Achieving a New Generation of Common Science Standards

A Science Education eBook

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Preface

Why is it that the perception of science education in the U.S. (and other countries as well) is driven by rankings of students on international test scores ? Observers and critics suggest that American students might not be able to compete in the global market place given their scores and rankings on international tests.

> *Could it be that American students actually perform consistently and very well on these tests, and have actually improved over many years?*

At the same time, there has been a movement to create a common core standards in the United States, and to use these standards to develop national assessments to test the performance of students, and use these achievement results to evaluate the performance of teachers, administrators and schools. By means of the Common Core State Standards Initiative, a single organization is developing the standards that will be used in the states as the basis for their curriculum. According to Achieve, the organization developing the common core state standards:

> The standards are informed by the highest, most effective models from states across the country and countries around the world, and provide teachers and parents with a common understanding of what students are expected to learn. Consistent standards will provide appropriate benchmarks for all students, *regardless of where they live*. (emphasis mine)

Based on The Framework for K-12 Science Education published by the National Research Council, a new generation of science standards is under development and will be published next year. The new science standards will become part of the trend of common core standards, and it is expected that new science assessments will follow.

Twenty states will collaborate with Achieve, a standards writing organization that uses donated funds from large corporations and foundations to carry out its tasks. There is a lot of excitement, especially for the twenty state departments of education that will be selected to participate.

These two trends, the interpretations of students' scores on international and high-stakes tests, and the initiative to develop common core standards for all students, regardless of where they live, followed by common academic assessments are dominant forces affecting education in 2011.

In this eBook, we will explore these trends by presenting posts on these topics:

• The Race to the Top
• Frameworks and Standards
• Using Tests to Assess Performance
• Reform

Questions will be raised about why common standards, and misconceptions surrounding the use of international and high-stakes tests continue to be connected with the reform education in the United States.

We will look at the Framework for K-12 Science Education, and discuss the underlying purpose of using common standards in American schools. We will also examine the results of international tests such as PISA and TIMSS and question the interpretation of critics that these results show that the “sky is falling” or that we have on our hands another “Sputnik moment.”

Finally, in a letter to the President, I integrate the President’s personal views of education with the humanistic science paradigm as a way to reform education.

About the Author

Jack Hassard is Professor Emeritus of Science Education, Georgia State University. He is author of The Whole Cosmos Catalog of Science, Science Experiences, Adventures in Geology, The Art of Teaching Science (2009), Second Edition, Routledge, and most recently, Science As Inquiry (2011), 2nd Edition, Good Year Books. Specialties include science teaching & learning, global thinking & education, geology, web publishing, blogging, writing, and antiquing.

Part 1. Introduction

1.1. The Race To Write The Next Generation of Science Standards

There is another “race to the top” in education, but this time it’s the race to develop a new generation of science standards.

Twenty states will collaborate with Achieve, a standards writing organization that uses donated funds from large corporations and foundations to carry out its tasks.

There is a lot of excitement, especially for the twenty state departments of education that applied and were selected by Achieve.

The new standards will be based a recent publication of the National Research Council entitled, A Framework for K-12 Science Education.

It’s true that the current science standards are 15 years old, and it indeed might be good to write new ones, but not under the present environment. The underlying premise of the standards movement is to centralize and create a common set of standards within each content discipline.

Following the development of common science standards, national achievement tests will be developed and used to test the daylights out of kids.

By writing new standards, and writing rigorous tests we will ensure that our students will be competitive in the global market place, thereby making for a stronger economy. This sounds really good, but it’s not supported in the research literature.

International Benchmarking

International benchmarking is a concept in education in which high-performing education systems (nations) are analyzed in order to improve one’s own educational system. According to Achieve, the United States should look to countries such as Finland, Korea, Singapore, Canada, and Japan because these are high-performing countries on the PISA and TIMSS international tests. According to Achieve:

> International benchmarking is important from a national perspective to ensure our long-term economic competitiveness. Many feel it is necessary for American students to be held to the same academic expectations as students in other countries. The successes of other nations can provide potential guidance for decision-making in the United States (Achieve, 2011 Website)

Achieve, and other organizations such as the National Research Council claim that American students are unable to think critically, and are not prepared to pursue careers in science and technology. It is also assumed that the results of the PISA and TIMSS international tests suggest that American students perform poorly compared the nations mentioned above, and that the science curriculum, which according to these groups needs to be revamped, and in need of a new framework. It is also claimed that American science education lacks a common vision, and that in order to compete in the global economy, American students need to be exposed to a very different science education—one that has more depth, and enables students to do science.

We can agree that science curriculum should always be critically evaluated, and improved, and that the way science is taught ought to reflect research in the learning sciences. Research to improve the pedagogy of science teaching, and the integration of technology into science education should be high on the to do list of educators.

We can not agree however that American students are doing poorly in international tests. In fact, American students perform very consistently on these tests. What is not revealed when comparisons are made is how statistically insignificant the differences are between rankings, as well as the fact, that except for Canada, American schools are vastly more divergent, and the poverty level of the U.S. is the highest among these countries. The one factor that influences test scores the most is the poverty level in schools and communities.

Are American students not prepared adequately to compete in the global economy? More students are graduating each year, and this trend has continued for 30 years. Students take more math and science courses in high school, with most states requiring 3 to 4 years of science and math. American firms are still the leaders in innovation, and lead all countries in the number of patents awarded. Even during the economic downturn, several American companies actually produced their all-time highs in patent creation.

Are American students graduating from high school unable to compete in the global marketplace? Is the United State less competitive in the global marketplace, and if it is, is it the result of the math and science curricula and is the performance of American students on international tests an indicator of this? The evidence seems to support a positive image of American students' ability to compete.

For example, the factors that determine a nation's economic competitiveness are multifaceted and complex. Rankings on achievement test Scores (even on international tests) are minuscule compared to the real forces that the impact the robustness of any economy. It's time to stop holding teachers and students hostage to the claim that their test scores have an effect on the economy.

The U.S. economic competitiveness index, which is ranked number four out of 139 nation, is influenced by corporate ethics, the failure of the U.S. Congress to get it's financial house in order, the incentives to businesses to take risks and be innovative, not by achievement test scores.

The World Economic Forum assessed the economic competitiveness of 139 nations based on 12 major

factors including basic requirements (institutions, infrastructure, etc.), efficiency enhancers (higher education, good market, labor market, financial market, etc.) and innovation and sophistication factors (business sophistication, innovation).

New standards will have little effect on helping students understand science if we do not deal with poverty which effects more than 46 million Americans. The government released new statistics that show that poverty is growing, and the present state of the economy will only make it worse. Unfortunately, Achieve, and its supporters believe that a single and consistent set of common standards can be developed for all students, regardless of where they live. Apparently, they are blind to the specific needs of students living in the 15,000 different school districts in the United States.

The single most influential factor effecting student success in school is their socioeconomic status. Research in science education has repeatedly shown that the present science curriculum is a failure for many students. The new framework does not offer content much different than the work done 15 years ago.

Reform is needed, but in not in the form of raising the bar, creating rigorous standards, or creating standards that so far removed from the real lives of students and teachers.

Will this be race to nowhere?

1.2. Misconceptions about the Effect of International Math & Science Test Scores

Why is it that the perception of science education in the U.S. (and other countries as well) is driven by rankings of students on international test scores? The perception is that United States students are not competitive in the global market place as evidenced by their position in the rankings of the scores obtained on tests such as PISA and TIMSS.

Yet, as Iris C. Rotberg has shown in her analysis of educational reforms on a global scale, most of the conclusions that we make based on international studies are not supported either by the findings or by research in general.

Student Test Score Rankings & Global Competitiveness

For example, the most visible conclusion that is made from the international studies is that “test-score rankings are linked to a country’s economic competitiveness.” Rotberg uses data from the World Economic Forum’s 2010 – 2011 global-competitiveness report to show that student test score rankings do not correlate with a nation’s economic competitiveness. For examples on the 2009 Programme for International Student Assessment (PISA) U.S. students do not rank in the top 10 member countries in any of these areas: Maths, Sciences, and Reading. The United States ranked 30 in maths, 23 in sciences, and 17 in reading.

Yet, in 2011, the United States was in 5th place in the rankings of 139 countries global competitiveness (dropping from the number 4 position from the last year). The comparisons across countries are made using 12 pillars of competitiveness, including basic requirements (institutions, infrastructure, etc.), efficiency enhancers (higher education, good market, labor market, financial market, etc.) and innovation and sophistication factors (business sophistication, innovation). Countries that scored higher were Switzerland, Singapore, Sweden, and Finland.

> *If you examine the report, student achievement test scores are not factored into the 12 pillars of competitiveness.*

What is making the United States less competitive, according to the report? Could it be the way math or science is taught in our schools? Could it be that are teachers are not competent to teach math or science?

The major factors identified in World Economic Forum analysis identifies as contributing to making the U.S. less competitive (i.e., dropping from 4nd to 5th) are really not surprising. The evaluation of institutions, the fact that the public does not trust politicians, and that the business community is concerned about government interference with business are three for starters.

Here are some more: the business community thinks the government spends its money too freely. There is also increasing concern about the nature of the auditing of private companies, as well as the downward trend of business ethics. And one of the major factors causing the United States to become less competitive is the "burgeoning levels of public indebtedness. The debt ceiling fiasco that we all witnessed in Washington led the United States losing its prized AAA credit rating from S&P.

Perhaps this factor is impacting the United States economic competitiveness more than anything else:

> Over the past decade, the country has been running repeated fiscal deficits, leading to burgeoning levels of public indebtedness that are likely to weigh heavily on the country's future growth. (Source: The Global Competitiveness Report, 2011-2012)

Iris Rotberg concludes that continuing to use student test scores is not a valid argument to understand a nation's competitiveness.

A nation's competitiveness is too complicated, and is impacted by other variables as identified above, and put rather nicely by Rotberg as follows:

Other variables, such as outsourcing to gain access to lower-wage employees, the climate and incentives for innovation, tax rates, health-care and retirement costs, the extent of government subsidies or partnerships, protectionism, intellectual-property enforcement, natural resources, and exchange rates overwhelm mathematics and science scores in predicting economic competitiveness.

> *Iris Rotberg concludes that continuing to use student test scores is not a valid argument to understand a nation's competitiveness.*

Taking the Lead

One of the outcomes of reading the international test reports is that corporate leaders, politicians, and influential policy makers continue the cry that U.S. education is lacking in math and science, and that our place in the world of economic prosperity is being challenged. There is no evidence to support this other than to say that the forces identified above are contributing to challenge America's prosperity.

