

## Understanding the politics of mathematical knowledge as an integral part of becoming critically numerate

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This paper was presented to the Association of Mathematical Education for South Africa (AMESA) at its first conference, Johannesburg, July 4-7, 1994.

*Criticalmathematical literacy involves the ability to ask basic statistical questions in order to deepen one's appreciation of particular issues, and the ability to present data to change people's perceptions of those issues. This talk focuses on the politics of mathematical knowledge as an integral part of criticalmathematical literacy: understanding that political struggles/ choices are concealed in supposedly neutral statistical descriptions of our world; understanding how numerical data can explode the myths about the institutional structure of our society; and, understanding the limitations of the knowledge we gain from mathematical analyses of our world.*

At a math conference on problem-solving, the teacher illustrating Polya's (1957) ideas on problem-solving by identifying analogous problems, stated that in the problem,

'if three people take ten hours to dig a hole, how many hours would it take ten people to dig that same size hole?', it's obviously equivalent if people dig the hole or if machines dig the hole.

From a criticalmathematics education perspective, whether people or machines dig holes involves crucial issues of concern to any society, issues such as automation, unemployment, and quality of life. To learn mathematical problem-solving without engaging these issues is to become functionally, as opposed to critically literate. Giroux's (1982) categorization of the *instrumental ideology* underlying so much of native-language literacy is helpful in understanding the nature of this kind of functional mathematics literacy. Instrumental ideology views knowledge as objective and external to the knower. Facts are neutral, stripped of the subjectivity of class, race, and gender perspectives. Functional mathematics curricula, based on this ideology, strip mathematics of its relationship to the learner and to our society, concentrating instead on mechanical proficiency and rote memorization. These instrumental curricula are based on a fragmented view of mathematical knowledge, a view which omits how statistical knowledge is

often used to obscure economic and social realities. At its worst, this view of mathematical knowledge can result in the kind of blind pursuit of "neutral" knowledge which produces, for example, nuclear weapons without awareness or questioning of the interests and choices that direct this science. As Marcuse (1964) argues:

In this society, the rational rather than the irrational becomes the most effective vehicle of mystification..... For example, the scientific approach to the vexing problem of mutual annihilation -- the mathematics and calculations of kill and over-kill, the measurement of spreading or not-quite-so-spreading fallout... -- is mystifying to the extent to which it promotes (and even demands) behavior which accepts the insanity. It thus counter-acts a truly rational behavior -- namely the refusal to go along, and the effort to do away with the conditions which produce the insanity. (pp.189-190)

Giroux's (1982) category of *interaction ideology* centers on the human dimensions of knowledge, viewing knowledge as a social construction. It regards meaning, as opposed to mastery of content, as the central problematic. This ideology underlies "humanistic" mathematics pedagogies which focus on alleviating "math anxiety", individualizing instruction at the students' own paces, and problem solving with a stress on process over product. In such pedagogies, there are important moments when students can grasp the nature of mathematics and their ability to do mathematics. Though interaction ideology is concerned with cognitive dissonance and moral development, it omits notions of political conflict and power differences among socioeconomic classes and racial, ethnic, and gender groups. That is "power and freedom collapse into an exaggerated notion of human will as well as a blindness towards those larger social forces that promote economic and cultural disintegration." (p.348)

Criticalmathematics literacy, on the other hand, involves the ability to ask basic statistical questions in order to deepen one's appreciation of particular issues, and the ability to present data to change people's perceptions of those issues. A critical understanding of numerical data prompts one to question "taken-for-granted" assumptions about how a society is structured, enabling us to act from a more informed position on societal structures and processes. (Frankenstein and Powell, 1989) For example, a criticalmathematical interrogation of housing subsidy data asks why aren't homeowner's tax deductions counted as housing subsidies?<sup>1</sup> For another example, a criticalmathematical analysis of declining block rates for various utility costs

<sup>1</sup> In 1981 alone, these deductions amounted to more than had been spent by the federal government on all housing assistance for low-income families since 1937. (Dollars & Sense, 1983)

reveals how this structure transfers money from the poor to the rich.<sup>2</sup>

The themes in my criticalmathematics literacy curriculum range from demystifying the structure of mathematics to using numerical data for demystifying the structure of society. Almost all of my students have knowledge of basic addition, subtraction, multiplication and division facts, although many would have trouble multiplying decimal fractions, adding fractions or doing long division. All can decode in reading English, but many have trouble succinctly expressing the main idea of a reading. Almost all have trouble with basic math "word" problems. Most have internalized negative self-images about their knowledge and ability in mathematics. My beginning lessons have students reading excerpts such as those presented below, where the main idea is supported by numerical details and where the politics of mathematical knowledge is brought to the fore. Then the curriculum teaches the development of the Hindu-Arabic place-value numeral system, the meaning of numbers and the meaning of the operations.

