The Problem with Traditional Math Education

When we live in a system, we absorb a system and think in a system.
-James W. Douglass

We do not see things as they are. We see things as we are.
-Talmud

The first problem for all of us, men and women, is not to learn but to unlearn.
-Gloria Steinman

The Reductionist Paradigm

REDUCTIONIST	**WHOLISTIC (holistic)**
Parable of the six blind men: What do you see? Pillar/branch/pipe/rope/fan/wall	
Constituent parts simplicity	Whole is greater than sum of parts complexity
Mathematics Education	
ARITHMETIC: Ratio/Rate/Percent/Fraction/Decimal	Proportional Reasoning
ALGEBRA: Linear/Rational/Quadratic/Roots/Factoring	Algebraic Reasoning
Problem Solving	
CONTRIVED Well Structured Problems	**MESSY** Ill Structured Problems

Spreadsheets balance the reductionist and wholistic paradigms.

Spreadsheets balance arithmetic and algebra.

	A	B	C	D	E	F	G
1		**2010 Population (US Census 2010):**	**308,745,538**				
2	Rank	Cause of Death	Number	Proportion of Total Deaths	Percent of Total Deaths	Crude Death Rate (2010)	
3		All causes	**2,468,435**	Decimal	100.0	**799.5**	
4	**1**	Diseases of heart	**597,689**	0.2421	24.2	=C4/C1*100000	
5	**2**	Malignant neoplasms	**574,743**	0.2328	23.3	**186.2**	

Quantitative and STEM Reasoning
Prompts for Discussion:

STEM faculty often struggle with the following:

- How to help students translate the particular problem they see in front of them into some "model" or concept; figure out what is known, what is unknown, what might be assumed, and then relate that to a formula that they are given.

- How to improve students' basic algebra and geometry (which we don't think should be beyond the grasp of any college student).

In light of these, consider the following two quotes:

The first comes from a recent article on productive struggle[1], while the second is from Jung:

1. "research on impasse-driven learning (VanLehn et al., 2003) in coached problem-solving situations suggests that successful learning of a principle (e.g., a concept, a Physical law) was associated with events when students reached an impasse during problem solving. Conversely, when students did not reach an impasse, learning was rare despite explicit tutor-explanations of the target principle."

2. "There are, however, others who are by no means unamenable to education, who, on the contrary, exhibit special aptitudes, but of a very peculiar and one-sided nature. The most frequent of such peculiarities is the incapacity to understand any form of mathematics that is not expressed in concrete numbers. For this reason, higher mathematics ought always to be optional in schools. Since the development of logical thinking is in no way connected with it. For the individuals mentioned above, mathematics is quite meaningless, and only needless torment. The truth is that mathematics presupposes a definite type of psychological make-up that is by no means universal and cannot be acquired. For those who do not possess this ability mathematics becomes merely a subject to be memorized, just as one memorizes a series of meaningless words. Such persons may, however, be highly gifted in every other way, and may either possess already the capacity for logical thinking, or have a better chance of acquiring it by direct instruction in logic. Strictly speaking, of course, a deficiency in mathematical capacity is not to be taken as an individual peculiarity. However it serves to show in what way a curriculum may sin against the psychological peculiarity of the pupil."[1]

[1] http://qz.com/535443/the-best-way-to-understand-math-is-learning-how-to-fail-productively/

[1] C. G. Jung, Man and his Symbols, ed. John Freeman (Aldus 1964)