For example, for the past year or so, the Carnegie Foundation funded and will continue to fund a process that will lead to a new generation of science standards. In the Summer of 2011, the National Research Council announced the publication of A Framework for K-12 Science Education which will be used by Achieve, Inc., to write a new set of science standards, K-12 to be published in 2012 or 2013. Achieve, which also wrote the Common Core Standards in math and reading/language arts, has begun the process, which involves cooperation with the AAAS, and NSTA. In one of their documents, which was a report on the analysis of ten countries' science standards, International Benchmarking Report in Science , Achieve had this to say about the relationship between the new standards, and the United States position in the world:

> Conditions are right for the United States to take the lead internationally in forging a new conceptual framework for science, and next generation science standards. The NRC framework and aligned science standards will create a fresh vision for science education and new directions for teaching, learning, and assessment that could contribute significantly to improving student understanding and achievement. Seizing the opportunity that this moment presents will bring us a step closer to moving the United States into the vanguard of international science education reform.

I found it interesting that the report did not include the United States as one of the ten countries to analyze. Looking at the various tables, and criteria, the U.S. would have been one of the highest ranked countries in terms of its 1996 National Science Education Standards.

So, you might wonder what is the problem with a new conceptual framework, a fresh vision for science education. Actually, this process might be valuable if it were tied directly to curriculum development and teacher education. However, the problem is that need for new standards is based on false premises, as explained earlier.

The new standards will be part of a continuing effort to reform science education along the lines of NCLB Act in which achievement test scores are used as the marker for measuring what students have learned in schools, and how well teachers and schools are performing. The standardization of the science curriculum seems to me to be the antithesis of innovation, which is one of the 12 pillars used to assess the competitiveness of a nation's economic system.

Science teaching has much to offer society, especially when science teachers embrace innovation, creativity, and inquiry as the core to their teaching approaches.

Continuing to use data in meaningless and unsupportable ways to achieve ends of a few corporate leaders, and policy makers is not in the best interest of American science education.

The Lens of Poverty

A report this week indicated that the poverty rates in the U.S. had increased and that one out of six Americans lives in poverty (46.2 million people). The poverty rates among African-Americans and Hispanics, 27.4 and 26.6, respectively, are more than double that of whites, which is 9.9 percent.

According to separate research analyses by Rotberg, and Tirozzi, the examination of international (or national) test results through the lens of poverty uncovers quite a different picture. Each researcher has reported that poverty and concentrations of poverty have adverse effects in schools on student performance (in all countries).

For example on PISA test results socioeconomic status accounts for more than 80 of the difference in performance. Tirozzi, using free or reduced lunch data as a marker of poverty, found that the U.S. has the largest number of students living in poverty (21.7), and that the only other nations (taking part in PISA) that had poverty levels close to the United States were the U.K, and New Zealand. U.S. schools with less than 10% poverty rank one in the world, those with 10 – 25% poverty rank third, behind Korea and Finland, and U.S. schools with 25 – 50% poverty are tenth in the world.

The recent cheating scandal in the Atlanta Public Schools an unfortunate example of what happens when education becomes deterministic based on a set of policies that drive schools and systems to "create a culture of fear" to make sure that schools meet accountability standards that are not based on supporting documentation or research.

There are many misconceptions surrounding the use of achievement test results in making claims about the quality of science education.

Suggested Readings:

Pisa Test Results Through the Lens of Poverty, Art of Teaching Science Weblog

International Test Scores, Irrelevant Policies by Iris C. Rotberg, Education Week, September 13, 2011

Balancing Change and Tradition in Global Education Reform by Iris C. Rotberg, et.al.

The Competitiveness Report 2010-2011, World Economic Forum

The Economics Behind International Education Rankings, Cynthia McCabe

Next Generation Science Standards

Part 2. Race to the Top
2.1. The Race to the Top: Some Thoughts

Note: Since I wrote this post, the U.S. Department of Education awarded Race to the Top Funds to eleven states. I've left this post as I wrote it.

The U.S. Department of Education received about $100 billion ($100,000,000,000) from the American Recovery and Reinvestment Act. It's an enormous amount of money that is going to be awarded to winning States. $4.35 billion has been earmarked as The Race to the Top fund, and it is that part of the Department's program that I will focus on here.

If the money were distributed equally across the country, it would amount to a little more than $13.33 per citizen. It would mean that the state of California would get slightly more than 10% of the money, or $489,333,333 (I consulted a website that provided population figures for all the states and multiplied by $13.33). Wyoming would receive the least coming in at slightly more than $7 million. But, of course, the money will not be distributed in this way. Each state must submit a proposal (first round was December; second round next Spring), and they must, in the proposal, agree to the criteria that the U.S. Department of Education has established.

Although the Request for Proposals (RFP) for the Race is still not available to the States, the Department published details of the Race Fund in the Federal Register (Notice of Proposed Priorities). I read it, and have summarized the priorities that will in effect how the various States prepare their proposals. By the way, the proposal must be submitted by the Governor of the State, and signed off by the Governor, the State's chief school officer, and the president of the State board of education.

Criteria for Race to the Top Fund

Of the long list of criteria, only two are absolute musts for a state proposal:

- States must have been approved by the Education Department for stabilization funds from the American Recovery and Reinvestment Act (most already have been)
- States must not have any laws in place barring the use of student-achievement data for evaluating teachers and principals. Note: A number of states changed the law in their state to qualify on these criteria.

The fundamental aim of the *Race to the Top Fund* is to ensure that states, which receive funds, take a systematic approach to educational reform. Specifically, as stated in the Federal Register (July 29, 2009), to receive funding, the applicant state must meet this priority:

The State's application must describe how the State and participating LEAs intend to use Race to the Top and other funds to implement comprehensive and coherent policies and practices in the four education reform

areas, and how these are designed to increase student achievement, and reduce the achievement gap across student subgroups (Priority 1).

Other priorities will be considered as proposals are evaluated. But according to the Department's documents, only the first priority (described above) will be required. The others, which follow, will enable the various states to develop proposals unique to their goals for reform. Here they are:

- Priority 2: Emphasis on science, technology, engineering, and mathematics (STEM). This should include the offering of *rigorous* (emphasis mine) course of study in STEM; collaboration among experts in museums, universities, research centers, and other STEM-related partners.
- Priority 3. Expansion and adaptation of statewide longitudinal data systems. The Department asks how the State plans to expand statewide longitudinal data systems to include or integrate data from special education programs, limited English proficiency programs, early childhood programs, human resources, finance, health, postsecondary, and other relevant areas, with the purpose of allowing important questions related to policy or practice to be asked and answered.
- Priority 4. Coordination and vertical alignment. In essence, this priority is to ensure that students exiting one level are prepared for success, without remediation, in the next.
- Priority 5. School-level conditions for reform and innovation. This priority is designed to encourage flexibility and innovation in selecting staff, implementing new daily schedules, awarding course credit to students on student performance, & providing comprehensive services to high-need students.

Student Assessment Funds

You will find a good summary in Education Week of how the Race to the Top will stress the use of test data to determine the effectiveness of any proposal or program at the State and LEA level. In fact, there is a separate competition for $350 million of the Race to the Top Fund money to stimulate a movement to develop "common student assessments." As I mentioned in another post, these "common students assessments" will be linked to the development of "common-standards." Forty-eight states have signed on to this movement.

Clearly, there is a lot of money available for education. But as you look closely at the details, it is evident that national tests, based on a set of common academic standards, will be used to establish the bar used to measure any program or project, and will be used to tie student achievement to teacher and school performance. Trying to link student achievement to teacher effectiveness and salary has always raised a red flag for me. I wrote about this in an earlier post (Is student achievement the measure of teacher effectiveness) in March, and called into question how student achievement data can be used as the measure of teacher effectiveness. Somehow, is should only be a part of the evaluation process. Surely, there is more to school learning than achievement test results.

Nevertheless, the *Race to the Top* is here, and will be implemented. What are some of your opinions about the Race Fund? What race are we talking about here? Is this a reformulation of No Child Left Behind? Instead of not leaving anyone behind, we'll all race forward? What do you think?

2.2. The Race to the Top: Hold on, there!

The Race to the Top program has captured my attention, especially in how the Department of Education will use these funds to reform education. As with large-scale efforts such as this one, achievement testing has become a central aspect of any program, projects, or effort suggested at the State or Local Education Agency (LEA).

One of the core concepts is that the Department wants to use student achievement test scores and results to evaluate the effectiveness of individual teachers, administrators and schools. Aside from irking most teachers around the country, the idea is not supported with scientific research.

Rick Biche, commented on a recent post, and pointed me to a "letter" written by the Board on Testing and Assessment (BOTA) of the National Research Council.

Now, the letter in question is this. It is entitled Letter Report to the U.S. Department of Education on the Race to the Top Fund, and as I said was authored by a committee of the Board on Testing and Assessment. It's important to keep in mind that the purpose of BOTA is raise questions about, and provide the guidance for judging the technical qualities of tests and assessments and intended and unintended consequences of their use.

The letter will not make the top administrators of The Race to the Top Fund happy.

The Race to the Top Fund will require that the States use achievement tests to measure "growth" of students, and use this kind of data to assess teacher performance. As most of us would agree, tests do play an important role in evaluating programs, innovations, and projects, but as the BOTA report says, an adequate evaluation calls for more than tests alone. In fact, most evaluations "collect data" throughout the course of a project or, in this case an entire course taught by an individual teacher. These evaluations would include both qualitative and quantitative data. The Race to the Top administrators want to use a single sit-down test as a measure of student academic performance, and within 72 hours, provide the feedback necessary to evaluate the teacher, administrator, or school.

In this approach, the Department is trying to use a test as a way to isolate the performance impact of teachers, and administrators. Here is what the BOTA letter says about this idea:

> Prominent testing expert Robert Linn concluded in his workshop paper: "As with any effort to isolate causal effects from observational data when random assignment is not feasible, there are reasons to question the ability of value-added methods to achieve the goal of determining the value added by a particular teacher, school, or educational program" (Linn, 2008, p. 3). Teachers are not assigned randomly to schools, and students are not assigned randomly to teachers. Without a way to account

> for important unobservable differences across students, VAM techniques fail to control fully for those differences and are therefore unable to provide objective comparisons between teachers who work with different populations. As a result, value-added scores that are attributed to a teacher or principal may be affected by other factors, such as *student motivation and parental support*.

The BOTA letter also raises issues about using large scale, high-stakes, and summative tests as a way to provide feedback on teaching and learning. To wit:

> Tests that mimic the structure of large-scale, high-stakes, summative tests, which lightly sample broad domains of content taught over an extended period of time, are unlikely to provide the kind of fine-grained, diagnostic information that teachers need to guide their day-to-day instructional decisions. In addition, an attempt to use such tests to guide instruction encourages a narrow focus on the skills used in a particular test—"teaching to the test"—that can severely restrict instruction. Some topics and types of performance are more difficult to assess with large-scale, high-stakes, summative tests, including the kind of extended reasoning and problem-solving tasks that show that a student is able to apply concepts from a domain in a meaningful way. The use of high-stakes tests already leads to concerns about narrowing the curriculum towards the knowledge and skills that are easy to assess on such tests; it is critical that the choice of assessments for use in instructional improvement systems not reinforce the same kind of narrowing.

