REINVENTING THE FUTURE WITH STEM | by Barbara Finkelstein
Theory to Practice | Lehigh University College of Education

It's a sunny morning in 2112. You are sipping a cafe macchiato in the breakfast nook of your home, newly refurbished with "green" building materials made out of re-engineered garbage. Before driving your driverless Google car over to the Springfield Cluster, you check your mail on the LED iTable to see what your client thinks about the latest iteration of the video game you and your three colleagues -- in Shanghai, Haifa and Rio -- are working on. You tap the left corner of the iTable to bring up your calendar. Lovely. You don't have to be in Vancouver until mid-week, when the four of you will meet in person with gamers to fine-tune the playability of the game. Better jot down your to-do's before you go: Take digital x-ray of teeth and forward scan to dentist. Print out new pants and shirt on 3-D printer. Set aside hour to visit grandmother in Chicago via vacuum tube transit to see how she is recuperating from titanium jaw implant. Clean house with virus-operated home cleaning system -- and surprise geologist wife, home any minute from a petroleum optimization project in Norway.

Only a digital optimist who has never contemplated the many cautionary tales about the limits of technology could have total faith in this Jetsons-like portrait of life a hundred years hence. Most of us understand that the road to any Springfield utopia is littered with unforeseen obstacles: Disease. Limited resources. Economic downturns. Political and social polarization. Yet most of us would take the sunny high-tech morning of 2112 -- with all its unseen complications -- over "simpler" times of inevitable crop failures and untreatable pandemics. The utopian vision of a world based on advances in science, technology, engineering and mathematics -- the so-called STEM disciplines -- is

a world full of rewards and traps, but it is the world millions, perhaps billions, of people want to live in.

It goes without saying that the developed world has embraced the benefits of a STEM-oriented economy. Who works on anything but a PC or a tablet? Who hasn't used databases, content publishing tools, customer relationship management systems or websites in the course of their work day? Yet every day media and think tank experts tell us that as the workplace becomes even more high-tech, we are in danger of losing our jobs to higher skilled workers, especially in Asia-Pacific. Indeed, media reports inform us that as many as 3.2 million jobs have gone unfilled for lack of qualified applicants. Has the United States really reached the point where its workers do not have the STEM education and training to do the work of a high-tech society?

We know, of course, that many American jobs already have moved overseas, especially to China and India, where, it is said, better education has resulted in better trained workers -- and where labor costs, incidentally, are lower. Along with other Asian tigers, these countries are leaving the U.S. behind in the dust. Everyone from newspaper columnists to economists is saying so, and telling us the evidence is everywhere. Just walk into a clothing store and look at the label: Made in China. Look at the cities of the world that are manufacturing our Smart Phones (Zhengzhou); our socks (Zhuji); our car parts (Sao Paulo). Most important, compare the math and science scores of students in China, Hong Kong and Singapore to the test scores of students in the U.S. Not only have the workers of the wider world taken our manufacturing jobs, but now they are topping us academically too. Are we in the United States, along with a foundering Europe, becoming, as essayist Gore Vidal once wrote, "irrelevant to the world that matters?"

HOW FAR AWAY IS OUR IMAGINED FUTURE?

To answer the question, we have to look at the "world that matters" and try to understand what we need to prepare ourselves for.

In a 2006 article for *Foreign Affairs*, the then-CEO of I.B.M., a technology and consulting company, described I.B.M. -- and thousands of other successful companies -- as a "globally integrated enterprise." I.B.M.'s endorsement of this relatively new economic system was unapologetic:

"The globally integrated enterprise will require fundamentally different approaches to production, distribution, and work-force deployment. This is already happening. Because new technology and business models are allowing companies to treat their different functions and operations as component pieces, firms can pull these pieces apart and put them back together again in new combinations, based on strategic judgments about which operations the company wants to excel at and which it thinks are best suited to its partners."