I start lessons with a graph or chart or short reading which requires knowledge of the scheduled math skill to understand. When the discussion runs into a math skill question, we "take time out" and I teach that skill. This is a non-linear way of learning basic numeracy because questions often arise that involve future math topics. I handle this by "previewing" -- the scheduled topic is "formally" taught and other topics are discussed so that students' immediate questions are answered and so that when the "formal" time comes for them in the syllabus, students will have some familiarity with them. For example, if we are studying the meaning of fractions and find that in 1985 "2/100" of the Senate were women, we usually "preview" how to change this fraction to a percent. We also discuss how no learning is linear and how all of us are continually re-viewing, re-creating, as well as pre-viewing in the on-going process of making meaning.<sup>3,4</sup>

<sup>2</sup> In 1972, "residents of Detroit's inner city paid 66% more per unit of electricity than did wealthy residents of nearby Bloomfield Hills." At that time, about "10,000,000 every year [left] the city of Detroit to support the quantity discounts of suburban residents." (Morgan, 1980)

<sup>3</sup> I have consulted with various adult numeracy organizations in South Africa, so I am aware that your context is different. I have an intuitive belief that initial learning experiences should be in ones first language and further learning would be most effective in a multi-lingual situation. If I were teaching adults who had no prior schooling, who could not decode reading, who were not familiar with basic numerical representations, I would focus my curriculum on more recreational kinds of mathematical experiences, such as looking for number patterns in addition tables, working out magic squares, etc. In this curriculum there would still be politics of mathematical knowledge: \* I would discuss the general politics of knowledge with which I conclude this article- that as humans we make sense of our world and acquire knowledge, whether we can write or read it or not. \* I would start with discussions which brought out the mathematical knowledge that students already know. And I would not stop there but build on

In this talk I will focus on themes about the politics of mathematical knowledge that constitute an integral part of criticalmathematical literacy: understanding that political struggles/choices are concealed in supposedly neutral statistical descriptions of our world; understanding how numerical data can explode the myths about the institutional structure of our society; and, understanding the limitations of the knowledge we gain from mathematical analyses of our world.

## The context for my criticalmathematics literacy curriculum

My students at the College of Public & Community Service (University of Massachusetts/Boston) are mainly working class, urban adults in their 30's, 40's, 50's, and older, who have not been "tracked" for college; many of them were labeled as "failures" in secondary school; most have internalized negative self-images about their knowledge and ability in "academic" disciplines. Approximately 60% are women; 30% people of color. Most work (or are looking for work) full-time, have families, and attend school full-time. Most work in various public and community service jobs; many have been involved organizing for social change. Students can work towards their degree using prior learning from work or community organizing, or new learning in classes, or new learning from community service (e.g., students lobbied the legislature and organized for welfare rights forming the Massachusetts Coalition for Basic Human Needs; students, asked by the community, worked with faculty to serve as consultants for the Roxbury Technical Assistance Project to help that community participate in planning its own development).

The faculty are activists as well as intellectuals; approximately 50% are women, 30% people of color. Teachers have less institutional power over students than in most universities, because we don't give grades, and students can choose another faculty member to evaluate their work if they are dissatisfied with the first faculty evaluation. We cannot require attendance or any other work that is not clearly discussed in the competency statement which details the criteria and standards for demonstrating knowledge of the

this, bridging to more academic mathematics. \* I would discuss the politics of intellectual recreations-- that getting satisfaction from seeing patterns or solving puzzles is not just an activity for those who have advanced schooling. \* I would present the history of the development of numbers, a history which is very multi-cultural and which grounds knowledge in material conditions.

<sup>4</sup> The theory and practice of this curriculum are discussed in depth in Frankenstein (1987) and in my text, *Relearning Mathematics* (1989).

topic which students are studying.

