Testimony

U. S. House of Representatives
Subcommittee on Research and Science Education, Committee on Science

Federal STEM Education Programs: Educators' Perspectives

May 15, 2007

Michael Lach
Director of Mathematics and Science
Chicago Public Schools
Medill Professional Development Center
1325 West 14th Place
Chicago, IL 60608
http://cmsi.cps.k12.il.us/
mlach@cps.k12.il.us

Mr. Chairman and members of the Subcommittee, thank you for inviting me here today to speak to you about this issue. It is an honor to sit before you alongside colleagues whom I've worked with and learned much from.

I am the Director of Mathematics and Science for the Chicago Public Schools. The Chicago Public School system consists of over 600 schools, nearly 25,000 teachers, and more than 400,000 students.

We have made great progress with mathematics and science instruction in Chicago. Student performance has risen considerably over the past five years, and the rate of improvement is faster than that of the state. (See Figure 1 and Figure 2.) To do this, we developed a comprehensive plan to coordinate all aspects of mathematics and science improvement, which we call the Chicago Math & Science Initiative. As part of this work, we created a vision for high quality instruction; built the support infrastructure to provide high quality, content-rich professional development to thousands of teachers over the course of an academic year; forged partnerships with local businesses, museums, laboratories, and universities to increase the content knowledge of our teachers; and enhanced our after-school offerings to include mathematics and science enrichment.

We've done this in a challenging context. Eighty-five percent of our students come from low-income families. Our resources are low; Illinois ranks 47th in the nation in the level of state support for education. Our capacity is limited—less than 5% of our K-8 teachers possess a state endorsement in mathematics. The Chicago Public Schools is an extremely decentralized school district. By state law, decisions about local school budgets, principal contracts, and curriculum are made by an elected body called the "Local School Council," not the Chief Executive Officer.

While we feel proud of our accomplishments, we know that we still have much work to do. An achievement gap remains in many of our schools. The number of students meeting and exceeding standards remains far too low. Our high schools, in particular, still have graduation rates that are not acceptable.

In as much as possible, we connect with external resources to help us improve mathematics and science in the Chicago Public Schools. Much of the intellectual design of our work comes from insights my colleagues on this panel have provided, from Dr. Nelson's leadership, to Dr. Weiss's insightful evaluations of large-scale change efforts, and to the National Science Teacher Association's consistent support for teachers. Most of the funding for our efforts comes from the district; we work in every manner possible to leverage additional funding from corporate and university partners in the Chicagoland area. In particular, we're happy to have several major universities that we work with in close partnership, and our relationship with Argonne National Laboratory has resulted in several programs that we have enacted together.

The gaps we face, and the resource and capacity limitations that we operate under make it unconscionable for us to turn down assistance. So my most important point today is that we really depend on the assistance and partnership of others—including the federal R&D mission agencies. They have an important role to place in science, technology, engineering, and mathematics education in the United States.

I'd argue that there are two major assets of the federal R&D mission agencies that will help K-12 STEM education. As the committee considers the most appropriate way to connect these agencies with K-12 teachers and schools, programs should be designed so that these assets are highlighted.

The first asset is human capital. The scientists and engineers of NASA, NOAA, NIST, EPA and DoE are the best and brightest in the world. They are the ones making new discoveries, creating new technologies, and literally exploring new worlds. The more we can connect students, parents, and teachers with their insights, energy, and perspectives, the better. The people of federal R&D mission agencies can both educate and inspire our students and teachers. A key priority should be to leverage this human capital so that they can assist schools and school districts in their work.

The second major asset is the facilities. The laboratories and tools that are part of the federal R&D infrastructure are top notch—the particle accelerators, the space craft, the computers, the data sets. Most of our students have a very incomplete picture of the real work of scientists and engineers. Many teachers have never been part of a real scientific project. The facilities that are part of the federal R&D mission agencies should be utilized not only to ground science learning in a well defined context, but to enable students and teachers to understand a vision of what they're trying to do. A second key priority of the federal R&D thus is to make the places where science and engineering are practices accessible in meaningful ways to students and teachers.

I'd like to highlight a few examples of these that come from my experience with Argonne National Laboratory and Fermilab.

- The Academies Creating Teacher Scientists program provides summer internships for teachers to conduct scientific research with ANL scientists.[1] In this program, both the human capital and the facilities of ANL are made available to select teachers in a sustained, supportive manner.