And finally, BOTA also raised questions about the feasibility and soundness of using "common assessments" to make assessments across states in the same way that NAEP currently does. As pointed out in the letter, there simply are too many variables that never can be controlled to allow administrators to make comparisons across states, and I would add across school districts, within a state. And one other point here is that the US Department of Education wants to pursue assessments to incorporate "international benchmarking." In another section, I'll show how international tests should not be used as benchmarks.

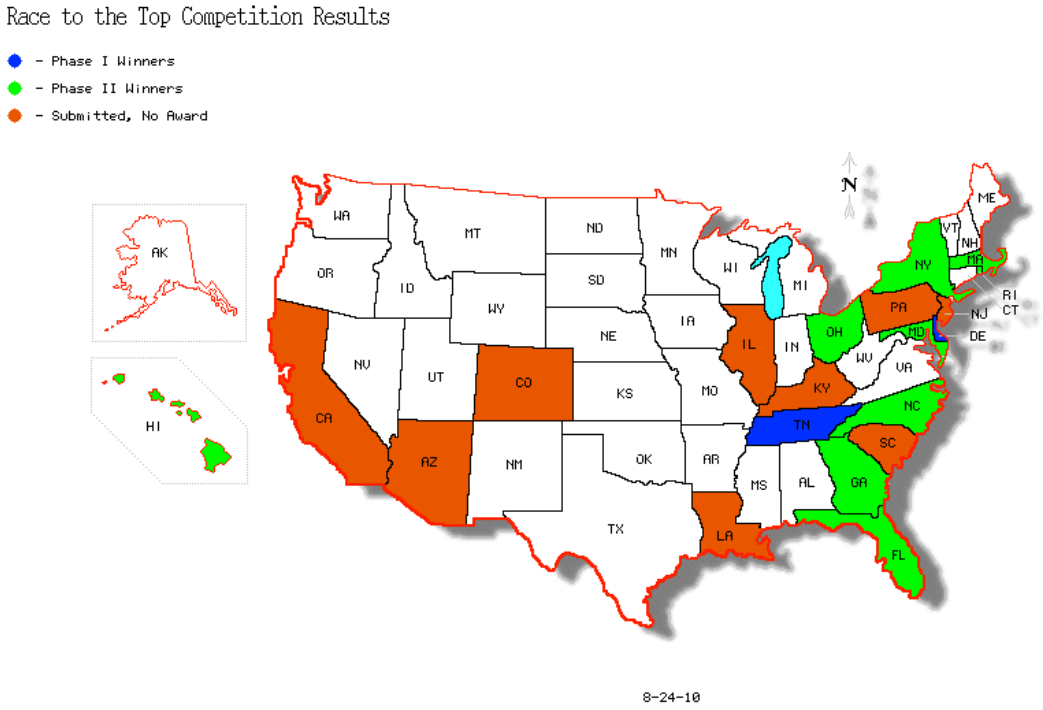
Well, what do you think about this? Do you think the US Department of Education will listen to the comments made by the Board of Testing and Assessment of the National Research Council? I hope they do. But I am not holding my breath. What do you think?

Note: Of course we know that the Race to the Top Funds have been distributed, and the letter sent by BOTA had no effect on the criteria, or on the final funded proposals.

2.3. Race to the Top Winners

Today, the U.S. Department of Education announced the Round Two winners in the competition for $4.5 billion in the Race to the Top Fund. If you recall, Delaware and Tennessee were the only states to receive funding in Phase I of the competition. Now, 9 states and the District of Columbia schools were selected as winners of millions of dollars in grant funds in the Phase II competition. There were 9 other states that were in the running for funds, but were not selected to receive funds. These states included: Arizona, California, Colorado, Illinois, Kentucky, Louisiana, New Jersey, Pennsylvania, and South Carolina.

Here is a map identifying the states that are receiving Race to the Top Funds. Interestingly the states that did receive funds are Eastern and Southern states.



The ten winners will receive grants ranging from $75 to $700 million as follows:

• District of Columbia: $75 million. Score: 450.0

• Florida: $700 million. Score: 452.4

• Georgia: $400 million. Score: 446.4

• Hawaii: $75 million. Score: 462.4

• Maryland: $250 million. Score: 450.0

• Massachusetts: $250 million. Score: 471.0

• New York: $700 million. Score: 464.8

• North Carolina: $400 million. Score: 441.6

• Ohio: $400 million. Score: 440.8

• Rhode Island: $75 million. Score: 451.2

The proposals from the States were required to advance reforms around four specific areas:

- Adopting standards and assessments that prepare students to succeed in college and the workplace and to compete in the global economy.
- Building data systems that measure student growth and success, and inform teachers and principals about how they can improve instruction.
- Recruiting, developing, rewarding, and retaining effective teachers and principals, especially where they are needed most.
- Turning around our lowest-achieving schools.

According to Washington, D.C., Superintendent Rhee, one of the winning applicants, its plan is to use the grant money for school turnaround, alignment of curricula to the new “common core” standards, and expansion of the new IMPACT teacher evaluation system. The funds would also go toward improving teacher professional development, especially in the area of using data to drive instruction. (Rhee recently resigned her post as Superintendent).

For many teachers, the top down proclamations implicit in the Race to the Top proposals, make the program suspect. But more importantly is the movement toward standardization through the acceptance of these states to the common core standards in math and literacy, and amazingly brazen over reliance on high stakes tests to determine the academic levels of students, determine teacher pay raises, and assess the performance of each school.

Carolyn Grannan, writing in the San Francisco Examiner, reports how Richard Rothstein of the Economic Policy Institute assesses the weakness of the Race to the Top through its use of testing, its narrowing of the curriculum to a focus on math and reading to the exclusion of everything else, its forcing states to allow more charter schools while ignoring the research giving no credence to that approach.

The state of Georgia, where I reside, was also one of the winners in the Race to the Top Fund. I’ll be reporting now and then on this state’s efforts to improve education through its Race to the Top proposal.

Part 3. Frameworks & Standards

3.1. Eight Reasons to Study the New Framework for Science Education

A Framework for K-12 Science Education was published this summer by the National Research Council. The document is being used by Achieve, Inc., to write a new generation of science standards. This part of the eBook includes 8 posts that were written about these efforts.

Have you seen the draft version of the new Conceptual Framework for K – 12 Science Education? The final, and published version will be announced on Tuesday, July 19 in Washington D.C. by the National Academy of Sciences. A committee of scientists, and teams of scientists and educators designed the Framework during the past two years. It will be an important document for at least the next 15 – 20 years, as the National Science Education Standards were for the past 15 years. Here are some reasons why it will be important.

1. **Credibility**. It was developed by a cadre of scientists, who constituted the committee, and by four design teams led by science educators and scientists with vast experiences at university and K-12 levels. It was organized by and will be published by the National Academy of Sciences. The Carnegie Foundation provided funding for this project.
2. **Attempt to Reduce Content to Core Ideas**. Science educators have sought ways to reduce the shear amount of content is contained in contemporary textbooks. Indeed, the 1996 Science Education Standards did not reduce content, but contributed to the expansion of concepts and ideas in science. The Framework authors, according to the Draft Version have attempted to move toward a more coherent vision by focusing on a limited number of core ideas in Earth, Life, Physical and Engineering & Technology.
3. **Research Oriented**. The new Framework will also build on the notion that students learn progressively in a developmental way. Basing their thinking on research in the learning sciences, you will see “learning progressions” as a key feature of the Framework.
4. **Basis for New Science Standards.** The Framework will be the guiding conceptual basis for a new set of Science Education Standards that will be developed Achieve, Inc. As with the Framework’s development, the NSTA and AAAS will be involved. However, the actual writing of the Science Standards will be done by Achieve, the same company that designed and wrote the Common Core Standards.
5. **New Curriculum Projects and Textbooks.** The combination of a New Framework and the subsequent writing of new Science Education Standards will no doubt lead to the development of new curriculum projects, and creation of new textbooks in science.
6. **Funding and Research**. The new Framework will influence science education researchers as they write proposals for funding from local, state and federal agencies. Research projects at Universities will also be influenced in terms of rationale and objectives. The NSES had a similar influence.
7. **High-Stakes Assessments**. Unfortunately, there is a national movement to continue and solidify the nation’s propensity for using standards to design assessments that are used as high-stakes markers to determine the achievement of students in school science, and now, unfortunately to use them as one influential factor in evaluation teacher and school effectiveness.

8. **Concerns about who is funding these efforts**. The movement, known as the Common Core Standards is funding that a very elite group of wealthy individuals and corporations, with little or no accountability. For example, if you visit the Achieve, Inc. website, you will that the following groups are funding them: The Battelle Foundation • Bill & Melinda Gates Foundation • The Boeing Company • Brookhill Foundation • Carnegie Corp. of New York • The GE Foundation • IBM Corp. • Intel Foundation • JP Morgan Chase Foundation • Lumina • Nationwide • Noyce Foundation • The Prudential Foundation • State Farm Insurance Companies • Washington Mutual Foundation • The William and Flora Hewlett Foundation

These are only eight reasons why you and I should study and become aware of the new Framework. Is there a movement to standardize education? Why do we continue these efforts when the effectiveness of "standards" in affecting student achievement is marginal?

3.2. Five Attributes of the Framework for K-12 Science Education

According to the committee that drafted and wrote the final edition of the Framework for K-12 Science Education, American science education needs a complete overhaul, currently lacks vision, and does not prepare students for a scientifically and technologically-based society.

Helen Quinn, Chair of the National Research Council's Conceptual Framework for K – 12 Science Education Committee had this to say about the state of science education in the USA:

> Currently, science education in the U.S. lacks a common vision of what students should know and be able to do by the end of high school, curricula too often emphasize breadth over depth, and students are rarely given the opportunity to experience how science is actually done.

Truth be told, this same argument was set forth in the late 1980s when the AAAS created Project 2061, Benchmarks for Science Literacy, which led to the creation of the National Science Education Standards (NSES). And these standards have become the benchmark for the state departments of education to develop their own standards in science.

The Framework for K-12 Science Education: Practices, Crosscutting Concepts and Core Ideas, according to the NRC committee, provides a blueprint for K-12 science education, and will lead to the development of a new set of science education standards.

What are some of the attributes of this new framework? Here are just 5 attributes, and of course I could identify many more. But I hope this will get you started exploring this new document.

