books under notice here give refreshingly new and different nuances of social justice/emancipatory inquiry in mathematics education.

Gutstein's (2006) book *Reading and Writing the World with Mathematics* presents the possibilities for mathematics to serve as a means for critically understanding the reality within which we live. Inspired by Freire's (1998) emancipatory work, Gutstein, a university educator and an activist, takes on the challenge of teaching a middle school class at Rivera, a pre-dominantly Latino neighborhood in Chicago. The motivation for doing so is to create or be a living example of an implemented blueprint for critical pedadogy in a mathematics classroom. Although politics is the last thing that teachers of mathematics may have in mind, Gutstein's work reveals the intrinsically political nature of mathematics education. Nearly 30 years ago, Anyon (1980) described social class and the hidden curriculum of work in different elementary schools in the United States as a function of their location in varying socio-economic neighborhoods. Anyon reported a "Flatlandesque" [1] world in which students from lower socio-economic classes were essentially being educated to be compliant workers, good at following directions and were never given the opportunity to use higher order thinking skills. Whereas the higher class students were educated in a way that emphasized critical thinking skills, communication and leadership skills to guarantee higher capital and managerial mobility in the job market. Gutstein's more contemporary students were in a similar position to the situation described by Anyon nearly 30 years ago, namely in life and schooling circumstances which encouraged their current status quo.

Gutstein sets the example for a pedagogy capable of creating a paradigmatic shift in student's mentality as to the nature and purpose of mathematical thinking. That is the usefulness and the power of mathematics to understand the world and the inequities in the world around us. The book suggests that mathematics has been "accepted as apolitical, and this makes it difficult for researchers, teacher educators, teachers and pre-service teachers to conceptualize teaching and learning mathematics for social justice" (p. 207). Even the NCTM standards which are big on equity can be criticized as being utilitarian in nature with little or no discussion on teacher development in critical pedagogy.

Gutstein, in his role as a classroom teacher sets up conditions that mediate a pedagogy for social justice where several carefully chosen mathematics projects are used to make sense of student's realities These mathematics projects include real world data such as mortgage approval rates in bigger cities according to race; the mis-information or distortion of land mass given in older maps using the Mercator projection. Interestingly Mercator maps came out during the peak of colonization. Other projects include using the cost of a B-2 bomber to compute how many poorer students in that community could be put through university. The book gives a message of hope as well as the grimness of schooling for many minority students in the United States. The value of Gutstein's approach lies in its goal to impact the social consciousness of students and a critical awareness of larger issues that impact their day to day life.

The work of Gutstein sets a brilliant and necessary example for a pedagogy of social justice emphasized in mathematics education literature in different parts of the world. For instance, Moreno & Trigo (2007, in press) in their analysis of inequities in access to technology in Mexico write :

> We will also need to teach students to think critically about the ongoing changes in the world and about how these changes can affect educational and national realities. Access to knowledge cannot be regarded as a politically neutral issue because there is an obvious problem of exclusion for those who are on the margins of the educational process at any of its levels. Our inclusion in the contemporary world of globalization demands that we have the critical ability to transfuse scientific and technological developments into our educational realities.

Skovsmose (2005) takes a more global stance and discusses critically the relations between mathematics, society and citizenship. According to him, critical mathematics give challenges connected to issues of globalization, content and applications of mathematics, mathematics as basis for actions in society, and on empowerment and mathematical literacy (mathemacy). In earlier writings Skovsmose (1997, 2004) argued that if mathematics education can be organized in a way that challenges undemocratic features of society, then it could be called critical mathematics education. However he lamented that this education did not provide any recipe for teaching, which Gutstein's book does. So we challenge the reader to ponder on several questions raised by Skovsmose if they do read Gutstein's book. Does mathematics have

no social significance? Can mathematics provide a crucial resource for social change? How may mathematics and power be interrelated?

The third question above is answered from a feminist perspective in the second book under notice, namely Burton's *Mathematicians as Enquirers*. The institution of academic mathematics has often been criticized as being both male dominated and setting a precedence for transmitting behaviors, teaching and learning practices that tend to alienate women. The sobering fact that women mathematicians are still by and large a minority in the mathematics profession today (Seymour, 1995; Seymour & Hewitt, 1997), in spite of numerous large scale initiatives by the National Science Foundation (in the U.S) to increase numbers of female students in graduate programs, necessitates we examine this problem from a different perspective. . Burton proposes an epistemological model of "coming to know mathematics" consisting of five interconnecting categories, namely the person and the social/cultural system, aesthetics, intuition / insight, multiple approaches, and connections. Grounded in the extensive literature base of mathematics, mathematics education, sociology of knowledge and feminist science, this model addresses four challenges to mathematics, namely "the challenges to objectivity, to homogeneity, to impersonality, and to incoherence" (p. 17). In other words, Burton argues that it is time we challenged the four dominant views of mathematics which are:

1. the Platonist objective view;
2. homogenous discipline, which goes hand in hand with an objective stance;
3. an impersonal, abstract presentation entity, complementing the view of an individualistic discipline, and the egotistical mathematician); and
4. a non-connected "fragmented" discipline (as many learners experience it).