## **The politics of mathematical knowledge: Political struggles/choices are concealed in supposedly neutral statistical descriptions of our world**

Perhaps the most dramatic example of the politics involved in seemingly neutral mathematical descriptions of our world is the choice of a map to visualize that world. Any two-dimensional map of our three-dimensional Earth will, of course, contain mathematical distortions. The political struggle/choice centers around which of these distortions are acceptable to us and what other understandings of ours are distorted by these false pictures. For example, the map with which most people are familiar greatly enlarges the size of "Europe"<sup>6</sup> and shrinks the size of Africa; most people do not realize that the area of what is commonly referred to as "Europe" is smaller than 20% of the area of Africa. That common Mercator map, created in 1569, highly distorts land areas, but preserves compass direction, making it very helpful to navigators who sailed from "Europe" in the sixteenth century. However, when used in textbooks and other media, combined with the general (mis)perception that size relates to various measures of so-called "significance"<sup>7</sup>, the Mercator map distorts popular perceptions of the relative "importance" of various areas of the world.<sup>7</sup> As Wood (1992) emphasizes:

The map is not an innocent witness... silently recording what would otherwise take place without it, but a committed participant, as often as not driving the very acts of identifying and naming, bounding and inventorying it pretends to no more than observe. (pp. 78-79)

In a variety of situations, statistical descriptions don't simply, neutrally record

<sup>6</sup> Grossman (1994) discusses how "Europe has always been a political and cultural definition. Geographically, Europe does not exist, since it is only a peninsula on the vast Eurasian continent." He goes on to discuss the history and various contradictions of geographers' attempts to "draw the eastern limits of 'western civilization' and the white race". (p.39)

<sup>7</sup> When a U.S. university professor asked his students to rank certain countries by size they "rated the Soviet Union larger than the continent of Africa, though in fact it is much smaller" (Kaiser, 1991, p.12), associating "power" with size.

<sup>8</sup> Although political struggles to change to the Peter's projection, a more accurate picture in terms of land area, have been successful with the United Nations Development Program, the World Council of Churches, and some educational institutions (Kaiser, 1991, pp.12-13), anecdotal evidence from many talks I've given around the world suggest that the Mercator is still widely perceived as the way the world "really" looks.

what's out there. There are political struggles/choices involved in: which data is collected; which numbers represent the most accurate data; which definitions should guide how the data is counted; which methods should guide how the data is collected; which ways the data should be disaggregated; and which are the most truthful ways to describe the data to the public. This section discusses specific examples in each of these categories.

### *\* Political struggle/choice over which data is collected:*

> When Reagan cut the Bureau of Labor Statistics (BLS) budget by 15%, the BLS eliminated many statistical series useful to the labor movement -- information on collective bargaining agreements; industry wage surveys (used in contract negotiations); strikes and lock-outs (except for stoppages involving 1000 or more workers, a misleading number since such workers are only a small proportion of the work force); and after-tax earnings (the before-tax data still collected paints a more positive picture). (Dollars & Sense, 1982, p.19)

> Over the next ten years, one-quarter of the U.S. government's 16,000 publications was eliminated. In 1985, the Office of Management and Budget "centralized and tightened the flow of information from government agencies to the public". (Rothberg, 1992, p.23)

### *\* Political struggle/choice over which numbers represent the most accurate data:*

> "Reasoning" that the Native American population could not have been so great, and arbitrarily cutting already reduced estimates in half, various "scholars" have concluded that about one million people were living in North America in 1500. Other academics, "argued on the basis of burial mound archeology and other evidence that the population of the Ohio River Valley alone had been [that] great". (Stiffarm & Lane, 1992, p.25) and that "a pre-contact North American Indian population of fifteen million is perhaps the best and most accurate 'working number' available." (p.27) Admitting the later figure, would also require admitting extensive agricultural institutions, as opposed to the less reliable hunting and gathering. Cultivators of land are "primarily 'sedentary' rather than 'nomadic'... and residents of permanent towns rather than wandering occupants of a 'barren wilderness'." (p.29)

> The December 1989 massacres in Romania, described initially as 4500 dead, and jumping to as much as 60,000, were widely reported in the U.S. press and Radio Free Europe (at that time, the only source of information for the Romanian people). A subsequent report in *The Boston Globe* (12/31/89) questioned the magnitude of the deaths based on evidence that

hospitals in the area were not swamped on the days of the alleged massacre. (Could the reported massive slaughter have motivated Ceausescu's overthrow?) At the same time, the U.S. media were reporting Pentagon (under)estimates of 220 civilian deaths from the U.S. invasion of Panama. The Panamanian Human Rights Commission estimated 4000 civilians dead. (Chediak, 1990, p.16)

*\* Political struggle/choice over which definitions should guide how data is counted:*

> In the United States, unemployment data is collected by surveying agencies to determine how many people are collecting unemployment insurance. Many groups, therefore, are omitted from the definition of the unemployed: workers who want full-time, but can only find, part-time work; full-time workers who are paid wages below the official U.S. poverty level; workers who have run-out of their unemployment benefits, have become discouraged in searching for more work and so no longer report to the unemployment agency.

