BUILDING AMERICAN COMPETITIVENESS: EXAMINING THE SCOPE AND SUCCESS OF EXISTING FEDERAL MATH AND SCIENCE PROGRAMS

HEARING

BEFORE THE

COMMITTEE ON EDUCATION AND THE WORKFORCE U.S. HOUSE OF REPRESENTATIVES

ONE HUNDRED NINTH CONGRESS

SECOND SESSION

May 3, 2006

Serial No. 109–39

Printed for the use of the Committee on Education and the Workforce

Available via the World Wide Web: http://www.access.gpo.gov/congress/house
or
Committee address: http://edworkforce.house.gov

U.S. GOVERNMENT PRINTING OFFICE

27–983 PDF WASHINGTON : 2006

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C O N T E N T S

BUILDING AMERICAN COMPETITIVENESS: EXAMINING THE SCOPE AND SUCCESS OF EXISTING FEDERAL MATH AND SCIENCE PROGRAMS

Wednesday, May 3, 2006
U.S. House of Representatives
Committee on Education and the Workforce
Washington, DC

The committee met, pursuant to call, at 10:30 a.m., in room 2175, Rayburn House Office Building, Hon. Howard P. "Buck" McKeon [chairman of the committee] presiding.

Present: Representatives McKeon, Johnson, Ehlers, Biggert, Platts, Tiberi, Marchant, Price, Boustany, Foxx, Miller, Kildee, Owens, Payne, Woolsey, Hinojosa, Tierney, Kucinich, Wu, Holt, Davis, McCollum, Grijalva, and Van Hollen.

Staff Present: Amanda Farris, Professional Staff Member; Ray Grangoff, Legislative Assistant; Jessica Gross, Press Assistant; Kimberly Ketchel, Deputy Press Secretary; Deborah L. Emerson Samantar, Committee Clerk/Intern Coordinator; and Rich Stombres, Deputy Director of Education and Human Resources Policy; Alice Cain, Minority Legislative Associate/Education; Lauren Gibbs, Minority Legislative Associate/Education; Lloyd Horwich, Minority Legislative Associate/Education; Tom Kiley, Minority Communications Director; Joe Novotny, Minority Legislative Associate/Education; Rachel Racusen, Minority Press Assistant; and Daniel Weiss, Special Assistant to the Ranking Member.

Chairman MCKEON. A quorum being present, the Committee on Education and the Workforce will come to order.

We are holding this hearing today to hear testimony on "Building American Competitiveness: Examining the Scope and Success of Existing Federal Math and Science Programs." under committee rule 1(b) committee statements are limited to the chairman and the ranking minority member of the committee. Therefore, if other members have statements they will be included in the hearing record.

With that I ask unanimous consent for the hearing record to remain open for 14 days to allow member statements and other extraneous material referenced during the hearing to be submitted in the official hearing record.

Without objection, so ordered.

Good morning. Thank you all for joining us at this hearing, which will focus on American competitiveness, and more specifically, on the scope and success of Federal math and science education programs.

This marks the second in a series of hearings the Education and the Workforce Committee is holding on the subject of American competitiveness. In our last hearing, we heard from Secretary of Labor Chao and Secretary of Education Spellings, as well as a panel from the business community. Each witness provided their input on how the United States can sharpen its competitive edge. I believe that hearing laid a perfect foundation for what we are about to embark upon this morning.

The goal for today's hearing can be summed up in three words, "What's out there?" we are here today to gain a better understanding of what Federal programs already exist to improve math and science education and how effective those programs are and perhaps what we can do to improve upon them.

Competitiveness is not just a vital topic but a news worthy one as well. The urge of many in Washington, including some in this hearing room, is to blindly throw billions of dollars at a variety of new programs in the name of competitiveness, or innovation, as some are inclined to say.

That, I believe, is not the appropriate course of action, not when there are more than 200 Federal math and science programs on the books, not when some 13 different Federal agencies already have a math or science focus, and not until we have a firm grasp of the Federal Government's current degree of success. In other words, to determine where to go next, it is best to gain a better understanding of where we already are.