1. **Dimensions.** It's a book length report, spanning 280 pages. It contains 13 chapters, divided into three sections: Section I: A Vision for K-12 Science Education; Part II: Dimensions of the Framework; Part III: Realizing the Vision. You can download a PDF file of the entire book for free here.

2. **Vision for K-12 Science Education**. According to the report, "The framework is designed to help realize a vision for education in the sciences and engineering in which students, over multiple years of school, actively engage in science and engineering practices and apply crosscutting concepts to deepen their understanding of the core ideas in these fields." Two reasons are given for writing a new Framework. The first is that it's been 15 years since we wrote the last set of standards (NSES). The second is that science education community has the opportunity to use the momentum of Common State Core Standards movement. In fact, Achieve, Inc., to write the new science standards, will use the Framework. Achieve wrote the reading/language art and math Common Core State Standards.

The vision is stated in terms of "by the end of the 12th grade, students should have gained sufficient knowledge of the practices, crosscutting ideas and core ideas to be able to." This is language similar to the way in which standards are presented in the NSES, and in most state science standards.

The vision of the new Framework, according to the Committee, is based on the earlier documents including the NSES 1996 standards, AAAS Benchmarks, the Science Framework for the NAEP, and Science College Board Standards for College Success.

3. **Practices**. This is the first of three major dimensions of the Framework (the other two follow in items 4 and 5 below). The Committee chose the term "practices" (as in scientific and engineering practices) to get us away from the notion that there is one scientific method. The Committee believes that students should learn how scientists and engineers do their work, and thus should be involved in the practices of science and engineering. You will find the "practices" very familiar because they are a list of science processes that emerged decades ago with the science reform era of the 1960s. The committee identified these as scientific and engineering practices that students should learn:

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics, information and computer technology, and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

There is also a lengthy discussion of how science and engineering differ, as well as how the "practices" of science and engineering are different from each other.

4. **Crosscutting Concepts**. The committee defines "crosscutting concepts" as concepts that bridge

disciplinary boundaries, having explanatory value throughout much of science and engineering. Examples of crosscutting concepts will be very familiar to you. Some include patterns, cause and effect, and stability and change. As stated in the report, the committee acknowledged that crosscutting ideas were no different than earlier reports' usage of terms like unifying concepts or common themes. Each crosscutting concept is explained in detail, and you can read about them in the report here. The complete list of crosscutting concepts include:

- Patterns
- Cause and effect
- Scale, proportion, and quantity
- Systems and system models
- Energy and matter
- Structure and function
- Stability and change

5. **Core Ideas.** Now we are getting to the heart of the Framework, the *core ideas*. The Committee wanted to focus on a limited number of ideas and the Framework organizes the science & engineering curriculum into four core areas with just a few core ideas identified in each area: Physical Science, Earth and Space Science (which the committee thinks is a new area of the science curriculum!), Life Science, and Engineering, Technology and Applications of Science (ETAS). ETAS is an area new to the science standards, although some of you might argue that STS, and Context-Based Teaching explored some of the ideas in this part of the Framework. Unfortunately, there is little integration of ideas, that is to say, wouldn't have been possible to integrate ETAS into each of the three content areas of Physical, Life and Earth/Space science?

Within each area, the Committee, through the work of separate design teams for each content area, identified just a few core ideas—three or four core ideas that the committee felt underscored the essence of that particular content area.

The report identifies the core ideas as shown in example taken from the Physical Science content area:

CORE IDEA PS1: MATTER AND ITS INTERACTIONS
How can one explain the structure, properties, and interactions of matter?

So, the first Core Idea in the physical sciences is "matter and its interactions" followed by a core question. Interestingly, the committee identified two fundamental questions for the physical sciences, which included: "What is everything made of?" and "Why do things happen?"

The committee then identifies "grade band endpoints for each content area at these grade level points: grade 2, grade 5, grade 8, and grade 12. These are quite specific paragraphs of what students should know about the core idea at these points along the students' school experience.

Each of the content areas of Life science, Earth/Space science, Engineering is detailed in the same manner as

the physical sciences.

I've identified for you only 5 attributes of the new Framework. There are many more, but I hope that these help you explore the Framework, from the standpoint of its strengths and weaknesses. Let us know what you think.

3.3. Five Criticisms of the Framework for K-12 Science Education

The standards devote insufficient attention to the need for an interdisciplinary curriculum, and represent a contracted view of the "common core" that disregards the role of schools in preparing students for citizenship. William G. Wraga, Professor, University of Georgia as quoted in Education Week

You probably know that the National Research Council has published A Framework for K – 12 Science Education: Practices, Cross-Cutting Ideas and Core Ideas. The Committee on a Conceptual Framework issued the report for K – 12 Science Education Standards.

As Dr. Wraga wrote, the standards, especially the Common Core Standards, lack any attention to interdisciplinary curriculum and it is his judgment that this has resulted from the "discipline myopia" that characterizes the Standards (in any field of study).

How does the Framework for K – 12 Science Education fare? There are several criticisms that I identify here, and ask you to think about your own professional work, and what you think of these criticisms.

1. **Composition of Committee and Design Teams**. You will probably agree that a committee that is going to create a framework for K – 12 science education ought to be comprised of a mix of individuals from academia, research organizations and K – 12 schools. An examination of the report shows that there were 19 individuals on the Conceptual Committee, and 19 people on the four design teams. There were no K – 12 educators on the Conceptual Committee. There were two persons listed of the 19 design team members who worked in either a state department of education or a school district. But there were no science teachers listed in the report. This is a serious problem in my opinion because it sends the message that K – 12 science educators are either not capable or not interested in serving on such boards, and committees.

2. **Discipline Myopia**. Using Dr. Wraga's terminology, you can see that I am extending this criticism to the Framework for K – 12 Science Education. The Framework promotes four disciplinary content areas, Life science, Earth/Space Science, Physical Science, and Engineering and Technology. As a result, the curriculum that is implied from the Framework is overly discipline oriented, and except for the addition of the area entitled Engineering and Technology, is no different

than the 1996 National Science Education Standards. Even in elementary and middle school, there is little attempt of interrelate the content of science. Interdisciplinary science is not a structure in the Framework.

3. **Student as Outsider**. This might seem overly critical, but the Framework is written from the standpoint of the discipline of science, and very little attention is placed on students, their communities, and environment. The content is seen as out there to be learned, rather than putting the context of learning at the center of the Framework. Much of the work in environmental education, STS, science and social issues is put on the periphery of the Framework.

4. **What about the Content?** One reader had this to say about the content in the life science section of the Framework: *"That section is certainly improved, but still reads as if written by individuals with only a superficial background in biology. In the evolution section, natural selection is still ill defined and treated as the only mechanism for change. In the information processing section, animals are apparently the only organisms that can sense and respond to their environment."* Although Dr. Fugate is questioning the nature of the content, because there were no science teachers on any of the panels, we can question the relevancy as it relates to K – 12 students. Or at least we can raise questions.

5. **Pipeline Mentality**. The Framework underscores the domination of curriculum by a pipeline mentality, and disregards the more important notion of preparing citizens to live in a changing world. Very few students will go on to careers in science or engineering, and as you read this report, you'd think that this is still the major goal for teaching science in our schools.

What do you think about the new Framework? What other criticisms would you name? Let us know what you think.

3.4. Some Problems with the New Framework for K-12 Science Education by the NAS

Why is there little criticism of the Framework for K-12 Science Education, which was released by the National Academy of Science (NAS) this year?

The organizing committee of the NAS worked for more than a year to develop a new framework for the teaching of K-12 science education. It was released to the public on the NAS website and you can download it free here.

As a science educator you probably are familiar with the 1990s publications AAAS Benchmarks for Science Literacy, and NRC National Science Education Standards, both of which preceded the new framework announced this week. The new Framework for K-12 Science Education will lead to a new set of science

standards which will be written and published by 2012, and they essentially will replace the Benchmarks and the NSES. The new standards for science will be written by Achieve, Inc., a Washington-based non-profit company that is funded by large corporations and foundations. Achieve will hire consultants to write the standards that then will in some way to tied into the Common Core State Standards in Reading and Mathematics which most states required be used in formulating state standards, and will be used to generate high-stakes achievement tests.

Why is there no criticism of the new Framework? If you read some of the press releases and articles that were written for newspapers and e-news sites, the writers tell us that science education needs a complete overhaul, and that the present science curriculum does not prepare students for STEM careers. You'd think the sky is falling!

There is little criticism of the new Framework because it is not in the best interests of many science educators and science teachers to upset or question such a prestigious group selected by one of the most important science organizations, the National Academy of Science. There is little criticism because if you are a science education researcher it might have negative effects on future funding possibilities from government and non-government sources. If you are a science teacher, the culture of schools today does not support critique or questioning of standards reform, or anything remotely connected to the Common Core State Standards movement.

These are general and overarching criticisms. There are deeper, and serious issues with the report. In the next post I am going to explore specific areas of the new Framework that are wanting, and how the developers created a document that is sterile, and lacks the messiness that teaching science turns out to be.

What do you think of the new Framework? If you have not seen the Framework, follow this link, and download the PDF file for free. Take a look at your area of expertise, and ask yourself if this is the kind of "content" that all students need to know? Tell us what you think.

3.5. Why does the framework for a "new generation" of science standards need to be revised?

Last month in a blog post, I raised questions about the new framework for a new generation of science standards, funded by the Carnegie Corporation, and developed by the National Research Council. In particular I looked at the scant criticism that exists in the literature of the current science standards (NSES).

Equity

In that post I called attention to a 1998 issue of the *Journal of Research in Science Teaching*, in which professor Alberto J. Rodriquez published a critical review essay in which he argues that the NRC's 1996 Science Standards uses a discourse of invisibility to lay out its massive reform for science education. He

claims that the standards do not directly address the ethnic, socioeconomic, gender, and theoretical issues that influence learning in contemporary American schools. Rodriquez goes further to suggest that equity must be a guiding principle in science education, and the standards should reflect this same principle.

The new framework was published last month and educators had an opportunity to complete a form that was used to provide “feedback” to the framework’s developers. The 190 page report entitled “A Framework for Science Education: Preliminary Public Draft” outlines a framework by the Committee on Conceptual Framework for New Science Education Standards.

Disciplinary Myopia

In an article in Education Week, Professor William Wraga, identifies “dangerous blind spots in the common-core standards.” In particular Dr. Wraga is critical of the common-core standards lack of attention to interdisciplinary curriculum, and the role of schools in preparing students for citizenship. In the latter he suggests that “disciplinary myopia” has led to standards that are overly technical and steeped in discipline concepts, processes and practice. He suggests, and we would agree, that interdisciplinary curriculum could lead to greater understanding by seeking connections among the disciplines. S-T-S, science-related social issues, and a lived curriculum ought to be starting points for a science curriculum; unfortunately this is not the case in the new science framework.