> In 1988, the U.S. Census Bureau introduced an "alternative poverty line", changing the figure for a family of three from \$9435 to \$8580, thereby eliminating the 3.6 million people whose family income fell between those figures, from food stamp, free school meal and other welfare benefits. At the same time, the Joint Economic Committee of Congress argued that "updating the assessments of household consumption needs... would almost double the poverty rate, to 24 percent". (Cockburn, 1989)<sup>8</sup>

*\* Political struggle/choice over which methods should guide how data is collected:*

> In the 1840's (highly respected) U.S. scientists measured skulls in an

<sup>8</sup> The U.S. poverty line is startlingly too low. Various assessments of the smallest amount needed by a family of four to purchase basic necessities in 1991 was 155% of the official poverty line. "Since the [census] bureau defines the [working poor] out of poverty, the dominant image of the poor that remains is of people who are unemployed or on the welfare rolls. The real poverty line reveals the opposite: a majority of the poor among able-bodied non-elderly heads of households normally work full-time. The total number of adults who remain poor despite normally working full-time is nearly 10 million- more than double the number of adults on welfare. Two-thirds of them are high school or college educated and half are over 33. Poverty in the U.S. is a problem of low-wage jobs far more than it is of welfare dependency, lack of education or work inexperience." Defining families who earn less than 155% of the official poverty line as poor would result in about one person in every four being considered poor in the U.S. (Schwarz & Volgy, 1993, pp.191-192)

effort to quantify human intelligence. Samuel Morton measured the volume of 600 skulls and found, consistent with the ideology of the times, that on the average, whites' skulls were larger than Indians' which were larger than blacks'. And he believed that large skull size correlated with intelligence. Steven Jay Gould has analyzed the fundamental errors in Morton's work: plain arithmetic errors in calculating the averages, errors which all magnified racial differences; inconsistently applied judgments about which skulls to include in the averages which always worked in favor of augmenting the average for white skulls and decreasing the average for other groups; variability in the measurement method, where filling the skulls with mustard seed produced different results upon remeasurement, and when he switched to the more consistent lead-shot, Gould found that Morton's seed measurements deviated from the lead-shot measurements in a pattern that exaggerated the racial differences in brain size. Gould argues that there was no conscious fraud here -- after all, Morton made no attempts to hide any of his raw data or his judgments or methods. (Gould imagines Morton unconsciously giving the known white skulls extra shakes to accommodate more mustard seeds.) "The prior assumption of white superior intelligence was so powerful... that it manifested itself at every step of the investigation, influencing the methods of data collection and ultimately controlling the conclusions." (Cohen, 1982, pp.216-217)

> The extent of homelessness is often measured by counting the number of shelter residents at a single point in time. "Using this method, the census found that on one night in 1990, only one-half of one percent of New York City's population stayed in a shelter." Surveys of shelter stays over a longer period of time reveal that "about 3% of New Yorkers spent time in a homeless shelter between 1988 and 1992." Further, the first method finds predominantly drug addicts and mentally ill who are chronically homeless, whereas the second method "reveals that many temporarily homeless people do not fall into these categories." (Dollars & Sense, 1994)

*\* Political struggle/choice over which ways data should be disaggregated:*

> The U.S. Office of Management and Budget makes the Military budget appear to be a smaller portion of the Federal Budget by including funds held "in trust", such a Social Security, in the portion of the federal budget going for social services; and, by counting war-related expenditures, such as the production of new nuclear warheads, the space program, and veteran's programs, as part of various non-military categories like the Department of Energy budget (the warheads!) and Direct Benefit Payments (veterans' income). In 1982, the government calculated that 25 percent of the budget went for "National Defense"; the alternative breakdown of the data gives a figure of 57 percent of the budget going to pay for "Past, Present and Future

Wars". (Max, 1981 and Greenwood, 1981)