So what do we know? Well, we know that just last fall the Government Accountability Office released a report that quantified the myriad of Federal programs established to increase the numbers of students pursuing science, technology, engineering and math degrees, and we are fortunate to have a witness poised to testify on that report this morning.

We know that in fiscal year 2004 alone we spent about $2.8 billion on these programs. Yet in spite of this substantial taxpayer investment, some wonder whether the number of science, technology, engineering and math graduates will be sufficient to meet our Nation's future academic and employment needs. Thus, our competitive advantage remains very much an open question.

Moreover, we know the GAO has recommended that before creating new Federal math and science programs we should know the extent to which existing programs are appropriately targeted and making the best use of Federal resources. Additionally, the GAO noted that in an era of limited financial resources and troubling Federal deficits, information about the effectiveness of these programs can help guide policymakers and program managers, and that information is what we are here to explore today.

What else do we know? We know that earlier this year, as part of the Deficit Reduction Act, Congress established an Academic Competitiveness Council designed to identify and review the more than 200 programs within the 13 separate Federal agencies with a math or science focus.

The Council will evaluate the effectiveness of the programs, determine areas of duplication, and recommend ways in which to integrate and coordinate them. Its activities recently began in earnest, and a final report must be submitted to Congress by next February, 2007. I am very grateful that today our committee will receive an update on the Council's activities thus far.

Simply put, there is a good deal that we do know, but there is even more that we don't. Through this hearing and our entire series of hearings on American competitiveness, this committee will do its part in gathering as much information as possible about the extent and success of Federal math and science programs. Only then can we make sound, reliable programs about what to do next. I look forward to continuing our discussion this morning, and I am eager to hear thoughts from our witnesses.

With that, I yield to my good friend, Mr. Miller, for his opening statement.

[The prepared statement of Mr. McKeon follows:]

Prepared Statement of Hon. Howard P. "Buck" McKeon, Chairman, Committee on Education and the Workforce

Good morning, and thank you all for joining us at this hearing, which will focus on American competitiveness—and more specifically, on the scope and success of federal math and science education programs.

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Competitiveness is not just a vital topic, but a newsworthy one as well. The urge of many in Washington—including some in this hearing room—is to blindly throw billions of dollars at a variety of new programs in the name of competitiveness—or "innovation," as some are inclined to say.

That, I believe, is not the appropriate course of action. Not when there are more than 200 federal math and science programs on the books. Not when some 13 different federal agencies already have a math or science focus. And not until we have a firm grasp of the federal government's current degree of success. In other words, in order to determine where to go next, it's best to gain a better understanding of where we already are.

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Mr. MILLER. Thank you, Mr. Chairman, and thank you for convening this hearing.

I welcome the witnesses. I can't think of a more important subject matter for this committee at this time. We heard over and over again about how America is falling behind in other countries when it comes to math and science education. The latest example is a new report from the American college testing program that found only 26 percent of U.S. high school graduates in 2005 were prepared to succeed at entry level college science courses and only 41 percent were prepared to succeed in college level math courses. Success was loosely defined as a C or better.

We have heard about how our Nation must successfully face a serious challenge from international contenders in order to keep our economy strong for a globalized world. Other countries from Asia to Europe are making aggressive investments in education, broadband access and in other initiatives to give their economies an innovative edge.

The question is, what are we going to do, what kind of commitment are we going to make to keep America competitive for generations to come. Last year, Democrats sought the answer to this question by proposing a comprehensive innovation agenda. In order to maintain our top position in global innovation and leadership, we believe it essential to graduate 100,000 new scientists, engineers and mathematicians over the next 4 years, double the funding for overall basic research and development in the Federal Government, make broadband Internet technology affordable and accessible to all Americans within 5 years, achieve real energy independence within 10 years and support entrepreneurial small businesses.

Democrats believe that only by making a renewed and sustained commitment to innovation will our Nation be able to maintain its global economic leadership and protect our national security and enjoy our prosperity at home with good American jobs. This was not a conclusion that was arrived at by Democrats out of whole air, this was after talking to CEOs of the high tech industry, in biotech industry, venture capital industry. In every corner of this country, people who are betting their companies, their futures, our economy, scientific discovery, their stockholders' money. All have said this is about America making a renewed and, importantly, a sustained, sustained commitment to innovation if we are going to be able to maintain our leadership in the world.