The article observed further that between 2000 and 2003, foreign firms built 60,000 manufacturing plants in China. Banks, insurance companies, professional-service firms and IT companies put up R&D service centers in India to support employees, customers and production around the world. These "fundamentally different approaches to production, distribution, and work-force deployment" also resulted in Australians interpreting American x-rays; Dubliners processing derivatives transactions for global investment banks, and chipmakers in South Korea and Germany leaning on the expertise of U.S. engineers. Whether we like it or not, the "global integration of operations is forcing companies to choose where they want the work to be performed and whether they want it performed in-house or by an outside partner," says I.B.M.

A 2012 story in *The Economist* describes much the same world minus the corporate sugar-coating:

"In the decade to 2010 the number of manufacturing jobs in America fell by about a third. The rise of outsourcing and offshoring and the growth of sophisticated supply chains has enabled companies the world over to use China, India and other lower-wage countries as workshops."

Two things, then, are happening at the same time: Industrial jobs are shifting to cheaper labor abroad and U.S. companies are calling for more sophisticated high-tech workers at home. Yet it is practically an unchallenged tenet of the faith that American workers do not have the skills that the globally integrated enterprise demands. And they lack these skills because U.S. schools are failing to educate them. Are we in fact hamstringing our citizens with schools incapable of educating us for the "world that matters?"

CRISIS OR CANARD?

Richard Rothstein, who studies educational policy at the non-partisan Economic Policy Institute, has suggested that panicking over dismal school performance is an American pastime. In 1896, for example, the Harvard Board of Overseers "published samples of freshman writing to embarrass secondary schools" and complained that there was "no conceivable justification for using the revenues of Harvard College" to instruct undergraduates who were unprepared for college work. A *New York Sun* editor wrote in 1902 that basic skills instruction had been replaced by "every fad and fancy." And political theorist Hannah Arendt complained in 1954 that "one of [the] most characteristic and suggestive aspects [in America] is the recurring crisis in education that, during the last decade at least, has become a political problem of the first magnitude, reported on almost daily in the newspapers."

The most recent loud warning about American education came in 1983 with the publication of *A Nation at Risk: The Imperative For Educational Reform*. This was a report to then-Secretary of Education T.H. Bell by the National Commission on Excellence in Education. Secretary Bell created the commission in response to

the "widespread perception that something is seriously remiss in our educational system." This "perception" was based on thirteen "indicators" of risk. Two exemplary ones:

+ International comparisons of student achievement, completed a decade ago, reveal that on 19 academic tests American students were never first or second and, in comparison with other industrialized nations, were last seven times.

+ The College Board's Scholastic Aptitude Tests (SAT) demonstrate a virtually unbroken decline from 1963 to 1980. Average verbal scores fell over 50 points and average mathematics scores dropped nearly 40 points.

Pause to consider that *A Nation at Risk* came out twenty-five years after the National Defense Education Act of 1958 poured millions of dollars into education, especially math education, largely in response to the Soviets' lead in the "space race." By the early 1980s, when our nation was said to be at risk, the nascent PC industry was hiring computer programmers, database specialists, mathematicians, artificial intelligence logicians and software engineers, many of whom had benefited from the government's commitment to math and science education. Despite the influx of trained workers into the Internet economy -- despite their contributions to the development of new business models, the creation of new products and services, and the transformation of the way millions of people around the world interact with each other personally and commercially -- many well-meaning pundits reminded us again with the No Child Left Behind Act of 2001 and the Obama Administration's Race to the Top that the U.S. had to redouble its efforts to improve its schools.

Critics have argued rightly that the genius who invents the light bulb or the personal computer is not proof of a superior educational system. Such individuals will always find a way to work with like-minded talents to fill the vacuum that nature -- and society -- abhor. The problem, they say, is that today most American students are performing worse in math and science tests than their counterparts around the world. Just as problematic is the purported decrease in interest in the STEM subjects. All this despite the many education initiatives, academic studies and government reports detailing the system's flaws and offering up fixes.