- Fermilab's Saturday Morning Physics sessions—in which I participated as a student—brings students to Fermilab to learn about modern physics topics and see real scientists in action.[2] Similarly, Argonne's distance learning project uses modern technology to provide the opportunity for CPS students to meet and interact with professionals in technical fields.[3] Both of these programs enable students to access the human capital and facilities of these laboratories.

- The online ask-a-scientist provides a mechanism for student and teachers to get accurate answers to scientific questions from practicing scientists.[4]

- And, in an expression of our work as partners, the director of education at Argonne participates in our annual Principal For A Day project.

[1] http://www.dep.anl.gov/p_k-12/acts/
[2] http://ed.fnal.gov/talks/fermilab1994/web/ed_prog_sec_student.html#saturday
[3] http://www.dep.anl.gov/p_k-12/distancelearning/
[4] http://www.newton.dep.anl.gov/

Given these comments, a picture emerges about the sort of work that isn't very helpful. Curriculum development is one. We know from decades of instructional material development that writing curriculum is a complicated, difficult process. More acutely, we know that robust curriculum is necessary but not sufficient for classroom improvement. In addition to strong materials, teachers need equipment, professional development workshops, coaching, and good assessments. Within a school, leaders need to understand how to support curriculum implementation, and manage improvement throughout grades and courses. Collections of lessons plans, by themselves, are only a small piece of the puzzle.

The proliferation of state and national standards and content also makes implementation difficult. Special topics can be motivating and interesting to both teachers and students, but given the now-famous finding from the TIMSS study that our curriculum is "a mile wide and an inch deep," adding more topics to cover only makes things difficult for teachers. If programs or projects are parochial, they're harder to connect to our work.

We also know that transforming classroom practice involves intensive capacity development sustained over time. It doesn't happen over night—or in a one-day field trip or workshop. A brief visit to a laboratory or launch can be inspiring—and I don't mean to downplay the importance of inspiring teachers and students about the world of science—but real change takes sustained work over time. Within an overall strategy, there's certainly a need for both.

I want to say a few words about the type of human capital development that we provide for teachers at the Chicago Public Schools. Our work falls into three major categories. The first is support for core instructional materials implementation, focusing on the direct application of content and pedagogy to the classroom. This is almost always led by the district, and is difficult to conceive any outside institutions other than curriculum developers with the capacity to provide this work. The second is to enhance the content knowledge of teachers via university coursework. The highly qualified teacher demands of the No Child Left Behind legislation as enacted in Illinois use coursework as the main driver for this work. Seminars and sessions that don't provide credit for teachers don't enable me to very easily meet my goals. The third is activities that inspire the study of science and mathematics; generally, we use outside institutions such as museums and laboratories to do most of this work.

In the Chicago Math & Science Initiative, the Chicago Public Schools was able to develop a coherent and comprehensive strategy for mathematics and science improvement thanks to NSF systemic initiatives. It took us some time both to arrange the human capital and organization in order to structure such a strategy, but the results to date are quite positive. The more the federal R&D mission agencies can align their work to similar district strategies, the better the chance of success. Without a clear connection to district's vision, there will be no traction. A plan enables forward movement. And it takes resources to develop and drive such plans.

When the proposals come to me as existing plans with little opportunity for localization, their chance of effectiveness is reduced considerably. Small programs that are aligned only peripherally to our strategies often just add complexity. We've had success because of our commitment to coherence, and the more the federal R&D mission agencies can align with that, the better. I can't think of any proposals that have come to me with an evaluation report documenting their effectiveness.

Communication between districts and the federal R&D mission agencies generally differs by the amount of collaboration that is intended in the partnership. For projects that are designed by the federal R&D mission agencies, individual teachers and schools find them by the usual methods—NSTA mailings, websites, email lists. We regularly email our teachers any opportunities that we hear about. For more strategic partnerships, programs are often developed jointly and are the result of an ongoing dialogue so that the strengths of the partnering institutions are leveraged. These partnerships require intense collaboration and flexibility from all sides.

The federal R&D mission agencies have an important role to play in improving K-12 STEM education. By leveraging the human capital land facilities that these institutions possess, and connecting these to the existing plans and strategies of the district, we'll collectively be able to advance the mathematics and science achievement of our students.

Answers

1. **How do you find resources for improving science and mathematics education in the Chicago Public Schools?**

Individual teachers find text, lesson plans, and other classroom resources via the usual methods—NSTA mailings, websites, emails. When the central office learns of opportunities such as this, we distribute them via email to our schools.