Burton conducted an empirical study with 70 mathematicians (35 male and 35 female), from 22 universities across the United Kingdom and Ireland, to both generate and test the validity of her epistemological model which demolishes the four dominant views. In particular, Burton shows the different "trajectories" (personal, social, and cultural variables) that led the participants into a career in mathematics. These trajectories contradict the myth that mathematicians are born into the profession. The emerging contradiction between these mathematicians' neo-Platonist belief about mathematics, despite the heterogeneity of the pathways into mathematics is discussed. The book gives an insight

through various case studies of the contrast between female and male mathematician's formative experiences when entering the field of professional mathematics. It seems to us that females seem to have to adapt to "males ways of knowing." For instance the literature in gender studies have documented the preferred learning styles and classroom cultures which encourages female students (e.g., Balenky et al., 1986) are in stark contrast to the way mathematics is traditionally taught. In Burton's book, one encounters the teaching of mathematics at universities in the didactically teacher centered traditional and authoritarian manner of lecturing, which conveys to students a dead perception of mathematics. The contradiction the book discusses is that this manner of teaching is in apposition to the excitement that mathematicians experience when doing research. Burton contends that educators need to gain an insight into the minds, beliefs, and practices of mathematicians because as is often the case at many universities, mathematicians often teach the content courses taken by prospective teachers. Further empirically showing that there exists a dichotomy between research practices and pedagogical practices among mathematicians sets up a sound research base for transmitting these findings to mathematicians. The ultimate hope of course is that mathematicians will begin to convey the creative and exciting side of their craft to the students in their classroom and to change the dominant epistemology of knowing in order to stop marginalizing female learners and learners of some racial and ethnic groups

An interesting case study that illustrates Burton's thesis is the story of one mathematics department in the United States (Herzig, 2002). Herzig asks the rhetorical question where all the students have gone, referring to high attrition rate of Ph.D. students in math programs. Similar to Burton's book, her study implies that many Ph.D. students experience discouragement and disillusionment in programs which offer limited opportunities for students to participate in authentic mathematical activities. Her findings also address what she calls "faculty beliefs about learning and teaching" where these beliefs contradict each other. Faculty use words such as "beauty, pleasure, delightful and pretty" (p. 185) when describing their work as mathematicians. On the contrary they use words such as "perseverance, persistence, stamina, tenacity, and pain" (p. 185) when talking about graduate students learning mathematics, thus, implying that the student either has what it takes or not. In this sense, these faculty were absolving themselves from all responsibility in the students success or lack thereof.

## *Concluding Points and Implications*

The two books under focus here have some implication for both the learning and teaching mathematics at all levels. It implies that we not only have to diversify faculties at the University level but also diversify the mathematics we teach and the context in which we teach it. From a political and economical standpoint both are important to ensure more diverse groups of people gain entry and succeed in the profession of mathematicians. In an ever changing world and global economy multiple viewpoints other than male dominated epistemologies are important to solve today's problems.

Efforts in increasing the participation of women in mathematics have not been very successful. One might ask why? The reasons might be the contrast between doing mathematics and learning mathematics. It is not enough to accept women and minority students into graduate studies on mathematics but there also has to be a change in how students experience mathematics when students. Burton (2004) and Herzig (2002) offer ideas on how a mathematics department can analyze their department and restructure it in a way that more diverse groups of people might experience success in the field.

If we look at the learning and teaching of mathematics in grade school one can say the same thing. If the goal is to help students understand mathematics and encourage them to continue their studies in mathematics, the course material must include elements of what it is to do mathematics. The book by Gutstein gives one example when describing how to use mathematics to analyze the social structure in our society.

## NOTES

1. Flatland was a 19th century underground publication. The author of this book Edwin Abbott (1984) spins a satire about Victorian society in England by creating an isomorphic world called Flatland whose inhabitants are a hierarchy of geometric shapes and exhibit the many peculiarities of 19th century England, including the oppression of lower classes and women.

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