

Rethinking Mathematics:

Teaching Social Justice by the Numbers

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2007 Midwest Sociology Society
Teaching Q/L: Examples from Across the Disciplines

Source: International Diabetes Federation

I thought math was just a subject they implanted on us just because they felt like it, but now I realize that you could use math to defend your rights and realize the injustices around you... Now I think math is truly necessary and, I have to admit it, kinda cool. It's sort of like a pass you could use to try to make the world a better place.

-Freida 9th grade Chicago Public Schools

Source: International Diabetes Federation

Rethinking Math Contents

- Driving while black or brown, racial profiling.
- How is the unemployment rate determined?
- How much is the war in Iraq costing us?
- How many Sears Towers tall is 135 billion?
- Is Environmental Racism real?
- Deconstructing Barbie: Math and popular culture.

Source: International Diabetes Federation

Quantitative Literacy Topics:

The Need for an Industry Standard?

Source: International Diabetes Federation

Quantitative Literacy:

The **skill set** necessary to process quantitative information and the **capacity** to

- critique,
- reflect upon,
- and apply it in making decisions.

Communicating with Numbers

Source: International Diabetes Federation

QL SIGMAA Chat Fall 2006:

- **How to assess QL?**
- **"Framework" for QL?:**
 - Varieties of QL
 - Types of QL
 - Call for more detail
- **What is QL?:**
 - Can you count?
 - Can you calculate?

Communicating with Numbers

Source: International Diabetes Federation

Mathematics and Democracy

- Elements/Definitions:**
 - Confidence with Math, Cultural Appreciation, Interpreting Data, Logical Thinking, Making Decisions, Math in Context, Number Sense, Practical Skills, Prerequisite Knowledge, Symbol Sense
- Expressions/Manifestations:**
 - Citizenship, Culture, Education, Personal Finance, Personal Health, Management
- Skills:**
 - Arithmetic, Data, Computers, Modeling, Statistics, Chance, Reasoning

Masters in Numeracy @ Alfred University

EDUC 571: Teaching Numeracy

If you have to teach teachers (K-12) how to teach numeracy...what should they learn?

National Assessment of Adult Literacy (NAAL):

Figure 2. Percentage of adults in each literacy level: 1992 and 2003

Literacy scale and year	Below Basic	Basic	Intermediate	Proficient
Present 1992	14	28	43	15
Present 2003	14*	29	44	13*
Document 1992	14	22	49	15
Document 2003	12*	22	53*	13*
Quantitative 1992	26	32	30	12
Quantitative 2003	22*	33	39*	13

*Significantly different from 1992.

NOTE: Detail may not sum to totals because of rounding. Adults are defined as people 16 years of age and older living in households or groups. Adults who could not be interviewed due to language spoken or cognitive or mental disabilities (5 percent in 2003 and 4 percent in 1992) are excluded from this figure.

SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 1992 National Adult Literacy Survey and 2003 National Assessment of Adult Literacy.

National Assessment of Adult Literacy (NAAL):

Basic:
Comparing ticket prices.

Intermediate:
Calculating total from catalog order.

Proficient:
Compare and contrast the cost per ounce of food items.

RATIOS!

Ratios in textbooks. Three dominant QL textbooks on the market:

Textbook #1, ratios appear once in a sidebar:
"comparisons only make sense when we compare quantities with the same units, hence ratios always end up unit-less."
Cost per ounce?

Textbook #2, ratios appear in a single example:
federal debt per person, different units!

Textbook #3, ratios never appear:
proportionality is discussed, something the other two do not do.

RATIOS!

Sociobiology: The New Synthesis

- Individuals of the same species should be inclined to help each other in **direct proportion** to their coefficient of genetic relatedness.
- The **sex ratio** of parasitic wasps should depend on how many females lay their eggs on a single host.

Developing Countries: A Diabetes Risk

Homicide

On each continent, countries expected to have a significant increase in the number of diabetes cases from 2000 to 2030 are shown. The projected increase in diabetes cases from 2000 to 2030 shows that the developed countries are at particular risk.

- “The family is perhaps the most violent social group.”
- Numbers vs. Ratios
- Infanticide study from England: 14 deaths by stepfathers vs. 15 deaths by fathers.
- “These numbers provide the numerators but are **meaningless** until we provide the denominators.”
- Infants are 20 to 100 times more likely to be killed by a step-parent.

Source: International Diabetes Federation

Developing Countries:

QL Topics:

On each continent, countries expected to have a significant increase in the number of diabetes cases from 2000 to 2030 are shown. The projected increase in diabetes cases from 2000 to 2030 shows that the developed countries are at particular risk.

- **Ratios and proportions:** A **ratio** is the comparison of the relative size of two quantities; a **proportion** is the equality of 2 ratios. The ratio of students to computers is 3:2, if there are 90 students how many computers are there?
- **Proportionality as distinct from proportions:** Quantities are **proportional** if their **ratio** is constant. The miles you drive are **proportional** to the gas you use but **not** proportional to the coffee you drink.
- **Constant of proportionality:** The **ratio** of miles to gallons is 100:4, the constant is 25 miles/gallons, computed by scaling the second quantity to one, 25:1.

Source: International Diabetes Federation

Developing Countries:

QL Topics:

On each continent, countries expected to have a significant increase in the number of diabetes cases from 2000 to 2030 are shown. The projected increase in diabetes cases from 2000 to 2030 shows that the developed countries are at particular risk.