> The Boston City School Department released figures that the 1992 high school drop-out rate was 9%, while the state Department of Education estimated that 38% of Boston's 1992 high school class quit school during the four years preceding graduation. The 9% rate is obtained by breaking down the data as "the number of students in grades 9 through 12 who drop out in the current year, divided by the total number of students in those four grades. It says nothing about what happens to one class of students, who can drop out during any of their four high school years". The 38% figure is obtained by breaking down the data focusing on "what happens to one group of students by the time they would normally have graduated". (Breslow, 1994)

> The U.S. government rarely collects health data broken down by social class. In 1986 when they did this for heart and cerebrovascular disease they found enormous gaps: "The death rate from heart disease, for example, was 2.3 times higher among unskilled blue-collar operators than among managers and professionals. "By contrast, the mortality rate from heart disease in 1986 for blacks were 1.3 times higher than for whites... the way in which statistics are kept does not help to make white and black workers aware of the commonality of their predicament." (Navarro, 1991, p.436)

\* *Political struggle/choice over the most truthful ways to describe data to the public:*

> The *New York Times* reported a march in San Salvador where Indians declared Columbus Day a day of mourning "for the thousands of Indians killed by whites." As Kovel (1990) states: "It is technically correct that 'thousands' of Indians have been killed by whites, but it is also true that millions of Indians were killed by whites, many tribes literally exterminated in genocidal operations."

> A front-page headline in the *New York Times* on May 9, 1992 read "Payrolls Increase and Jobless Rate Retreats to 7.2%" and "Figures better than expected support view of economy reaching solid ground." The headings did not state that the number from which the jobless rate had "retreated" from was 7.3%, "a figure that only surfaced in the fourth paragraph of the text. Featuring a one-tenth of a percentage point (or 1.4%) drop would have made it difficult to be so euphoric." The *Financial Times* headlined the same news: "Fall in jobless shows sluggish U.S. recovery", which more accurately reflects the small jobless drop and the fact that employment was rising at about half the rate normal at the start of an economic recovery. Ten days later a report that housing starts in April 1992 had declined by 17% from their March pace, the 'biggest decline in eight years' was relegated to the

*Times* business section. (Herman & Schaap, 1992, p.20)

> Many products in the U.S. advertise themselves (on their packages) as "95% fat-free", a very misleading claim to people who want to reduce their intake of calories from fat. Since much of the weight in most foods comes from water, the percentage of fat by weight is low, but that does not mean the percentage of calories (what counts in an individual's low fat diet) is low in fat. For example, whole milk is 96% fat-free by weight (since most of the weight is water), but 50 percent of whole milk's calories come from fat. (Nutrition Action, 1990)

### **The politics of mathematical knowledge: Numerical data can explode myths about the institutional structures of our society**

The fact that statistical descriptions of our world are neutral, but involve political struggle/choices, does not mean, as my students initially believe after we discuss examples like those above, that "they're all lies" or that we can't learn anything about our world from numerical data. The important point is to interrogate the data, to know what kinds of questions to ask to reveal what political struggles/choices were involved in the descriptions, and to analyze the data along with the context in which the data was created. Further, as Marcuse (1964) argues, without an overarching theory, which the individual data illuminate or challenge, the organizing structures of society will be clouded, and the sense that people control those structures disappears:

"The trouble is that the statistics, measurements, and field studies of empirical sociology and political science are not rational enough. They become mystifying to the extent to which they are isolated from the truly concrete context which makes the facts and determines their functions. This context is larger and older than that of the plants and shops investigated, of the towns and cities studied, of the areas and groups whose public opinion is polled or whose chance of survival is calculated... This real context in which the particular subjects obtain their real significance is definable only within a theory of society." (p.190)

In my critical mathematics literacy curriculum, the numeracy is learned through mathematical descriptions that, in the U.S. context, present an alternative perspective from the popular media, school texts and "taken-for-granted" assumptions about how our society is structured. Following are some specific examples of how numerical data can explode the myths about the institutional structures of our society:

\* A common myth in the United States is that "undeserving" poor people are



"robbing" the U.S. tax payers through welfare money. First of all, statistical studies reveal that 70 percent of those on welfare are children; "a majority remain on welfare for less than four years, and a high percentage work part-time." (Scheer, 1994, p.365) "Only one in five of the females reared in families 'heavily' dependent on AFDC [Aid for Dependent Children] had become dependent themselves by the time they had reached their mid-twenties." (Scientific American, 1988) On the other hand, taxpayers' aid for "dependent" corporations amounted to \$104.3 billion in 1994, contrasted with \$75.1 billion spent on all programs for poor people. (Harvey, 1994, p.10) Further, every poor family in the U.S. in 1990 could have been lifted to the poverty line for \$28 billion, while in that same year the top 1% of U.S. taxpayers received tax breaks of \$39 billion. (Jackson, 1991)

\* The chart opposite (*The Nation*, 2/18/91) powerfully demolishes myths that have grown about the U.S. conduct of its war against Vietnam.

