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Guest Editorial…

What is Mathematics Education For?

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> 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?
>
> -Paulo Freire

We are not experts in social and political theory, but rather educators struggling to understand the implications and manifestations of Paulo Freire's (Freire & Shor, 1987, p. 46) statement, with particular reference to mathematics education. The views expressed here are personal and emergent, and intended to be provocative.

According to Apple (2000): "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" (p. 243). However, there are signs of change, building on a major shift within the discipline of mathematics education from a mainly cognitive and pedagogical perspective towards recognition of the historical, cultural, and social contexts of both mathematics and mathematics education (e.g., various chapters in Boaler, 2000). This shift is encapsulated in the phrase "mathematics as a human activity" whence the acknowledgment of the political situatedness of mathematics education is a natural outgrowth (Mukhopadhyay & Greer, 2001).

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Mathematics, Mathematics Education, And Mathematics In People's Lives

The answer to the question "What is mathematics?" is generally considered to be relatively unproblematic, although continuing to evolve as a result of internal developments and external factors such as accessibility to the power of computers as processors of symbols and images. However, having accepted that modern mathematics is a worldwide, unified discipline, close-knit through global communication and networks of scholars and institutions, there remain the questions of the relationship between that body of knowledge and what is taught in schools, how, and why. Given the pace at which mathematics has been, and is being, developed, the gap is increasing between the body of knowledge and what can reasonably be included in school education. At the same time, there is more and more concern about the gap between school mathematics and the lived experience of students and the adults that they become.

Davis and Hersh (1981, pp. 39) composed an imaginary dialogue between "the ideal mathematician" and the public information officer of the University, part of which goes like this:

P.I.O.: Do you see any way that the work in your area could lead to anything that would be understandable to the ordinary citizen of this country?
I.M.: No.
P.I.O.: How about engineers or scientists?
I.M.: I doubt it very much.
P.I.O.: Among pure mathematicians, would the majority be interested in or acquainted with your work?
I.M.: No, it would be a small minority.

It is, then, hardly controversial to assert that mathematics is now too big to allow school students to be exposed to more than a fraction. So, on what basis, and by whom, are selections made?

Both reflecting and reinforcing the highly organized nature of mathematics as a discipline, there is a very striking uniformity of school mathematics curricula across the world. Usiskin (1999, p. 224) observed students in Shanghai solving Euclidean geometry problems exactly like those in Japanese and American texts, even to the point of noticing the abbreviation "SAS" (for the Side-Angle-Side congruence condition) among the Chinese characters. As Usiskin also pointed out, the existence of international exercises such as the Third International Mathematics and Science Survey (TIMSS) assumes enough curricular commonality to make such comparisons meaningful (e.g., p. 213).

As another example of how mathematics education shows remarkable uniformity over time and cultures, Fasheh (1997) describes living through four educational systems in Palestine—British, Jordanian, Jordanian with Israeli modification, "Palestinian"—and then comments:

> What is startling about the math curriculum is—with the exception of some changes at the technical level—how stubborn and unchanging it has remained under the four completely different realities in which I have lived, studied, and taught; how insensitive and unresponsive it has been to the drastic changes that were taking place in the immediate environment! When something like this is noticed, it is only natural to ask whether this is due to the fact that math is neutral or that it is actually dead! (p. 24)

However, in various parts of the world, attempts have been made to combat global homogenization of mathematics education combined with the predominant mode of teaching that dissociates mathematics from people's lived experience. Describing "People's Mathematics" (Julie, 1993), Volmink (1999) commented that it "developed independently and indigenously rather than an attempt to embrace the loudest fad from the West" (p. 94) and listed as distinguishing features:

- an ability to reveal how school mathematics can be used to reproduce social inequalities
- a rejection of absolutism in school mathematics and its contribution towards seeing mathematics as a human activity and therefore necessarily fallibilist
- an incorporation of the social history of mathematics into mathematics curricula
- a belief in the primacy of applications of mathematics

The last point above exemplifies one trend that we consider potentially positive. Insofar as there is greater emphasis in curricula on applications of mathematics and increasing incorporation of data handling into the curriculum, these changes open up possibilities for diversification through using mathematics to analyse socially and culturally relevant problems. For example, Gutstein (2003) writes about teaching in a low-income Mexican immigrant community in Chicago:

> I use ideas of social justice along with helping students develop mathematical power (being able to reason and communicate mathematically, develop their own mathematical thinking, and solve real-world problems in multiple and novel ways)—and pass the "gatekeeping" standardized tests. (p. 35)

Another ways of making connections between mathematics education and the lives of students is to break down the barriers between schools and communities (e.g., Abreu, 2002; Civil, 2002; Moll & Greenberg, 1992). Fasheh (2000) declared "I cannot subscribe to a system that ignores the lives and ways of living of the social majorities in the world; a system that ignores their ways of living, knowing and making sense of the world" (p. 5). By an extension of these principles, those who research mathematics education are separated only artificially from the social and political realities within which they work (Vithal & Valero, 2001).