- **Rates:** Ratios between quantities with different units, and involving the word “per”, such as 25 miles per gallon or 1.5 students per computer.
- **Conversions:** A **ratio** signifying a change in units.
- **Scales:** A **ratio** signifying a change in magnitude.
- **Percentages:** A **ratio** where the second quantity is scaled to 100 gives a percentage. The ratio of students to computers is 150 to 100, meaning that the number of students is 150% that of the number of computers. Distinguishing between part-to-part, ratio of boys to girls is 2:3, and part-to-whole, ratio of boys to students is 2:5.
- **Probability:** The **ratio** of the number of ways an event can occur to the total number of possible occurrences.

Source: International Diabetes Federation

Developing Countries:

QL Topics:

On each continent, countries expected to have a significant increase in the number of diabetes cases from 2000 to 2030 are shown. The projected increase in diabetes cases from 2000 to 2030 shows that the developed countries are at particular risk.

- **Total change vs. percent change:** The number of adults scoring below basic decreased from 1992 to 2003 by 4 percentage points or by 15.4%. **Percent change is nothing more than the ratio of total change to the original value.**
- **Linear models:** The **ratio** of rise to run is the constant called the slope, and can be interpreted as a rate giving total change.
- **Exponential models:** The **ratio** of one output to the previous output is the constant % change.
- **Handling data:** Representing quantitative information visually with charts and graphs, numerically with tables, and analytically with equations; and interpreting such mathematical models and drawing inferences from them. Analyzing data with statistics.

Source: International Diabetes Federation

Developing Countries: A Diabetes Risk

On each continent, countries expected to have a significant increase in the number of diabetes cases from 2000 to 2030 are shown. The projected increase in diabetes cases from 2000 to 2030 shows that the developed countries are at particular risk.

President Bush's \$2.77 trillion budget proposes increases for the military but reductions for other areas.

	Discretionary budget, in billions	Change in discretionary budget	
Military	\$439.3	+6.9%	Does not include supplemental appropriations, estimated to be \$50 billion for wars in Iraq and Afghanistan in 2007.
Homeland Security	30.9	+1.3	Increases FEMA spending. Provides for new border agents, technology and detention space to deter illegal immigrants.
Health and Human Services	67.6	-2.3	Reduces projected Medicare spending by \$36 billion over five years. Includes money for pandemic influenza preparedness.
Education	54.4	-3.8	Continues financing for No Child Left Behind Act. Includes private-school vouchers for students in under-performing schools.

Source: White House Office of Management and Budget

Developing Countries: A Diabetes Risk

On each continent, countries expected to have a significant increase in the number of diabetes cases from 2000 to 2030 are shown. The projected increase in diabetes cases from 2000 to 2030 shows that the developed countries are at particular risk.

Scores Drop

Average scores for college-bound high school seniors on the reading and math segments of the SAT had their biggest drop in 31 years in 2006. The most recent tests were the first to include a writing segment.

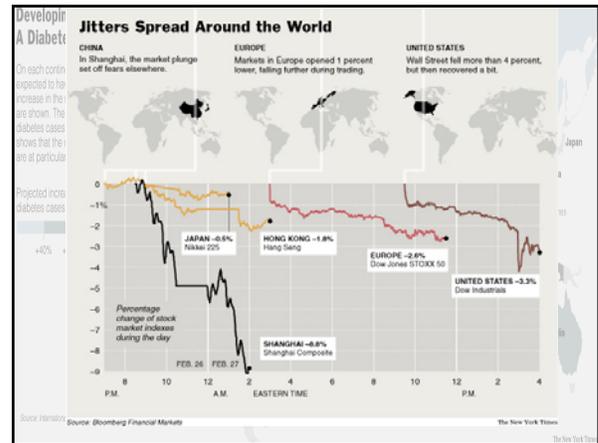
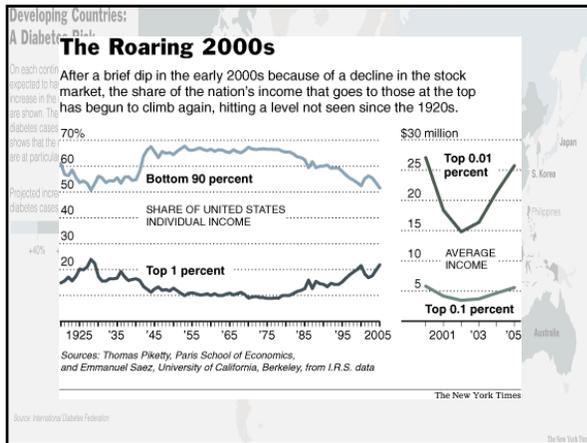
Average Scores, All Students

According to Sex

- Boys, math
- Boys, reading
- Girls, reading
- Girls, math
- Girls, writing
- Boys, writing

*Formerly called verbal

Source: College Board



Developing Countries: A Diabetes Risk

World Population and Wealth

Continent	Population (millions)	% of World Population	# of Students (in class)	Wealth (GNP) (in billions \$)	% of World GNP	# of Treats (in class)
Africa	906	14.0%	4.2	495.4	1.8%	0.5
Asia	3905	60.4%	18.1	7172.6	25.5%	7.7
Oceania	33	0.5%	0.2	442.4	1.6%	0.5
Europe	728	11.3%	3.4	9606.3	34.2%	10.3
US and Canada	331	5.1%	1.5	8933.6	31.8%	9.5
Latin America	581	8.7%	2.6	1430.7	5.1%	1.5
WORLD TOTAL	6464		30	28081		30

Copy this table into Excel.

Compute the totals.

Compute the percentages.

Compute the number of students and number of treats for each category using the class size as the total.

Source: International Diabetes Federation

The New York Times