Servicing Economic Interests

Wraga also focuses in on the unfortunate single purpose of schooling as depicted in the common standards, and that is that education should be in the service of economic interests. We see this in news reports each Spring when test scores are released which typically lead to “a sky is falling” mentality amongst chief school officers, governors, and other politicians. Repeated attention to international test results leads to unfounded comparisons among countries. Wraga sees this as a narrow function of schooling, and wonders why vocational, social, civic, cultural, and individual goals give way to a single goal, which he identifies as the academic goal.

The same criticisms can be leveled at the framework for science education in that NRC’s Framework is steeped in a disciplinary approach to content. In fact, the word “interdisciplinary” is found only twice in the framework, and one of these was part of one of the committee member’s biography. The science framework is neatly organized into four traditional content areas: life, earth, and physical science, as well as engineering and technology. The framework does identify crosscutting ideas, but this is not at all what science educators would view as anything remotely close to interdisciplinary curriculum.

Reform

For over a century, science reform efforts have been put forth in a variety of ways perhaps beginning with the Committee of Ten report in 1895, which set us on the path of disciplined approach to curriculum. Although progressive ideas were part of reform, for example Dewey’s laboratory school at the University of Chicago,

Jackman's Nature Study Movement (c. 1910), and the Progressive Education Movement (c. 1930s), the traditional school, and its focus on academics and basics dominated educational reform.

The goals of science education were articulated through successive NSSE yearbook publications in 1932 (A Program for Science Teaching), 1947 (Science Education and American Schools), and 1960 (Rethinking Science Education); the "golden age" NSF alphabet curriculum projects of the 1960s and 1970s; at the behest of hundreds of national reports starting with the 1983 "A Nation at Risk" claiming that schooling should instill global competitiveness amongst our students; The AAAS Project 2061 benchmarks for science literacy; the 1994 National Science Education Standards; the implementation of state-wide standards and high stakes tests for student, teacher, and school performance accountability; the acceptance by 48 states of common standards in literacy & mathematics; and now the coming of a new generation of science standards.

Does the new framework offer a new set of goals for science education, and do these goals reflect the nature of K-12 science teaching? Although the framework offers "a less is more lesson" by limiting the number of "core ideas" in each of the four content area, the framework is linear, and there is no upfront conviction that science in the real world is interdisciplinary, nor are there examples. True, the framework has a chapter on crosscutting elements including crosscutting concepts such as patterns, cause and effect, scale, stability (the science processes of earlier reform efforts). It also discusses the importance of topics in engineering, technology and science, but these ideas are not integrated into the actual framework. They appear as of secondary importance.

The framework was not developed by K-12 teachers, or science educators, each possessing not only the content knowledge to develop a framework, but bring to the table the professional experience of working with K-12 students, the actual nature of classroom life, and anecdotal evidence & research so important to an understanding of 21st Century school. I am not suggesting that professional scientists should not be involved in the development of the framework. I am suggesting that teachers and science educators should be at the core or center of this development, not on the outside looking in.

Rodriguez, A. (1997). The dangerous discourse of invisibility: A critique of the National Research Council's national science education standards *Journal of Research in Science Teaching, 34* (1), 19-37
DOI: 10.1002/(SICI)1098-2736(199701)34:13.0.CO;2-R

3.6. The Real Meaning of Standards: Rigor, Shock, Stacking Up, Raising the Bar!

There was an article in today's Atlanta Journal/Constitution newspaper by Maureen Downey, a columnist who writes on education issues entitled "Georgia's Core Values." The article had nothing to say about "core values", but had a lot to say about the new national math and English/language arts "core" standards.

Lack of Criticism

Surprisingly Downey writes without any criticism or questioning of the standards movement; she simply describes what the State of Georgia has decided to do (adopt the new standards in math and language), tells us that finally parents in Georgia will be able to find out how their school "stacks up" with schools in New York or California, that finally, because of the core national standards, there will be a battery of national tests that we can rely on to really compare schools, that states that embrace the new standards are in a better position to garner some of the Race to the Top Funds, and that indeed, the Thomas B. Fordham Institute, an education think tank thinks the whole shebang of standards is a great idea!

Downey's article is in stark contrast to my post yesterday in which I call into question the way in which standards are being developed, and by whom. Here, in part, is one issue to consider:

> As you explore the nature of the standards movement as it is happening in the United States, it appears as if non-profits, and professional organizations are at the heart of the development of these standards. The Federal government's role in all of this is rather interesting. Rather than funding universities, which must be accountable, the organizations that are developing the standards receive funding from non-governmental businesses, organizations, and private philanthropic groups. The groups doing the development, and the funding sources are accountable in this process to no one.

Follow the Money

If Downey were to follow the money, she would discover that there is actually a core group of foundations and businesses that are providing the money for institutes (like the Thomas B. Fordham Institute) and non-profits (like Achieve, Inc.—a group largely responsible for writing the new standards. If you go to any of these organizations, and click on the link that lists the organization's financial contributors, you will probably not be surprised to learn that many of same contributors form the financial foundation for the entire standards movement.

For example, the Fordham Institute is funded by these groups: The Achelis and Bodman Foundations, The Lynde and Harry Bradley Foundation, The Broad Foundation, The Brookhill Foundation, The Louis Calder Foundation, The Challenge Foundation, Doris and Donald Fisher Fund, The Bill and Melinda Gates Foundation, The William and Flora Hewlett Foundation, Hoover Institution on War, Revolution and Peace, The Joyce Foundation, The Ewing Marion Kauffman Foundation, The Koret Foundation, The Kovner Foundation, Richard M. Fairbanks Foundation, The Robertson Foundation, Charles and Helen Schwab Foundation, Searle Freedom Trust, The William E. Simon Foundation, The Spencer Foundation, The John Templeton Foundation, The Walton Family Foundation.

Achieve, Inc., is funded by these groups: The Battelle Foundation • Bill & Melinda Gates Foundation • The Boeing Company • Brookhill Foundation • Carnegie Corp. of New York • The GE Foundation • IBM Corp. • Intel Foundation • JP Morgan Chase Foundation • Lumina • Nationwide • Noyce Foundation • The Prudential Foundation • State Farm Insurance Companies • Washington Mutual Foundation • The William

and Flora Hewlett Foundation

Note the overlap.

Diane Ravitch (in her book The Death and Life of the Great American School System) refers to some of these organizations as the Billionaire Boys' Club (she especially recognizes the Walton Family Foundation, The Bill & Melinda Gates Foundation and Eli and Edy the Broad Foundation, each founded by billionaire men). Since the late 1980s (Sam Walton created his foundation in 1987), these three organizations have been behind a host of reform initiatives including school choice, charter schools, for profit schools, funding of advocacy groups (such as Achieve), performance-based teacher pay programs (Gates is investing millions), competition, deregulation, "tight" management, and "investments" in education. As Ravitch points out, there is very little challenge to the ideas promoted by these men and their foundations.

Literature of the Standards

Downey's article, and much of the literature on standards is punctuated with language that is based on metaphors implicit in competition and sports. For example, Downey says: "now comes the hard part, getting students up to speed on the greater ***rigor*** embedded in the standards so they can pass the national tests…" Webster defines rigor as meaning "harsh inflexibility in opinion, temper, or judgment; the quality of being unyielding or inflexible; and act or instance of strictness, severity, or cruelty. Closely connected with that fact that the new standards will be more rigorous than those in the past, is the notion that the new standards are "***raising the bar***" that students will have to achieve through the new national tests. Downey puts it this way: "It's not a sure bet that the Core Standards will improve American academic performance because the hard part is ensuring that the curriculum, teachers and tests embrace the ***raised bar***."

We are on roll right now with respect to the adoption of The Common Core Standards. Everyone is being asked to "get involved and become a Common Core supporter." Nearly all of the states are on board (only Texas and Alaska are holdouts). The advocacy groups that have a huge stake in the development and implementation of the Common Standards are conducting the research that is being done on the standards. For example, both the Fordham Institute and Achieve have written reports (that rate the Core Standards A+) that state boards of education use to argue the case to adopt the standards.

Whose Accountable?

And here is an amazing aspect of all of this. None of these groups are accountable to anyone (other than their own board of directors). Yet, these advocacy groups insist that schools, administrators and teachers should be held accountable. And indeed, many of these groups are advocating that teacher pay be based on the achievement of students on the tests that these advocacy groups develop. It is truly amazing.

And finally, when you examine these organizations, or the teams that write the frameworks and standards, you rarely find the name of a teacher as a member.

We have a serious problem here, and to use the language of sports, we need to step up!

3.7. Standards' Gatekeepers Upset When Georgia Parent Questions New Coursework

Last week, in a piece published in the Atlanta Journal (Let's discuss how bogus new math coursework is), Kimberly Learnard, a Fayette County, Georgia parent took the Georgia Department of Education to task, including Superintendent Kathy Cox, criticizing the Georgia Performance Standards in Mathematics.

A Parent Questions the Georgia Math Standards

She took exception to one of the methods advocated in the new mathematics standards, in which she claimed, "It is based on group discussion." To her all that students did was sit around in small groups waiting for one of the students to speak up, and teach the other students. She was also concerned that "Georgia's new math curriculum has no textbooks."

Her concern here was that there was little opportunity for parents to reinforce classroom teaching since students did not have a textbook to take home. She was also concerned that the number of students participating in accelerated classes has decreased in the past year. She called the new math curriculum "pie-in-the-sky, untried, unproven, experimental, nontechnical conversational math". Learnard also pointed out that Georgia ranks 47th in nation in math, and has not moved since Cox took over as Superintendent.

A number of readers wrote in and congratulated Leonard, and agreed that the new math curriculum appears dubious; a parent from Cobb indicated that her students had textbooks; however there seemed to be a current of support for Leonard's criticism.

There is very little criticism of the nature of and how standards are used in U.S. schools. The standards movement began nearly 20 years ago, and all of the content areas have developed standards at the national level, and states have modified, or copied the national standards to create their own framework. One of the few criticisms that I could find in the science education literature was a research article by Alberto J. Rodriquez entitled The Dangerous Discourse of Invisibility: A Critique of the National Research Council's National Science Education Standards. Other critiques have been published (Shiland, Lynch), but they are rare. So, when Kimberly Learnard, parent from a community in Georgia, takes the time to write an article, we see a bit of democracy in action.

Professors Defend the Georgia Math Standards

Then, yesterday, two university administrators from a university in Georgia wrote a three-column retort to Learnard's article. Acting as gatekeepers for the State Department of Education Georgia Performance Standards in Mathematics, the authors report that New Math Coursework Rigorous, Move Effective, and published the piece in the Atlanta Journal. They blame Georgia's low SAT scores (47th in the nation) on the

"old" math standards (QCC), and claim that the new Performance Standards were adopted on the basis of success (to them in Japan and North Carolina). I find it interesting that they use results on international tests (TIMSS) claiming that Japanese students score higher on the TIMSS test because of their math curriculum because it has fewer topics, its more rigorous and in-depth, its integrated, and results in a clear, focused path to higher education. But this is a weak argument, especially for U.S. schools, which are more diversified.