Purdue University, for example, produced a report called "Attracting Students to STEM Careers, 2007- 2013." Purdue's team of seven analysts believe that a "national crisis has been identified in the area of global technological competitiveness. Statistics on the state of education in the United States indicate a decreasing trend in domestic students choosing to major in and successfully complete degrees" in the STEM disciplines. The report cites various engineering organizations that have called for "major initiatives to be undertaken nationally to address these educational trends." Among these: The American Society for Engineering Education's Engineering Deans Council; the Corporate Roundtable

(1994); the National Research Council (1995); the National Academy of Engineering (2002), and the National Science Foundation.

Another organization, the Business-Higher Education Forum, sounded the same alarm when it published a report called "Increasing the Number of STEM Graduates: Insights from the U.S. STEM Education & Modeling Project (2010)." It argues that the STEM disciplines are "vital to American competitiveness, yet relatively few students obtain a STEM bachelor's degree (2005, 2007). The report observes that ninth graders in the U.S. numbered 3.8 million in 1997, but of the 1.7 million students in this cohort that eventually enrolled in two- or four-year colleges, only 233,000 graduated by 2007 with a STEM bachelor's degree.

The Georgetown University Center on Education and the Workforce set out to analyze what was diverting students from the STEM path. It wrote in 2011 that even students enrolled in STEM majors tend to steer away from STEM careers. For one, STEM majors can earn more over their lifetimes in some non-STEM occupations than they can in STEM occupations. And STEM workers with bachelor and master's degrees may start out with high-wage STEM jobs after college, but often leave for more lucrative managerial and professional occupations. The Center's authors wonder who will fill the 1.1 million net new STEM jobs and the 1.3 million STEM job openings to replace STEM workers who permanently leave the workforce between 2008 and 2018.

An examination of U.S. Census Bureau statistics on the number of students graduating with science and engineering degrees, however, tells a somewhat different story.

According to U.S. Census Bureau tabulations, 502,561 students in 2009 received a bachelor's degree in science and engineering. This number was up from 399,686 in 2000. Female recipients outnumbered male recipients by 3,071 and 4,032, respectively. In regard to master's degrees: 94,706 were rewarded in 2000; 132,390 in 2009. About 43 percent of these degree recipients in 2000 were women and about 45 percent in 2009. Some 25,966 doctoral degrees were awarded in 2000; 33,470 in 2009. About 36 percent of Ph.D.s went to women in 2000; about 41 percent in 2009.

When the definition of "science and engineering" degrees included physics, earth sciences, mathematics, computer sciences, biological sciences, agricultural sciences, social sciences and psychology, the numbers were even stronger. In 2000, 41,365 students earned doctoral degrees, with women receiving about 44 percent of these. In 2009, 49,562 students received Ph.Ds, with women earning about 47 percent.

Women with STEM-related Ph.D.s are prominently represented in the biological sciences (52.2 percent) and psychology (71.4 percent). Otherwise, men outnumber women in most of the "hard sciences:"

Discipline	Men (%)	Women (%)
Engineering	79	21
Computer Sciences	78	22
Physics	70	30
Mathematics	69	31
Earth Sciences	61	39

The difference between male and female Ph.D. recipients in agriculture and social sciences was narrower:

Discipline	Men (%)	Women (%)
Agriculture	57	43
Social Sciences	51.5	48.5

So, while the annual number of post-secondary STEM degrees is still only a relatively small portion of the overall 56 million people aged 25 or older who hold a bachelor's degree -- and even though women's interest in STEM both drops off after the B.A. level and centers largely on agriculture and the social sciences -- most of the STEM numbers are climbing. If these numbers are showing improvement, why are so many observers of the U.S. educational system worried that we are falling behind in the STEM subjects?