To summarize, we are suggesting that the relationships between these three aspects—mathematics as a discipline, mathematics as a school subject, and mathematics as a part of people's lives—need serious analysis.

> I see mathematics playing an important role in achieving the high humanitarian ideals of a new civilization with equity, justice, and dignity for the entire human species without distinction of race, gender, beliefs and creeds, nationalities, and cultures, but achieving these goals depends on our understanding of the relation between mathematics and human behavior. Consideration of this relation is normally untouched by mathematicians, historians of mathematics, and mathematics educators. (D'Ambrosio, 1999, p. 143)

What Is Mathematics Education *For*?

We list, and make brief comments on, a number of answers. All have validity, so how they are evaluated is a matter of balance and priorities, which vary with experience, intellectual history, beliefs, values, and ideologies.

1. For some mathematicians, the obvious purpose of mathematics education is to produce more mathematicians (and also scientists, engineers, and others who will use substantial technical mathematics in their work). At the extreme, this supports a conception of mathematics education as a pyramid, with curriculum planned primarily for the few at the peak, and the majority left to struggle up as far as they can manage. Some of the calls for "mathematics for all" amount to just trying harder to push more people further up the pyramid. There is a hint of that attitude in the following statement by the National Council of Teachers of Mathematics (NCTM):

> NCTM challenges the assumption that mathematics is only for the select few. On the contrary, everyone needs to understand mathematics. All students should have the opportunity and the support necessary to learn significant mathematics with depth and understanding. There is no conflict between equity and excellence. (2000, p. 5)

2. However, recently it has become extremely common to portray the main reason for mathematics education as the training of a workforce able to compete successfully in the global economy of the information age. The following statement comes from a spokesperson of the People's Republic of China, but could have come from almost anywhere in the world:

> As the economy adapts to information-age needs, workers in every sector must learn to interpret computer-controlled processes. Most jobs now require analytical rather than merely mechanical skills. So most students need more mathematical ability in school as preparation for their future jobs. ... [P]eople must deal daily with profit, stock, market forecast, risk evaluation etc. Therefore, mathematics relevant to these economic activities, such as ratio and proportion, operational research and optimization, systematic analysis and decision theory, etc., should be a part of school mathematics education. (Er-sheng, 1999, p. 58)

Gatto (2003) presents an argument that public schooling in the United States was shaped by industrialists (notably Carnegie, Morgan, Rockefeller, and Ford) in order to produce a docile and efficient workforce.

3. Briefly and uncontroversially, mathematics—as much as literature or music—is part of the cultural heritage that can make people intellectually well rounded and creative solvers of intellectual problems. We assert, without argument or evidence, that mathematics education has mostly failed disastrously in these respects.

4. Mathematics is also characterized as the purest form of reasoning, embodying the highest standards of proof; and as a training in dispassionate, objective, rational thinking. We do not attempt here to analyse the various critiques of this position.

5. It is often stated that mathematics is needed as preparation for the practicalities of everyday life. Does this statement bear scrutiny? Is it not the case that most people handle the practicalities of daily life effectively without benefit of school mathematics beyond simple arithmetic and that the knowledge and skills that are essential are acquired through learning within practices situated outside of school? On the other hand, we argue below that there are other aspects of people's lives that could and should be radically improved through access to mathematical tools for critical analysis.

6. From the perspective of a different value system, the most important reason for mathematics education is to make accessible to many people powerful mathematical ideas as conceptual and critical tools to analyse issues relevant to their lives (e.g., Skovsmose & Valero, 2002). For example, the application of mathematics as a critical tool for the analysis of American society is illustrated by an exercise beginning with the question "If Barbie was as tall as one of us, what would she look like?" (Mukhopadhyay, 1998).