David Berliner points out that TIMSS data for the USA, when analyzed by socioeconomic levels, shows great disparities and inequalities. He points out that schools in the most affluent neighborhoods do well on these tests, but schools in poorer neighborhoods do not. Until inequalities are fixed, scores on international assessment will not change. As Berliner points out, the USA has more than 15,000 school districts, and to use a single test score on a test made of 40 – 50 items does not describe the qualities or inequalities inherent in the USA's schools.

This article shows how difficult it is to argue, to raise questions about the State's educational system when its business as usual in defending the approach of the state to education of students. In the past year, the results on middle school mathematics (40% failed) and social studies (70% failed) were dismal. In fact they were so bad, that the state threw the social studies test results out.

Standards Move the Locus of Control Away from the Classroom

The mathematics and science standards are result of hard work by teachers and professors, but in my own view, they have been used to create a system of education that removes educational decision making from where it should be, and that is at the local level, with teachers leading the way. High-Stakes testing now dominates the curriculum of schooling, and much of the methodology used to "prepare" students each year for the test. Unfortunately how well students do on the standardized tests that are derived from the standards has been shown in every empirical investigation to be based primarily on the socioeconomic status (SES), not on the nature of instruction, or the curriculum.

The authors of the article about defending the mathematics standards use language (code words) that we've heard for years: a more rigorous curriculum; staying the course; strong, cohesive, and coherent. Rigorous means harsh, severe or strict with very little flexibility. "Stay the course" is the phrase that the Bush Administration used to describe its Iraq policy. A strong, cohesive and coherent curriculum is a synonym for rigorous. In the last sentence of their article they state:

> with our strong, cohesive and coherent mathematics curriculum, student achievement by all metrics will steadily improve.

And of course, the metrics they have in mind are high-stakes tests and the SAT. Interestingly the article placed next to theirs was entitled SAT is losing a bit of its clout.

3.8. Some Reasons why the national standards movement is not good for learning

For several years, I have written about the National Standards Movement, and in general, have been critical of the movement, and suggested that in a liberal democracy such as our, common standards seems to the antithesis of our beliefs in the education of citizens.

Sometime ago, I wrote this about standards:

> Standards represent the dogmatism of a particular group that actually writes and finally publishes the science standards. A very small group of people in the science education community are involved in this process. Yes, the directors of this project will tell you that the draft was put on line for review, and the same will happen with the draft of the actual standards by Achieve. But reviewing them does not mean that your views will be included. Review of the Framework was more of a survey, rather than an actual review of the Framework.
>
> To assume that one set of standards in science will be appropriate to every school, each community, and every student seems very undemocratic. The medical profession doesn't even come close to having a uniform set of standards—physicians wouldn't let that happen. But in education, we hire non-public and private school professionals, many of whom have never had any experience working with students or teachers in the K-12 environment, and this group writes the standards for the millions of professional teachers, none of whom are really involved in the process. Do you see a problem here?

The march to standardize and uniform the curriculum is a dangerous movement in a democratic society, and one that is so diverse in cultures, languages, and geography as America. How can we really think that one set of statements of science objectives written by non-practitioners can be truly be valid for all learners, all schools, and all teachers.

As Jay Mathews wrote in an article in the Washington Post, having national standards in each state is alive and well, and most states have made plans to implement the standards statewide. The plan is to adopt a single set of standards, as has been done in mathematics and language arts, in each of the major subject areas. In fact, Achieve, Inc., is in the process of writing a new set of science standards based on The Framework for Science Education released earlier this summer by the National Research Council.

Why aren't the national science standards a good thing for learning?

Discipline Myopia. Using Dr. William G. Wraga's (University of Georgia) terminology, you can see that I

am extending this criticism to the Framework for K – 12 Science Education. He has suggested that

the standards devote insufficient attention to the need for an interdisciplinary curriculum, and represent a contracted view of the "common core" that disregards the role of schools in preparing students for citizenship.

The Framework promotes four disciplinary content areas, Life science, Earth/Space Science, Physical Science, and Engineering and Technology. As a result, the curriculum that is implied from the Framework is overly discipline oriented, and except for the addition of the area entitled Engineering and Technology, is no different than the 1996 National Science Education Standards. Even in elementary and middle school, there is little attempt of interrelate the content of science. Interdisciplinary science is not a structure in the Framework.

It probably won't Work. Jay Mathews has suggested that although common standards sounds good, it won't work. He cites Jay P. Green's Blog (University of Arkansas), who thinks that the tide has turned against nationalized standards primarily because that in order for standards to really work, they need to integrated with changes in curriculum, assessment and pedagogy, and changing all of these will take tons of money. We don't have the money, and this could be a good thing reform of education that is more student-centered.

Digital Models of Learning. In this regards, it was once thought that having a set of national standards would be good for the digital learning movement. But research reported a recent conference on learning at Harvard suggests that having different sets of standards is not a barrier to digital learning teaching and learning materials developers. In fact, you know that digital environments thrive on innovation, and change, and for students, the digital world is ubiquitous.

Not in the best interest of students. The standards movement is not in the best interests of students, it's in the best interests of the organizations and individuals behind the standards movement. Who are these organizations, and how close are they to what really happens day-to-day in the classroom. Many critics of the standards movement point to the idea that is a corporate led by a very elite group of wealthy individuals that really don't want to have an open discussion on the merits of common standards. Authoritative demands were issued by the US Department of Education in its Race to the Top Fund insisting that if states did not adopt the Common Core Standards as part of their proposal for funding, then it could have negative impacts on the assessment of the proposal. Last minute deals were made in a number of states to accept this demand.

The standards movement sound like a good idea, but unfortunately it will lead to further eroding of schooling, especially with the increased demands to test the heck out of students. The recent cheating scandal in Atlanta was the tip of the iceberg of the corporate reform movement in U.S. education.

Even the Governor's (Georgia) report revealed that a "culture of fear" took over the Atlanta School System, created by the dominance of the testing mentality of the Georgia Department of Education, and its demands

for continuous increase on academic tests to measure student achievement.

Although the Georgia Department of Education has not been cited for having any part in creating the “culture of fear” in Atlanta, it appears that thoughtful educators point to the last decade of enforcement of the NCLB Act as creating this unfortunate environment.

The standards movement, if it continues to be the dominant paradigm in schooling, will only continue this downward trend.

You might want to read these articles on the Standards:

- In a Liberal Democracy, Can Inquiry Science Teaching Flourish with Common Standards?
- National Academy of Science Releases new Framework for K-12 Science Education
- Why do we teach science?
- Voluntary, nationwide education standards in science. Voluntary?

Part 4. Using Test Results

4.1. Students Lag in Science So Says the National Center for Education Statistics

There was story on cnn.com today that caught my attention entitled U.S. students behind in math, science, analysis says. The analysis was written by the National Center of Educational Statistics and was a summary analysis of several international assessments including the Trends in International Mathematics and Science Study (TIMSS), and The Programme for International Student Assessment (PISA, 2006 results).

Comparing U.S. Test Results with the Rest of World

The story was a report of a brief talk given by the U.S. Secretary of Education (Mr. Arne Duncan) in which he used the results on the "Condition of Education" issued by the National Center of Educational Statistics. You can see the full report by clicking on the previous link. The basic question in the report was: How do U.S. students compare with their peers in other countries? For all the details that are in the report, the analysis comes down to this:

> The performance of U.S. students neither leads nor trails the world in reading, mathematics, or science at any grade or age (quote from report's summary).

The Secretary of Education uses the results of the analysis to say that

> we are lagging the rest of the world, and we are lagging it in pretty substantial ways. I think we have become complacent. We've sort of lost our way.

Unfortunately politicians believe that the data represents an accurate picture of student learning, and use it to drum up support for their policies. Yet, U.S. scores have not changed since 2000.

If you look at the PISA results, which are for the year 2006, U.S. 15 year-old students scored higher than some peers, and scored lower than some peers on the major areas of testing as reported by PISA: overall scientific literacy, identifying scientific issues, explaining phenomena, and using scientific evidence. Rank ordering the countries by score (similar to way we rank order competitive sports), in overall scientific literacy, Finland leads the way with a score of 563 (500 is average), the U.S. scores 489 (21st), and Mexico scores 410 (30th).

Is the Sky Falling?

Is the sky falling? Have we lost our way? Should we pay math and science teachers more? Can we educate our way to a better economy?

I've written before that the results of international comparisons and other large-scale assessments need to be carefully scrutinized before making sweeping generalizations about the fitness of a country's or state's educational system. For example, the U.S. has more than 15,000 independent school systems; to use an average score that is representative of the students in these schools based on a sit-down test of 48 to 60 items doesn't describe the qualities or inequalities inherent in any country's schools.

Results as reported by PISA and TIMSS help shape the public image of science education (or mathematics education), and it is unfortunate that educators allow this to happen. Dr. Svein Sjøberg of the University of Oslo in a publication entitled Pisa and Real Life Challenges: Mission Impossible, questions the use of tests such as PISA and TIMSS. He informs us that:

The PISA project sets the educational agenda internationally as well as within the participating countries. PISA results and advice are often considered as objective and value- free scientific truths, while they are, in fact embedded in the overall political and economic aims and priorities of the OECD. Through media coverage PISA results create the public perception of the quality of a country's overall school system. The lack of critical voices from academics as well as from media gives authority to the images that are presented.

PISA measures only three areas of the curriculum (math, science, reading), according to Dr. Sjøberg , and the implication is that these are the most important areas, and areas such as history, geography, social science, ethics, foreign language, practical skills, arts and aesthetics are not as important to the goals of PISA. TIMSS, according to his analysis (and I would agree) is based on a science curriculum that many science educators want to replace, yet uses test items that could have been used 50 years ago. In general the public is convinced that these international tests are valid ways of measuring learning, and that the results can be used to draw significant conclusions about the effectiveness of teaching and learning.

If you live in the world of psychometrics and modeling, the results that are gathered by these international testing bodies is a dream come true. Sjøberg puts it this way:

> PISA (and even more so TIMSS) is dominated and driven by psychometric concerns, and much less by educational. The data that emerge from these studies provides a fantastic pool of social and educational data, collected under strictly controlled conditions – a playground for psychometricians and their models. In fact, the rather complicated statistical design of the studies decreases the intelligibility of the studies. It is, even for experts, rather difficult to understand the statistical and sampling procedures, the rationale and the models that underlie the emergence of even test scores. In practice, one has to take the results at face value and on trust, given that some of our best statisticians are involved. But the advanced statistics certainly reduce the transparency of the study and hinder publicly informed debate.