TEST ANXIETY

Concern over STEM subject preparedness comes from looking at American rankings in the Trends in International Mathematics and Science Study. The so-called TIMSS test measures math and science test scores of Grade 4 and Grade 8 students of some 36 and 48 countries, respectively, and consists of subject matter taught in school curricula. All countries are measured against the TIMSS scale average of 500. In 2007 the American math scores for Grades 4 and 8 were above average (529, 508). But students elsewhere in the world scored higher. Grade 4 students in Hong Kong, for example, scored 607; Grade 8 students in Chinese Taipei scored 598.

Another test, the Program for International Student Assessment (PISA), studies the "literacy," or general knowledge, of 15-year-old students in mathematics, reading and science. The most recent data from 2009, when 65 education systems participated, show that in math the U.S. scored 487 against the average of 500.

To name a few countries that scored better:
+ Shanghai-China (600)
+ Singapore (562)
+ Hong Kong (555)
+ Korea (546)

In science the U.S. students scored 502.

To name a few countries that scored better:
+ Shanghai-China (575)
+ Finland (554)
+ Hong Kong (549)
+ Singapore (542)

"If you looked at these numbers out of context, you would have to conclude that the U.S. *is* falling behind," says Alexander Wiseman, an associate professor at Lehigh University in the College of Education. "But many educators are looking at the same data sources -- TIMSS and PISA -- and observing that we have students performing at the highest levels in the world."

Wiseman says that evaluating U.S. students in relation to students in Japan, Singapore, China or Korea -- countries with high stakes education systems -- results in an apples-to-oranges comparison. "We don't have the kind of system where only students who test well on standardized tests get to participate in TIMSS and PISA," Wiseman says. "Students across our entire educational spectrum, from suburban high schools to inner city schools, take these tests. The real question is, would we want to live in a country that focuses on the academic skills only of the top scorers on standardized tests?"

The TIMSS and PISA test designers themselves offer up a caveat that points to at least one inherent problem in the tests: "The content represented by the scale scores is not the same across different ages within a subject domain." In other words, a test given in Singapore may be significantly different from a test given in the United States.

Moreover, researchers who study TIMSS and PISA have observed that some countries do well in TIMSS but not in PISA -- as was the case with the U.S. Jan de Lange of the Freudenthal Institute in The Netherlands has written that financial considerations may shape a country's decision whether or not to administer a particular test. "Many countries participating in these large cooperative studies are unwilling or unable to fund much more expensive multiple marker studies [instead of multiple-choice tests], even if such studies have demonstrated their efficacy," he said in a 2006 presentation to the International Congress of Mathematicians in Madrid.

Mioko Saito, a researcher with the International Institute for Educational Planning (UNESCO), and Frank van Cappelle, a researcher at the Melbourne Graduate School of Education, wrote in 2010 that a "legitimate concern expressed by some [country] ministers is the unfair comparisons via 'league-table' in which countries are ordered in ranking. Moreover, taking into consideration the different contextual and cultural background, cross-national surveys are often criticized as less attuned to local issues and concerns."

Even if we are willing to take international rankings with a grain of salt, what should we conclude about test scores inside the United States that have fallen over time?

David C. Berliner and Bruce J. Biddle, educators who have studied the drop in Graduate Record Exam (GRE) scores from 1965 to the early 1970s, write that the percentage of students who took the test during that period actually doubled. "Since 1971 the percentage of students taking the GRE has not varied greatly, but average GRE scores have gradually risen," they write in *The Manufactured Crisis, Myths, Fraud, and the Attack on America's Public Schools*. "What this means is that average total GRE scores are now roughly the same as they were in the 1960s -- despite the fact that the percentage of students taking the GRE now is more than twice it was a generation."