7. According to Davis and Hersh (1986):

> The social and physical worlds are being mathematized at an increasing rate. The moral is: We'd better watch it, because too much of it may not be good for us. (p. xv)

Mathematics not only reflects our view of the world, but also helps to shape it, so that "when part of reality becomes modeled and remodeled, then this process also influences reality itself" (Skovsmose, 2000, p. 5). What Skovsmose terms "the formatting power of mathematics" is by no means a new development, but it is amplified by technological developments. It seems clear that the ratio:

$$\frac{\textit{accessible information}}{\textit{conceptual means for making sense of it}}$$

is accelerating, with unforeseeable consequences.

Looking Around

In sketchy and illustrative form, some prominent features of the contemporary politico-educational scene in the USA are the following:

Underfunded mandates: A recent entry in *Harper's Index* (Sept. 2003) reads:

> Change since last year in federal spending to implement the No Child Left Behind Act: $1,200,000,000. (p. 13)

In case you are wondering, the change was downwards.

A "black box" model for control of schools: Within the black box are the teachers and the students and the human interactions that constitute teaching/learning. What is inside the box can be ignored as control is exerted through the manipulation of external levers—money, testing, and punishment being the main ones.

Corruption: Robert Kimball, an assistant principal in Houston, was surprised that in his high school with a freshman class of 1,000 that was reduced to fewer than 300 by senior year, the number of dropouts reported was zero (Winerip, 2003). When he blew the whistle, Robert Kimball was isolated and expects to be fired in January—you might like to track his story. Horn and Kincheloe (2001) compiled a generally skeptical analysis of the "Texas miracle".

Fantasy: The first President Bush set a goal for the USA to be number one in math and science education by the year 2000. Now it is mandated that every child in the USA will pass reading and math proficiency tests by 2014. There is only one way in which this could happen, namely by disappearing those who don't make it, like the dropouts of Houston.

Inequity: All of the above are contributory factors to the failure to diminish the "performance gap" between white students and minority groups, in particular African-Americans and Latinos. We attended a meeting recently where a public school teacher spoke of a report (in English) being sent to parents who do not speak English telling them that their child, who also does not speak English, had scored zero in a test written in English. There is currently a class action suit, Williams vs. the State of California, arguing that California provides a fundamentally inequitable education to students based on wealth, and based on language status. As background for this case, Gándara, Rumberger, Maxwell-Jolly, and Callahan (2003) have documented seven aspects of this inequity.

Naïve expectations about the power of research: Slavin (2002) wrote as follows:

> At the dawn of the 21st century, educational research is finally entering the 20th century. The use of randomized experiments that transformed medicine, agriculture, and technology in the 20th century is now beginning to affect educational policy… [A] focus on rigorous experiments evaluating replicable programs and practices is essential to build confidence in educational research among policymakers and educators. However, … there is still a need for correlational, descriptive, and other disciplined inquiry in education. (p. 15)

The best cautionary rejoinders that we know of to the expectations that mathematics education can be automatically improved through evidence-based policies generated by rigorous research (again, the image of a black box comes to mind) are Freudenthal's (1978) book *Weeding and sowing* and Kilpatrick's (1981) paper *The reasonable ineffectiveness of research in mathematics education*. The latter, in particular, points out that the improvement of mathematics education is hard because it is not an engineering problem, but a human problem. The endeavor rests in fundamental ways on questions that lie beyond the powers of research to generate definitive answers, but rather related to beliefs, values, and the aims of education.

Intellectual child abuse: Without singling out any example (you might like to select your own), we assert that the most salient features of most documents that lay out a K-12 program for mathematics education is that they make an intellectually exciting subject boring.

Emotional child abuse: One of the really big questions in mathematics education is: "Why do so many people fear and dislike mathematics?" Here is one answer, from a Bronx school (Wilgoren, 2001):

> It is a morning ritual… [The teacher] stalks across his classroom, scowls at his sixth-grade students and barks the same simple question: "What is this?" "This is math," they respond. "I don't have to like it to pass it. I don't have to enjoy it to learn it. I don't have to love it to understand it. But I must, and I will, master it". (p. A1)

Final Comments

Freire used the term "conscientization" to refer to a process of critical self-consciousness. As stated in the opening quotation, this implies reflection on the political nature of what we are doing as teachers or others engaged in education. During a recent meeting with students at Portland State University, Donaldo Macedo commented on the virtual absence from university education courses of classes on topics such as "ethics" or "ideology". This comment recalls the statement of Chomsky (2000) that "the goal [of schools] is to keep people from asking questions that matter about important issues that directly affect them and others" (p. 24). Is it possible to turn this around, to make schools and universities places where people do ask such questions? How many graduate programs in mathematics education have a class on political aspects of mathematics education? The establishment of such classes might be a good way to start, if change is to occur within our field.

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