4.2. Why Using Achievement Test Results Is Not The Road To Take

> Two roads diverged in a wood, and I—I took the one less traveled by, And that has made all the difference.—Robert Frost

From the White House, to most Governors' houses around the country, Americans are being led down a pathway that the creative and innovative would not take; and that is the road more traveled. We are following road signs that tell us that in order to compete in the global economy, and to increase economic growth, we must improve student achievement, especially in math and reading. Neither of these road signs is based on any research evidence. They are based on political dogma that has its roots in fear and authoritarianism.

For example, in their provocative paper, Into the Eye of the Storm: Assessing the Evidence on Science and Engineering Education, Quality, and Workforce Demand, Lowell and Salzman provide convincing arguments and data that student achievement levels in math and science have no effect on the enrollment of students in science and engineering in college, nor is there a positive relationship between achievement levels and national economic performance.

Politicians would have parents and the general public believing that the sky is falling and we are in dire straights when it comes to science and math education in the United States. The fact is that science education is led by the one of the most able bound, professionally prepared, and stable group of educators, as reported by the National Science Foundation, and that a survey of American science teachers report very high job satisfaction.

Print | Close

Table 1-13
Professional satisfaction and commitment of public middle and high school teachers: Academic year 2003–04
(Percent)

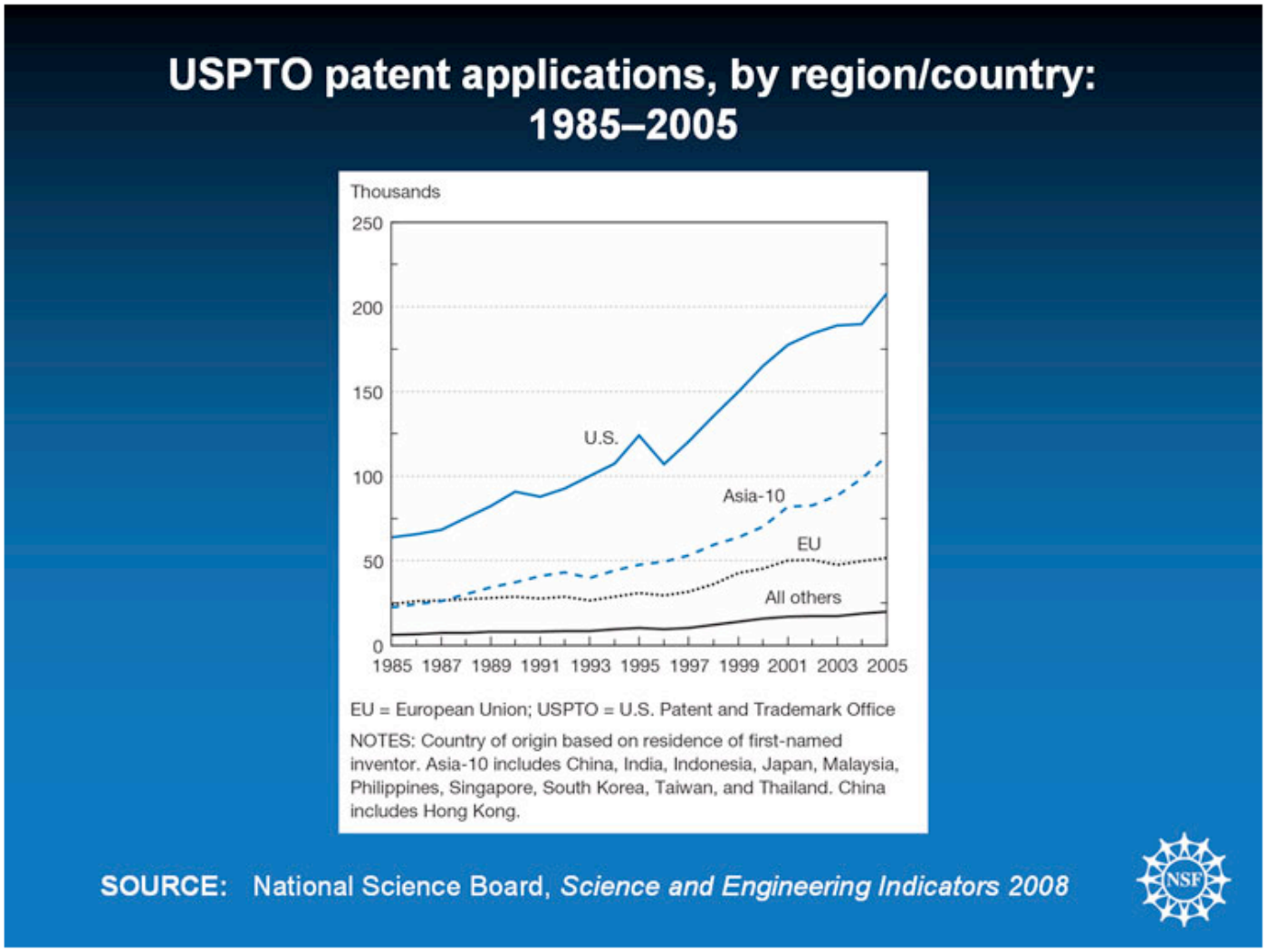
Professional satisfaction and commitment	All teachers	Mathematics	Science	Other teachers
I am satisfied with being a teacher	89.6	89.6	87.2	89.9
How long do you plan to remain in teaching?				
As long as I am able	41.8	41.8	39.7	42.1
Until I am eligible for retirement	33.9	32.4	33.8	34.1
Continue unless something better comes along	9.0	9.2	11.0	8.7
Definitely plan to leave as soon as I can	3.0	3.3	3.7	2.9
Undecided at this time	12.3	13.2	11.8	12.2
If you could start over again, would you become a teacher?				
Certainly	39.3	41.5	32.0	40.1
Probably	26.4	24.4	28.5	26.4
Even chances	17.6	15.6	21.6	17.3
Probably not	12.0	12.1	13.2	11.8
Certainly not	4.6	6.3	4.7	4.3

SOURCES: National Center for Education Statistics, Schools and Staffing Survey, 2003–04; and National Science Foundation, Division of Science Resources Statistics, special tabulations.

Science and Engineering Indicators 2008

Source Data

Furthermore the NSF reports that the United States has consistently led the world in inventiveness as measured by the number of patents applied for between 1985 – 2005. and this seems to be continuing. The community of scientists in the United States has consistently produced thousands of peer-reviewed articles per year, and is only exceeded in this output by the European Union, which is comprised of many nations. The United States also graduates more individuals with doctoral degrees than any other nation in science education and engineering. Furthermore, K-12 students fare very well on tests, and consistently show improvement over time, and with its peer group of industrialized nations, does very well. We are not in 21st place of rankings as someone (whom I admire) in the White House recently said.



One of the problems we face, and as pointed out the Lowell and Salzman, is that many of the factors that affect student achievement are non-school factors. For example it has been shown by PISA researchers that the impact on test scores by factors such as single-parent families (as much as 18 – 30 scale points difference), parental education level, family income, and other socioeconomic factors play a significant role in achievement.

We need to take another road to improve education in general, and science education specifically. Assuming that teaching to a “common” test will result in some kind of improvement of the American economy, and the general well being of the nation is narrow, and not based on evidence.

Perhaps the road we are taking should be blocked, or work on it slowed to enable an alternative roadbed to

begin that will be open to talent development, creative and inventive projects and processes, and put professional teachers and their leadership in charge and leading the way.

We need to take the road less traveled, and that would be the humanistic science education path that we have explored at this weblog.

4.3. Science Scores on International Assessments: The Sky is Falling

In yesterday's post, I described Science Debate 2008, and efforts to engage the two major candidates for President to answer 14 important questions about science.

Science Question Asked of Presidential Candidates

The one question that focused on science education was as follows:

> A comparison of 15-year-olds in 30 wealthy nations found that average science scores among U.S. students ranked 17th, while average U.S. math scores ranked 24th. What role do you think the federal government should play in preparing K-12 students for the science and technology driven 21st Century?

Each candidate discussed this question (you can read each candidates' response by following this link and then scroll down to question #4). You can decide for yourself which candidate provided the kind of answer that will improve science education in the nation's schools. To give you a flavor for what they said, here are two excerpts from their answers. One of the candidates said that:

> All American citizens need high quality STEM education that inspires them to know more about the world around them, engages them in exploring challenging questions, and involves them in high quality intellectual work. (Please note: I added the link to the STEM education coalition)

The other candidate said that:

> America's ability to compete in the global market is dependent on the availability of a skilled workforce. Less than 20 percent of our undergraduate students obtaining degrees in math or science, and the number of computer science majors have fallen by half over the last eight years. America

must address these trends in education and training if it hopes to compete successfully.

International Assessments

Note that the question on science education was couched in the language of international assessments, e.g. "A comparison of 15-year-olds in 30 wealthy nations found that average science scores among U.S. students ranked 17th, while average U.S. math scores ranked 24th." What does this mean? Is the sky falling?

Large-scale international assessments of student achievement receive a great deal of attention when the results become public. Normally, the results comparing countries are reported in a fashion similar to standings in professional sports, where 1 is at the top, which is typically Singapore, followed by lower scoring countries, and as suggested in the question, placing the U.S.A. 17th out of 30.

There is a real problem in using results to compare one country to another. As some researchers have pointed out, the scores reported are averages for the country of the students who took the test. Often the differences between average scores from country to another are not significant, BUT politicians, educators and the public see that if their country is not NUMBER ONE, "the sky is falling."

And its not just a concern expressed by U.S. politicians. Svein Sjoberg of the University of Norway reports (in a study–Real Life Challenges: Mission Impossible) that results on the PISA test (Programme for International Student Assessment) of students in Norway provided "war-like headings" in most of Norway's newspapers. In fact the commissioner of education of Norway was quoted as saying, "Norway is a school loser, and now it is well documented."

So, when U.S. students score 17th on an international test, policy makers make the claim that science education in the U.S. is in free-fall, and needs to uplifted. Remember, that the score used on these tests is an average. There are more than 15,000 independent school systems in the U.S. and to use an average score on a science test (typically comprised of 40 – 60 questions) does not describe the qualities or inequalities inherent in the U.S.A.'s schools.

David Berliner (in a research study entitled Our Schools vs. Theirs: Averages That Hide The True Extremes) points out that the TIMSS (Trends in International Mathematics and Science Study) data for the U.S.A., when analyzed by socioeconomic levels, shows great disparities and inequalities. For example, schools in the most affluent neighborhoods do well on these tests, but schools in poorer neighborhoods do not. And Berliner points out that scores on international tests will not change unless the inequalities in the schools are fixed.