Berliner and Biddle studied the scores for other advanced education tests too: the Graduate Management Admissions Test (GMAT); the Law School Admission Test (LSAT), and the Medical College Admission Test (GMAT). They write that the scores for all three tests have increased since the early 1960s. In the MCAT, for example, verbal ability rose from 519 to 541. Quantitative ability rose from 548 to 583. And science knowledge rose from 515 to 567. Only general information fell from 541 to 527.

AN APPLES TO APPLES COMPARISON

Concerned about an unscientific comparison between the U.S. and high-stakes educational systems in China, South Korea, Japan and Singapore, a group of superintendents in Chicago formed a consortium of districts "committed to providing a world class education for their students." One goal was to be first in the world in math and science by the year 2000. This First in the World Consortium chose TIMSS as its measure.

The Consortium students made up a relatively homogeneous group -- comparable in homogeneity to the test groups in Shanghai, Korea and Japan: Nearly four out of five students (78 percent) were white, non-Hispanic. Fourteen percent of students were Asian/Pacific Islanders, while seven percent were Hispanic and two percent were black, non-Hispanic.

According to an extensive analysis of the fourth and eighth grade math tests and the twelfth-grade advanced math and physics tests, "FiW students did exceedingly well."

In fact, only Singapore scored higher than FiW in fourth- and eighth-grade math. Only Korea scored as well as FiW in fourth-grade science. Several countries scored as well as FiW in eighth-grade science (Singapore, Czech Republic, Japan, Korea, Bulgaria, Netherlands, Slovenia and Austria). Several scored as well as FiW in twelfth-grade general mathematics (Netherlands, Sweden,

Denmark, Switzerland, Iceland, Norway, Australia), and as well in twelfth-grade general science (Sweden, Netherlands, Iceland, Norway, Canada, New Zealand, Australia). Only in twelfth-grade advanced math and twelfth-grade physics did a significant number of countries score higher than FiW.

Former special assistant for STEM education to U.S. Secretary of Education Arne Duncan Michael Lach suggests that "FiW results indicate that our most advantaged kids are absolutely competitive. But the kids on the South Side and the West Side of Chicago are not competitive because of the social and economic inequalities that frame their educational experience."

Lach's explanation may strike some observers of American education as an excuse for low test scores. But educators point to more than anecdotal evidence in the success of various inner city schools that have strengthened their entire curriculum for the purpose of enhancing the students' critical thinking and problem-solving skills -- not for the purpose of taking international tests.

Diane Ravitch, a longtime educational policy analyst who once supported the testing goals of No Child Left Behind, has turned against the obsession with test-based initiatives. In *The Death and Life of the Great American School System*, she cites the example of the San Diego school district, which attempted to introduce Blueprint, an educational reform plan originally implemented in New York City's District 2 system. Two years into San Diego's reform program, mathematics was added along with reading as a core subject. Teachers who objected to the Blueprint methodology were fired. More than a third of the district's teachers left between 1998 and 2005, and some 90 percent of the district's principals were replaced. Ravitch was surprised to learn that curriculum never even entered into the Blueprint plan.

As for the issue of student achievement, Ravitch writes, "It was a mixed scorecard... Elementary schoolchildren made significant progress, but not as much as those in comparable urban districts across the state, such as Santa Ana, Fresno, Garden Grove, Long Beach, and Los Angeles. The reforms 'largely fizzled in middle and high schools.' The district's dropout rate increased almost every year starting in 1999 and grew by 23 percent during [the Blueprint administrator's] tenure."

IF NOT TESTS, WHAT?

First, we should qualify that while American education is not experiencing the crisis that critics allege, educators and policymakers do need to acknowledge the need for a renewed emphasis on STEM education. "The fact is that other countries, like China, like India, wanted to understand how the U.S. became an economic powerhouse, and they concluded that science and math were responsible," says Linda Rosen, CEO, Change the Equation. "They focused very strongly on the K-12 pipeline to produce a population of their own citizens that was strong in these subjects."

What will our renewed emphasis on STEM look like?