More strategic partnerships—such as the ones described above—come about via ongoing dialogue with our partners in museums, laboratories, and universities. These are generally designed together.

2. **What resources have you garnered from the federal R&D mission agencies? How has this contributed to improving your students' understanding of science?**

As mentioned, our partnerships in particular with Argonne National Laboratory and the Fermi National Accelerator Laboratory have resulted in several successful programs that connect teachers and students with the scientists, engineers, and facilities of these institutions.

3. **What type of support that the federal R&D mission agencies could provide would have the most impact on STEM education for your teachers and students in Chicago Public Schools?**

The most productive supports are those that (1) inspire students and teachers to study science and mathematics and (2) provide students and teachers with a deep understanding of the real-world work of scientists and engineers. Supports that are not particularly effective include (1) lesson plans and curriculum development, (2) workshops that don't connect directly to specific instructional materials or university credit. To enable deeper collaboration, resources need to be allocated with the expressed purpose of connecting K-12 schools and districts with the federal R&D mission agencies.

Figures

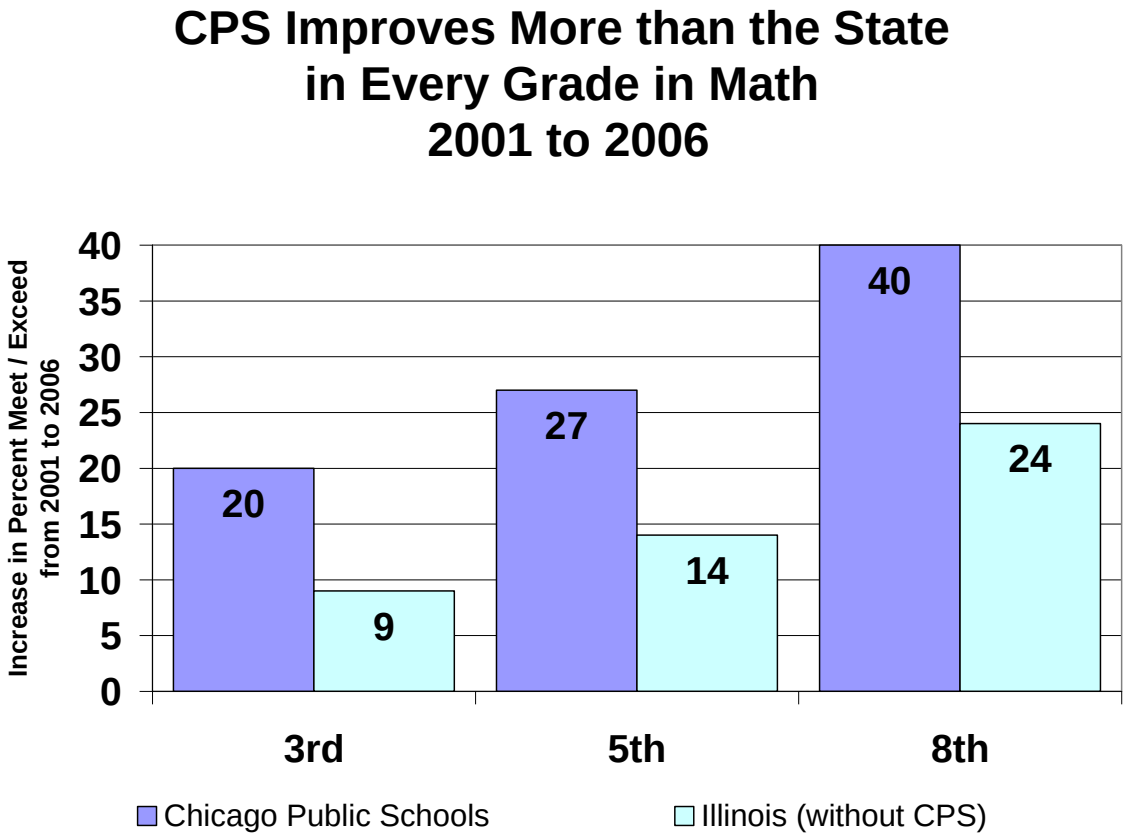

Figure 1: CPS Mathematics Performance on the Illinois Standards Achievement Test versus Illinois, 2001-2006