\* Numerical data is also a part of exposing the false myths about hunger in Africa:

> *Myth: Drought is the main cause of famine in Africa.* Imperialist seizing of the best land for export agriculture degraded the environment and impoverished the peasants, giving plantations and other commercial interests a large labor force that could be paid low wages, ensuring high profits. Only the chronically impoverished die from drought.

> *Myth: African hunger is caused by overpopulation.* Only about 1/4 of Africa's potentially arable land is now under cultivation. 2/3 of the remaining arable land in the world is in sub-Saharan Africa. A U.N. Food and Agriculture study found that even with current low levels of farm technology Africa could support a population 2.7 times greater than its population in 1975. Although Africa has highest continental population growth rate, data from all over the world proves that the surest way to lower birth rates is by raising living standards. The key problem is not too many people, it is too much inequality.

> *Myth: African governments bear the main responsibility for declining food production.* The "anti-farmer coalition", made up of African elites, multinational corporations, western governments and international agencies, has implemented policies undermining food crops. For example, most agricultural assistance is directed to cash crops, mainly benefitting large commercial interests--between 1975 and 1980 the countries along the Sahara's southern border got \$7.45 billion from international aid agencies such as the World Bank. But, even though nearly all the region's food

### WHAT DOES HE MEAN?

*"Our troops . . . will not be asked to fight with one hand tied behind their back."*

—President Bush, national address, January 16

Tons of bombs dropped on Vietnam by the U.S.: 4,600,000<sup>1</sup>

Tonnage dropped on Cambodia and Laos: 2,000,000<sup>1</sup>

Tonnage dropped by the Allies in World War II: 3,000,000<sup>2</sup>

Gallons of Agent Orange sprayed: 11,200,000<sup>3</sup>

Gallons of other herbicides: 8,000,000<sup>3</sup>

Tons of napalm dropped: 400,000<sup>4</sup>

Bomb craters: 25,000,000<sup>4</sup>

South Vietnamese hamlets destroyed by the war: 9,000  
(out of 15,000)<sup>4</sup>

Acres of farmland destroyed: 25,000,000<sup>4</sup>

Acres of forest destroyed: 12,000,000<sup>4</sup>

Vietnamese killed: 1,921,000<sup>5</sup>

Cambodians killed (1969-75): 200,000<sup>5</sup>

Laotians killed (1964-73): 100,000<sup>5</sup>

Vietnamese, Cambodians & Laotians wounded: 3,200,000<sup>5</sup>

Total refugees by 1975: 14,305,000<sup>5</sup>

American troops who served in Vietnam: 2,150,000<sup>6</sup>

American troops killed: 57,900<sup>7</sup>

Sources: (1) Jim Harrison, "Air War in Vietnam," recent conference paper; (2) Howard Zinn, author, *A People's History of the United States*; (3) Marilyn Young, *The Vietnam Wars*; (4) Noam Chomsky, *Manufacturing Consent*; (5) "Indochina Newsletter," Nov.-Dec. 1982; (6) Lawrence Baskir and William Strauss, *Chance and Circumstance*; (7) National Archives. Thanks for inspiration to "Harper's Index."

production comes from rainfed agriculture, only 8% of the aid went to rainfed crops. The bulk of the aid further expanded export production.

> *Myth: The "free market" holds the solution to Africa's food problems.* Africa's worst enemy is the world market, and the world financial system is a greater cause of hunger in Africa than is the drought. Most African countries are dependent on exporting minerals and agricultural products. World market prices for these raw materials tend to stagnate or decline over time. But the prices of manufactured imports tend to ratchet upward. By 1982 a full year's worth of African exports could pay for only 27 days worth of the continent's imports. So African governments are in great debt and the IMF forces austerity like eliminating food subsidies as a condition for new loans.