In keeping with the conviction, described by Diane Ravitch and others, that one size does not fit all, educators, corporate CEOs and researchers in every academic discipline are proposing technology tools, curricula and even public boarding schools to help students acquire the critical thinking and problem-solving skills they will need to compete in the globally integrated *economy*. And while people can only guess at the type of jobs that might exist, say, a hundred years from now -- driverless platoon supervisor, predictive spending habits analyst, personalized medicine coordinator -- what is certain is that the future workplace will always need workers and entrepreneurs whose greatest asset is the critical thinking they learned not only in their STEM classes, but also in their social studies, foreign language, philosophy and English classes.

Let's start with the technology tools because they represent an embarrassment of educational riches. Computer scientists, education professors and Harvard Business M.B.A.s, to name only a few categories of entrepreneur, are designing tools aimed strictly at engaging students in STEM and other academic subjects -- not at preparing them to take tests. Hundreds of these software programs and hardware devices, ranging from Stanford University's "Teachable Agents," which paradoxically let students function as teachers in a variety of science modules, to Raspberry Pi's credit card-sized microprocessor, which helps children learn how to program computers, are showing up in elementary school classrooms around the country.

University language labs are going the way of typewriters, replaced by digital conversations and grammar lessons listenable on iPods and other mp3 gadgets.

Even college textbooks, such as *College Physics* and *Introduction to Sociology*, became available this year as part of a free open education platform called OpenStax College, a project of Rice University.

Online math and science courses also come free by way of the Khan Academy, Stanford University and MIT, among others.

A free iPad app by I.B.M. updates the "Minds of Mathematics" timeline it designed in the 1960s with Charles and Ray Eames, and adds a series of short animated films on a variety of mathematical concepts.

These learning tools -- the most expensive being Raspberry Pi's $35 microprocessor -- are only the sparks thrown off by a technology explosion that seeks to excite students about the practical applications of STEM education -- and to remind them that in the U.S., "it's not all about the test."

The curriculum in a math and science-focused educational system has not neglected reading -- largely because of No Child Left Behind testing requirements -- but educators say it should be about much more than basic literacy.

"We've gotten where we are today due to our applications of our math and science education," says Thomas Hammond, an assistant professor at Lehigh University, who has focused much of his research on the use of technology in social studies instruction. "Most of our big societal problems come out of our lack of social studies knowledge. For example, I wouldn't say we have a healthcare crisis on our hands because we have insufficiently well-trained doctors and researchers. We have a crisis of rising costs and access because we do not have a political system to effectively deal with it."

One worrisome trend, says Hammond, is the tendency by school districts to fold the social studies curriculum into another discipline, usually English. "The basis for this decision in one Pennsylvania school district is the drop in student test scores between fifth and sixth grade," he says. Hammond argues that emphasizing STEM opens up opportunities to study the history of industrialism and new technologies; the shift away from imperialism and the economic ascendance of the developing world, and the role of writers, such as Henry David Thoreau, William Dean Howells, Frank Norris, Ayn Rand, Arthur Miller and David Mamet in the critique or affirmation of American business principles.

"Educators have been saying for years that No Child Left Behind promoted a narrowing of the curriculum," says special assistant for STEM education Michael Lach. "The goal is to push for a well-rounded education that combines STEM and the humanities."

Business-education coalitions, such as the Business-Higher Education Forum and Change the Equation, insist that this well-rounded education can no longer mean an 8:00 a.m. - to - 3:00 p.m. day of silo-ed classes in math, science, English and history. When President Obama visited the College of Nanoscale Science and Engineering in Albany, New York, this May, he got a rundown of an undergraduate course list that consists of "Nanotechnology Survey," "Societal Impacts of Nanotechnology" and "Computer Control of Instrumentation," funded by some one hundred strategic partners, including Motorola, the U.S. Department of Energy, Georgia Institute of Technology, Syracuse University and Samsung.