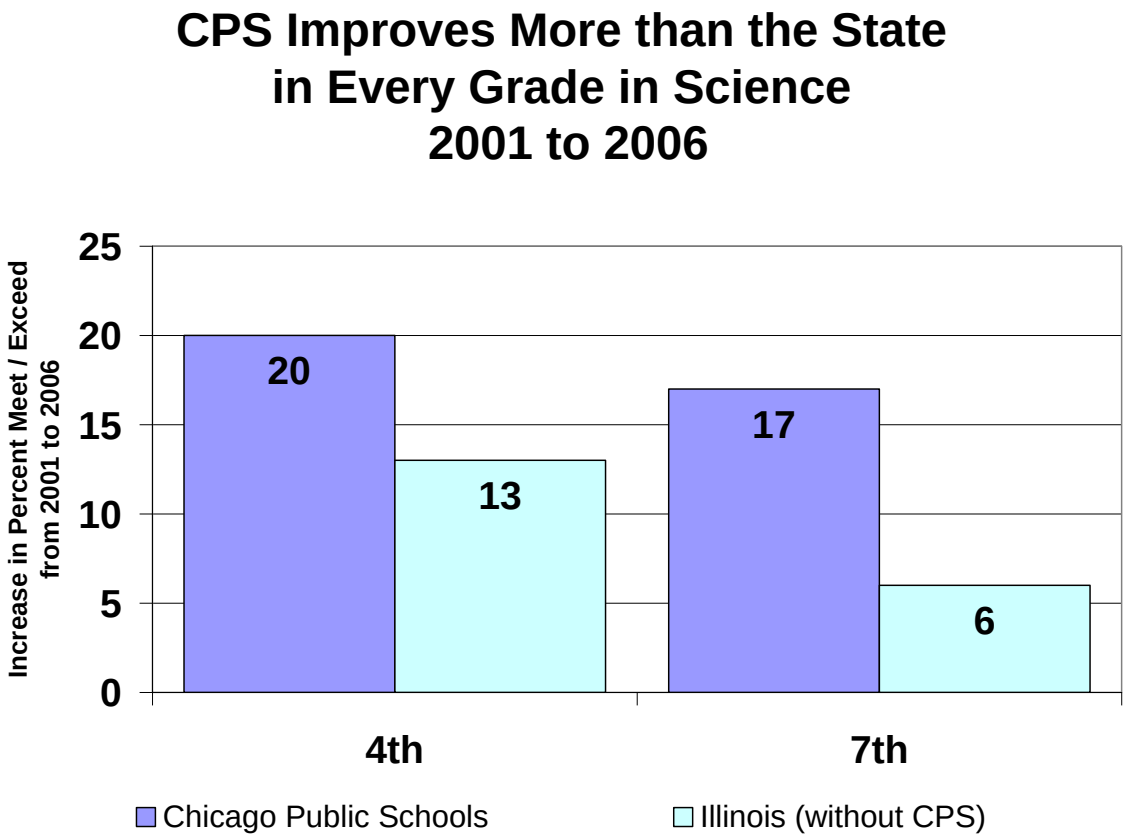

Figure 2: CPS Science Performance on the Illinois Standards Achievement Test, 2001-2006

Biography

Michael C. Lach is Director of Mathematics and Science for the Chicago Public Schools, overseeing mathematics and science teaching and learning in the 500 elementary schools that comprise the nation's third largest school district. Mr. Lach began teaching high school biology and general science at Alceé Fortier Senior High School in New Orleans in 1990 as a charter member of Teach For America, the national teacher corps. After 3 years in Louisiana, he joined the national office of Teach For America as Director of Program Design, developing a portfolio based alternative-certification system that was adopted by several states. Returning to the science classroom in 1994 in New York City Public Schools, and then back to Chicago in 1995 to Lake View High School, he was named one of Radio Shack's Top 100 Technology Teachers, earned National Board Certification, and was named Illinois Physics Teacher of the Year. He has served as an Albert Einstein Distinguished Educator Fellow, advising Congressman Vernon Ehlers (R-MI) on science, technology and education issues. He was lead curriculum developer for the *Investigations in Environmental Science* curriculum developed at the Center for Learning Technologies in Urban Schools at Northwestern University and published by It's About Time, Inc. He has written extensively about science teaching and learning for publications such as *The Science Teacher, The American Biology Teacher,* and *Scientific American.* He earned a bachelor's degree in physics from Carleton College, and masters degrees from Columbia University and Northeastern Illinois University.