> *Myth: U.S. foreign aid is helping Africa's hungry.* Food aid can undermine local food production by flooding local markets and depressing food prices. Nearly all U.S. foreign aid is directed at repressive elites (in countries, for example, with naval bases or CIA listening posts--of U.S. aid to sub-Saharan Africa, nearly half goes to 4 out of the 48 countries, even though these countries contain only 12% of this region's population, because they are of military importance to the U.S. government) who have enriched the few while impoverishing the many. They use U.S. aid money to strengthen their hold on power (by, for example, purchasing food with U.S. aid and then selling it on the open market, not benefitting the poor at all). Given the undemocratic nature of these regimes, U.S. aid is more likely to perpetuate poverty than eliminate it.

> *Myth: Donating surplus U.S. food is the best way to help alleviate hunger in Africa.* Food aid does nothing to solve the underlying problem of poverty. Only by taking active responsibility for what U.S. corporations and the U.S. government are doing to perpetuate inequality can we confront the real causes of hunger in Africa. (Danaher, 1985)

### **The politics of mathematical knowledge: Understanding the limitations of the knowledge we can gain from mathematical analyses of our world.**

Foucault (1980, p. 131) theorizes that: "Each society has its regime of truth, its 'general politics' of truth: that is, the types of discourse which it accepts and makes function as true..." Lave (1988) shows one way that mathematical discourse underlies the regime of truth in the United States. In an ethnographic study of adults' grocery shopping behavior, she found that choices among items are first made qualitatively. That is, an item may be the

best buy mathematically but is rejected because the package is too big to fit on the pantry shelf. However, shoppers fell back on arithmetic calculations when there were no other criteria for choice. School mathematics, filled with shopping applications, made money into a value-free, 'natural' term, so in the real-world shopping experience, the discourse of arithmetic calculations makes shoppers feel their decision among items is rational and objective. Thus, as Lave argues, "price arithmetic contributes more to constructing the incorrigibility of 'rationality' than to the instrumental elaboration of preference structures." (p.158)<sup>9</sup> Borba (1991) further argues that "the use of mathematics in everyday life not only makes our choices seem more 'rational', but serves to end the discussion. Once we use mathematics to justify a decision, no one can question that decision - after all, it is now 'scientifically proved'.

So after I have developed the idea that, once one understands the political struggle/choice involved in learning about the world through statistical descriptions, one can see through the "taken-for-granted" assumptions about the structure of our institutions, I return to examining some of the limitations of that knowledge. The following examples illustrate how numerical data can obscure knowledge of reality by providing a discourse, a "regime of truth" that distances us emotionally from injustice and outrage:

- \* Harvard University professor Robert Fogel's *Time on the Cross* (1974) used statistical arguments "with voluminous computer-processed data...[that] purported to show that the slave system in the South was both more humane and economically more efficient than the free labor system that existed at that time in the North." The book was received enthusiastically in the mass media until specialists undertook a careful review. A typical critique: "readers of *Time on the Cross* are inclined toward a benign view of slavery when they read that the average slave on the Barrow plantation received only 0.7 whippings per year. In the first place the figure is too low because it is based on an erroneous count both of the number of slaves Barrow owned and the number of times he whipped them. But more important, the figure is not the most relevant measure of the importance of whippings. A whipping, like a lynching, is an instrument of social discipline intended to impress not only the immediate victim but all who see or hear about the event. The relevant question is 'How often did Barrow's slaves see one of their number whipped?' - to which the answer is every 4 1/2 days. Again,

<sup>9</sup> I also contend (Frankenstein, 1987) that the shopping applications of U.S. school arithmetic curricula contribute to the appearance of 'naturalness' in the way social and economic structures are organized. My students, for example, find it ludicrous to imagine a restructured society where food is free, where eating is a civil right and not a paid-for commodity.

the form in which the figures are expressed controls their meaning. If one expressed the rate of lynchings in the same form Fogel and Engerman chose for whippings, it would turn out that in 1893 there were only about 0.00002 lynchings per black per year. But obviously this way of expressing the data would cause the reader utterly to misunderstand the historical significance of the 155 Negro lynchings that occurred in 1893." (Koblitz, 1984) In 1993, Fogel won the Nobel Prize in economics!