Having said that, they also made it clear that they didn't believe, and we presented it to them as we didn't, this was a Democrat or Republican issue. It is an American issue.

I hope that we can put partisanship aside, roll up our sleeves and do whatever it takes using the best ideas from the Democratic innovation agenda from the President's competitive initiative to maintain America's position in global innovation and leadership.

Given this hearing's specific focus on math and science education, I would like to take a minute to talk about what steps we can improve K-12 schools.

First, we cannot talk about competitiveness without talking about the need to get highly qualified teachers into every classroom. California alone will need to hire 80,000 to 100,000 new teachers in the next 10 years. Too many of our children, especially those in high poverty schools, are taught by teachers who lack a major in the subject matter they teach. For example, 70 percent of the math classes in high poverty middle schools are taught by teachers without even a minor in math. Yet it still comes to a surprise when students are not proficient or they are not excited about a career involving math or science.

Last year I introduced a bill to enhance teacher quality, the Teacher Excellence for All Children Act. The TEACH Act was introduced at that time. It will provide $2 billion of funding for school districts to reward outstanding math and science teachers who transfer to the hardest-to-staff schools and pay an increase of $12,500 a year.

It would also recruit the top talent to teach math and science in our schools to provide $4,000 a year for up-front tuition assistance for outstanding graduate and graduate students who commit to teaching math or science in high school, elementary or secondary schools for 4 years. These scholarships would also be available to experienced teachers of other subjects who want to go back to school and get credentials necessary to teach math, science or other subjects which have a severe shortage of qualified teachers.

Again, this isn't just an idea that we drew out of whole cloth. This is after talking to leaders in the business community, the Business Roundtable and others, the Teaching Commission, who said that this must be done. These are the people that would end up having to pay the taxes to supply the services to provide the talent, and they have said that this must be done. That is why we have supported this act. We hope to make this a bipartisan act. We have asked for sponsorships to that. It is very important that we do that.

The other interesting fact is we have met with CEOs at Stanford University, when we met with them in Boston, when we met with them in Austin, we met with them in Seattle, the leaders in the biggest and most innovative companies in the world. They all put, again, increased resources available to education as the priority in terms of getting America back on track for a long cycle of American leadership in the world economy, in the areas of innovation.

We are very encouraged by the fact that you are holding this hearing. We think that there is a great deal of urgency to this. We also believe that this cannot be something where we can start and go, start and go. People have to be able to rely on the sources being

there. We are all reminded—Mr. Archey here has reminded us of the impact of the Moon shock.

It was more than just sending a person to the Moon and bringing them back safely. It was about building the greatest public-private partnership in the histories of the world that led to three decades, four decades of innovation, of discovery, that nobody has matched in terms of the American ability and talent to do so.

I consider these hearings crucial, I consider them urgent, and I believe that the Congress must now start to make decisions about the dedication of these resources to those areas that have shown such great promise to improve America's competitiveness in the world.

Thank you, Mr. Chairman, for the time.

[The prepared statement of Mr. Miller follows:]

Prepared Statement of Hon. George Miller, Ranking Minority Member, Committee on Education and the Workforce

Many of us in Congress have been warned by many from across the American economy and across the American intellectual community of the deficits that we now have when we look at our position, vis-à-vis other nations of the world—whether it is the number of graduate students in engineering, math, and sciences in China, Korea, and India, and elsewhere in the world—of the fact that we now rank 16th, down from 11th, in broadband penetration in this country, or that our 12th graders still languish near the bottom in math and science by international comparisons. These are serious issues that deserve our serious attention and I welcome this hearing today.

To help address these challenges, Democrats last year proposed an innovation agenda as a challenge to the Congress and the Administration to make innovation science and technology once again America's top priority in economic growth and job creation.