Results on these international achievement tests, taken out of context, might not be the best way to assess how well science is taught in any country's schools. How can school science be assessed that will help us close the gap between schools? What suggestions do you have? Do you think that these international test

results are valid ways of assessing school science learning?

Part 5. Reform

5.1. Dear Mr. President: The Need for Meaningful Reform in Science Teaching

We know you have a lot on your plate—a deep recession, two wars in the Middle East, health care reform, extreme partisanship, and the fast spreading swine flu. Yet the one area that that is essential to our well being as a nation–education–has yet to become center stage. I know it is a high priority of yours, and I know when you think the time is right, you will bring it forward for open discussion. I believe that teaching is an art, and that teachers in our culture should work with their students creatively in classrooms characterized as humanistic, experiential, and constructivist.

This letter is an attempt on my part to think out loud, and share with you views held by many science teachers across the nation that believe that their work is a calling, and that their work with students should be grounded in the latest research that supports an active learning environment in which students explore, innovate, and solve meaningful problems. I believe that you would share these views that are held by many of my colleagues.

Education Beliefs of the President

Your beliefs and your experiences are clearly explored and described in your books, Dreams from My Father: A Story of Race and Inheritance; and The Audacity of Hope. I read them in the order of their publication, and the books helped me understand your ideas, and it convinced me that you would be open to reforming science education from a humanistic science tradition.

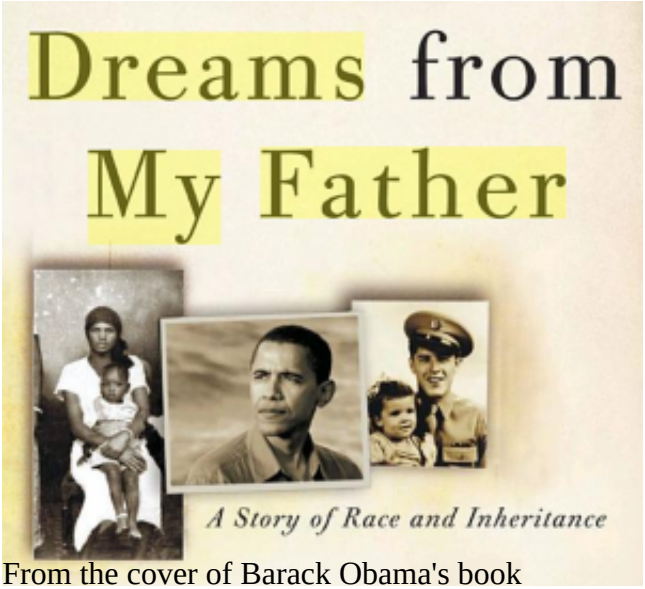
Although you do not have a chapter in either book specifically related to “education,” your thoughts about education, your experiences with your own schooling and educational experiences, and your work in Chicago as a community organizer provide the reader with your fundamental views of education and the reform that is needed.

Those of us in the science teaching community have followed your views on science and technology in our society and in our schools, and many are more than satisfied with your appointments as members of the Science and Technology Advisory Council. I think there was much support within the community for your appointments of Dr. John Holdren as director of the Office of Science & Technology, and Dr. Stephen Chu as Secretary of the Department of Energy. Further, the stimulus package that was put into law provided an additional boost to the National Science Foundation, and the Department of Education has received nearly 100 billion dollars for America’s schools, and educational infrastructure. These are all positive initiatives, and I think they have received enormous support within the science teaching community.

The reform of science teaching that needs to be considered focuses on a paradigm shift from a traditional view of science to humanistic science. This paradigm centers on the way in which students and teachers interact in the classroom. The humanistic paradigm implies that teaching, at its core, is a creative and courageous profession that needs to reform itself from the bottom up—from the local school upward, not from

Federal mandates downward. I think we've lost our way in this regard, and I am hoping that your personal school experiences in Djakarta, Honolulu, Los Angeles, New York, and Cambridge will inform you, and that the community organizing work you did in Chicago as a young man will be brought into the dialogue. Your sharing of these experiences can have a profound impact on how others view teaching, and help us chart a humanistic course.

In Chapter 13 of your book, Dreams from My Father, you talk about your desire to become involved with the public schools in the area of Chicago that you were doing your work–on the Southside.



From the cover of Barack Obama's book

I want to recall a section in that chapter that was very powerful, and supports the humanistic paradigm that I will propose here. You and your colleague & friend Johnnie had decided to visit a high school, and the principal of the school introduced you to one of the school counselors, Mr. Asante Moran. He was, according to the principal, interested in establishing a mentorship program for young men in the school. In his office, which was decorated with African themes, you discovered that Mr. Moran had visited Kenya 15 years earlier, and he indicated that it had a profound effect on him. In the course of your short meeting with Mr. Moran, he clearly told you that real education was not happening for black children, and then he offered you his view on what "real education" might be. Here is what he said on that spring day in 1987:

> Just think about what a real education for these children would involve. It would start by giving a child an understanding of himself, his world, his culture, and his community. That's the starting point of any educational process. That's what makes a child hungry to learn—the promise of being part of something, of mastering his environment. But for the black child, everything's turned upside down. From day one, what's he learning about? Someone else's history. Someone else's culture. Not only that, this culture he's supposed to learn is the same culture that's systematically rejected him, denied

> his humanity (p. 158, Dreams from My Father).

Child-Centered Science Education

Starting with the child as he or she is, and helping them connect to their environment—this is the core of humanistic teaching. Most teachers know and try and act on this humanistic philosophy, but for many, it is an upstream battle. The locus of control is far removed from the individual teacher's classroom. The control is centered in state departments of education, and the No Child Left Behind act (NCLB). And much of that control creates a conflict for innovative teachers. As responsible professional teachers, they want their students to do well on the high-stakes, end-of-year exams, yet know intuitively that this persistence on testing leaves creative teaching behind.

There is a need to shift the locus of control away from the Federal and state power centers, and move it to the vast number of communities of schools (there are about 15,000) around the nation. These 15,000 districts have a better understanding of the nature and needs of its students, and have a cadre of teachers who, I submit, are quite able to formulate curriculum, and design instruction that favors a humanistic paradigm. I am not suggesting that we erase the National Science Education Standards. I am suggesting that professional teachers are able to interpret the Standards, and create educational experiences grounded in constructivist and humanistic theory, and provide in the long run, meaningful school experiences.

Bottom Up, Not Top Down

I believe that you understand what I am talking about. Your motivation to leave New York City and move to Chicago to become a "community organizer" was because of your belief in "grass roots change." In fact, in your first book, here is what you said:

> In 1983, I decided to become a community organizer. There wasn't much detail to the idea; I didn't know anyone making a living that way. When classmates in college asked me just what it was that a community organizer did, I couldn't answer them directly. Instead, I'd pronounce on the need for change. Change in the White House, where Reagan and his minions were carrying on their dirty deeds. Change in the Congress, compliant and corrupt. Change in the mood of the country, manic and self-absorbed. Change won't come from the top, I would say. Change will come from a mobilized grass roots (Dreams for My Father, p. 133).

Humanistic Perspective

Humanistic science education is not a new perspective on teaching. It has had to compete with the pipeline

ideology of traditional school science, which has been ineffective for most students. Pipeline ideology is primarily based on training for the scientific world, and the organization of the curriculum tends to a strict adherence to canonical science.

A humanistic science perspective tends to be context-based or science-technology-society based. Instead of a science concept being the starting point for learning, the humanistic science teacher starts with contexts and applications of science. Science concepts are explored within these contexts. Humanistic science teaching thrives in STS programs, environmental science projects, gender projects, and culturally focused investigations. These experiences shed light on science-related social content for students, and often focus on the affective outcomes of learning, how students feel about science, how it impacts their lives, and what they can do to solve science-related social issues. Many teachers know from experience that projects like these help students see themselves as citizen-scientists, using social and scientific processes to solve real problems.

Recent results on The Nation's Report Card show that there has been little change in 17 year olds performance in math and reading from 2008 to 2004, and 1973. Although there were slight gains in achievement among all students, the achievement gap between white students and black & Hispanic students has not changed. And the NCLB act was intended to close the gap. Your able Education Secretary, Mr. Arne Duncan has said that he wants "real and meaningful change" in the nation's schools. Real and meaningful change cannot be more of the same—longer school days, the same curriculum and standards.

Meaningful Reform

I suggest that for meaningful reform in science teaching, there needs to be an openness to new ideas, and there needs to a very strong involvement of grass-roots teachers for this kind of reform. Teachers and students should not be on the receiving end of decisions made by academic vice-presidents, governors, and commissioners of state departments' of education. These constituencies are important, but the reform must be grounded in practice & related science education research; reform needs to be on the hands of professional teachers.

Well, there you have it. Am I totally off base here? Can meaningful reform be a grass-roots effort? What are your thoughts? I hope you will be willing to share them.

Resources: Grounding Humanistic Science in Research—Starting Places:

- Abel, Sandra K. & Lederman, Norman G. (Eds). (2007) Handbook of Research in Science Education. Mahwah, NJ: Lawrence Erlbarum Associates. Most up-to-date review and exploration of research in science teaching. Humanistic science is reviewed in Chapter 29.
- Aikenhead, Glen S. (2005) Science Education for Everyday Life: Evidence-based Practice. New York: Teachers College Press. Provides evidence-based research to support humanistic science. Review of this book.
- Bransford, John D., Brown, Ann L., & Cocking, Rodney R. (Eds.) (2000). How People Learn: Brain, Mind, Experience, and School. Washington, DC: National Academies Press. From the link you can

read this book online at the NAP site.

- Capobiano, Brenda. (2007). "Science Teachers' Attempts at Integrating Feminist Pedagogy through Collaborative Action Research." Journal of Research in Science Teaching. 44: 1 -32. A powerful example of the kind of research in which teachers explore their own practice based on feminist and humanistic perspectives.
- Cross, Roger T. & Peter J. Fensham (Eds.). (2000) Science and the Citizen. Melbourne: Arena Publications. An important book that explores the issues related to S-T-S and humanistic science.
- Hines, Maxwell. (2003) Multicultural Science Education: Theory, Practice and Promise. New York: Peter Lang. An important book shedding light on multicultural science education.
- Hutcheson, Charles (2005) Teaching in America. Springer. The purpose of this book is to facilitate the transitions of international teachers from their native countries into American science classrooms, using original research.
- Lemke, J.L. (2001) Articulating communities: Sociocultural perspectives on science education. Journal of Research in Science Teaching 38 (3) 296 – 316. An important paper by one of the leading science education researchers exploring sociocultural perspectives in science education. A sociocultural perspective most basically means viewing science, science education, and research on science education as human social activities conducted within institutional and cultural frameworks.

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Omne tulit punctum qui miscuit utile dulci — Horace