The following examples show attempts to re-personalize anonymous, "cold, hard" facts:

- In an attempt to make the impact of the U.S. "Operation Desert Storm" war real, to make the enormity of well over 100,000 deaths comprehensible, students at the University of Rochester in New York created a public visualization of chalk marks on a wall, where each line represented one of the victims of the Gulf War -- "each slash has a face, a mother, a father, someone who misses them." (Cockburn & Wypijewski, 1991, pp.12-13)
- Jennifer Lindberg, a volunteer with the Mennonite Board of Missions in San Antonio, Texas attempted to personalize the impact of this war by cutting out 100,000 pictures of faces from magazines, creating a collage that is mounted on 439 cardboard panels forming a labyrinth the size of a high school gym. (*The Progressive*, 1993, p.15)<sup>10</sup>

## The Politics of Knowledge in the (Mathematics) Class

There are many other aspects of the politics of knowledge that are integrated into this curriculum. Some involve reconsidering what counts as mathematical knowledge and re-presenting an accurate picture of the contribution of all the world's peoples to the development of mathematical knowledge (Frankenstein & Powell, 1994). Others involve how mathematical knowledge is learned in schools: Winter (1991), for example, theorizes that

<sup>10</sup> A U.S. Census Bureau demographer extrapolated from the United Nations' 1987 census of Iraq, and using standard mortality rates and demographic models of excess deaths during public health crises, estimated that during the Gulf War 13,000 Iraqi civilians were killed by the bombing and 70,000 civilians died in 1991 as the result of the collapse of the Iraqi public health system. In total, she estimated 150,000 Iraqi deaths, including 40,000 women and 32,000 children, or about 48 percent of all Iraqi casualties. For her efforts she was fired, charging that she falsified data. She fought back and won. (Colhoun, 1992)

the problems so many encounter in understanding mathematics are not due to the discipline's "difficult abstractions", but due to the cultural form in which mathematics is presented; Sklar (1993, p.53), for a different aspect, cites a U.S. study which recorded the differential treatment of black and white students in math classes<sup>11,12</sup>; and, of course, Freire (1970) theorizes about the politics of "banking education".

Underlying all of these are more general concerns, concerns I argue should form the foundation of all learning, concerns about what "counts" as knowledge and why. I think that one of the most significant ideas Paulo Freire (1982) has contributed to the development of a critical literacy is that:

Our task is not to teach students to think -- they can already think, but to exchange our ways of thinking with each other and look together for better ways of approaching the decodification of an object.

This idea is so important because it implies a completely different set of assumptions about people, pedagogy, and knowledge creation. Because some people in the U.S., for example, need to learn to write in "standard" English, it does not follow that they cannot express very complex analyses of social, political, economic, ethical and other issues. And many people with an excellent grasp of reading, writing and mathematics skills need to learn much about the world, about philosophy, about psychology, about justice, and many other areas in order to deepen their understandings.

In a non-trivial way we can learn a great deal from "intellectual diversity." Most of the burning social, political, economic, and ethical questions of our time remain unanswered: in the U.S. we live in a society of enormous wealth and we have significant hunger and homelessness; although we have engaged

<sup>11</sup> This study, discussed in an article by Dr. Deborah Prothrow-Stith, former Massachusetts commissioner of Public Health, involved "66 teachers [who] were told to teach a math concept to four pupils-- two white and two black. All of the pupils were of equal, average intelligence. The student teachers were told that in each set of four, one white and one black student was intellectually gifted, the others were labeled as average. The student teachers were monitored through a one-way mirror to see how they reinforced their students' efforts. The 'superior' white pupils received two positive reinforcements for every negative one. The 'average' white students received one positive reinforcement for every negative reinforcement. The 'average' black student received one positive reinforcement for every 1.5 negative reinforcements, while the 'superior' black students received one positive response for every 3.5 negative ones."

<sup>12</sup> Discussing the above study in class brings up the math topics of ratios and forming matrix charts to visualize the data more clearly. It also involves students who are themselves learning mathematics in reflecting on topics in mathematics education. I discuss in great depth how the idea of breaking down the dichotomy between teaching and learning permeates my criticalmathematical literacy curriculum in Frankenstein (in press).



in medical and scientific research for scores of years, we are not any closer to changing the prognosis for most cancers. Certainly we can learn from the perspectives and philosophies of people whose knowledge has developed in a variety of intellectual and experiential conditions. Currently "the intellectual activity of those without power is always labeled non-intellectual". (Freire & Macedo, 1987) When we see this as a political situation, as part of our "regime of truth", we can realize that all people have knowledge, all people are continually creating knowledge, doing intellectual work, and all of us have a lot to learn.

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