Some of the most encouraging school reform efforts, where STEM is integrated into a broader curriculum including history and English, show up in high-poverty inner city neighborhoods. Students at MS 233, or the Laboratory School of Finance and Technology, in the South Bronx were seen as chronic low achievers until Teachers College doctoral candidate Ramon Gonzalez took over as principal and to some extent used Dr. James Comer's School Development

Program to re-create good cognitive and developmental experiences that students might not have gotten when they were infants and toddlers. A 2011 *New York Times* article about the school concluded that Gonzalez, an "empowered principal," achieved the academic and behavioral improvements in his school because he was able to "create his own curriculum, micromanage his students' days (within the narrow confines of the teachers' union contract, anyway) and spend his annual budget of $4 million on the personnel, programs and materials he deems most likely to help his kids." Since Gonzalez arrived at the school in 2003, student math proficiency rates rose from 13 to 60 percent and English proficiency rates from 10 to 30 percent. He believes these rates will improve further by adding a high school, and even a boarding school, onto the middle school.

California's Silicon Valley got in on school reform too when Rocketship Education, a non-profit elementary charter school network committed to eliminating the achievement gap between inner city and suburban schools, opened in 2007 with a reading center, a computer learning lab, specialist teachers for English, social studies, math and science, and enrichment programs in physical education, music and art.

DON'T SHOOT THE PIANO PLAYER

Is American education in need of reform? Yes -- but not because the whole system is broken. The separation of knowledge into distinct disciplines -- mathematics, chemistry, social studies, English -- might have made sense before the advent of predictive analytics, which depends on a deep understanding of statistics, data mining and customer need and whim, or before the study of economics required as much intimate knowledge of household buying habits, global warming, game theory and many other phenomena that have an impact on poverty and wealth. Speculating on who the next Steve Jobs might be, former high school teacher Tony Wagner wrote in a *Wall Street Journal* op-ed that the Google director of talent told him the "most important thing educators can do to prepare students for work in companies like hers is to teach them that problems can never be understood or solved in the context of a single academic discipline."

Indeed, says Lynn Columba, associate professor of education at Lehigh University, College of Education, the most effective STEM education will be cross-disciplinary. "Students learn math and science by making connections, and by integrating concepts and procedures," says Columba, author of *The Power of Picture Books in Teaching Math and Science: Grades PreK-8*. "Outside of school, we do not compartmentalize thinking as just math or science. Problems in the real world are always multi-dimensional -- historical, cultural, sociological, economical, political, technological and anthropological."

Restructuring education so that it looks more like an "interdisciplinary" high tech workplace must be high on the reform agenda.

Rethinking the obsession with international test rankings must be part of that agenda too. As Diane Ravitch and many others discovered in studying the effects of the Blueprint initiative, a school day full of reading and math drills is a joyless affair. The command and control management style imposed on the San Diego school district, and on the New York City District 2 system, did not result in any long-lasting or favorable educational outcomes -- and it's unlikely that a comparably punitive managerial style in the workplace would inspire the creative risk-taking that brought an Apple or an Amazon to life.

Finally, looking at American schools in isolation -- without acknowledging the impact of the current recession, the one trillion dollars in student loans, and especially the shifting labor and resource requirements of a behemoth we now call the globally integrated enterprise -- unreasonably asks schools to shoulder the burden of an educational system in need of sensitively wrought change. The many business-education partnerships throughout the U.S. attest to the anxiety that educators and business have over what the future holds for the American workforce. But it also expresses their determination to help us prepare for the best of what our idealized Springfield has to offer.

The changes American education is undergoing as it struggles to incorporate intelligent problem-solving and critical thinking into the curriculum will not come about over night. "This notion that we have to be poised and ready to continue learning in any way that we can means that the unknown future is not scary but rather exhilarating," says Change the Equation's Linda Rosen. It takes courage to look ahead and not know exactly what's coming, but keep learning just the same. It's the way we are -- and always were.