In order to maintain our #1 position in global innovation and leadership, we believe it is essential to:

- Graduate 100,000 new scientists, engineers and mathematicians over the next four years
- Double the funding for overall basic research and development in the federal government
- Make the miracle of broadband Internet technology affordable and accessible to all Americans within 5 years
- Achieve real energy independence within 10 years, and
- Support entrepreneurial small businesses

Democrats believe that only by making this renewed and sustained commitment to innovation will our nation be able to maintain its global economic leadership, protect our national security and enjoy prosperity at home with good American jobs.

When we were working on the Innovation Agenda, we met with CEOs of high-tech companies, biotech companies, with some of the leading venture capitalists in the world. They reminded us time and again that in the early 1960s when President Kennedy talked about sending a person to the moon and bringing that person back, that it was about creating the greatest public-private partnership in the history of the world where the federal government joined up with the private sector, with the academic centers in this country and created the legacy that we have been living off that led to the high-tech revolution and the bio-tech revolutions where we have led the world. We may not have a Sputnik, but we do need that same sense of urgency.

That said, competitiveness is not a Democratic issue or a Republican issue—it is an American issue—and I hope that this is an issue where we can put partisanship aside, roll up our sleeves and do whatever it takes—using ideas from the Democratic Innovation Agenda and from the President's Competitiveness Initiative—to maintain our #1 position in global innovation and leadership. There is recognition on both sides of the aisle that you don't get to keep being Number One just by virtue of the fact that you're Number One. You have to earn it every day.

There are two things that I think we can and must do better if we are to continue earning this distinction.

First, we cannot talk about competitiveness without talking about teacher quality. California alone will need to hire 80,000—100,000 new teachers over the next 10

years, and how well we do in attracting the very best people to these jobs—and then keep them there—will make a tremendous difference in maintaining our competitive edge.

Too many of our children-especially those in high-poverty schools-are taught by teachers who lack a major in the subject they teach. For example, 70 percent of math classes in high-poverty middle schools are taught by teachers without even a minor in math. Then we are surprised when these students aren't proficient! We have to get serious about teacher quality—and I recently introduced a bill, the Teacher Excellence for All Children Act, that does just that. It provides over $2 billion in funding for school districts to reward outstanding math and science teachers who transfer into the hardest-to-staff schools with pay increases of $12,500 per year.

A core component of the TEACH Act of 2005 is to improve math and science education for all children. This is achieved by recruiting top talent to teach math and science in our schools by providing $4,000 per year of up-front tuition assistance for outstanding undergraduate and graduate students who are studying to become teachers and who commit to teaching math or science in a high-need elementary or secondary school for four years. These scholarships are also available to experienced teachers of other subjects who want go back to school to get the credentials necessary to teach math, science, or another subject for which there is an acute shortage of qualified teachers.

The TEACH Act also helps new math and science teachers build their skills through new teacher induction programs that will help them with the transition into teaching through working closely with mentor math and science teachers, a lighter teaching load, and other proven strategies that improve teacher satisfaction and retention.

Second, we cannot talk about competitiveness without talking about No Child Left Behind. The debate on reauthorizing this law has the potential to leverage our education system into this century. When we reauthorize the law, we are going to get some pressure to un-do some of NCLB's core values, including meaningful accountability, and as a nation we cannot and must not afford to return to the status quo from before NCLB.

Our competitive challenges mean we need all of our children more than ever. We cannot afford to leave any of our children behind—and part of the way we can help them move forward is to fully fund this law. The funding has not kept pace with what we've asked schools to do—to educate every child in this country to proficiency. Getting serious about meeting this goals would transform not only the lives of the students who aren't getting a first-rate education—and it would transform our nation. The shortfall between what was promised and what has been provided is $55 billion—serious money that would make a serious difference if we infused it into our classrooms.

Lastly, we cannot talk about competitiveness without talking about our high school dropout problem either. A dropout rate of nearly 50 percent in some communities bodes poorly not just for those who don't graduate, but also for their communities and our country. Investing in the education of every child in this country—and coming up with incentives to get students who have dropped out back into the classroom—should be part of any comprehensive approach to competitiveness. We must nurture the talent of all of our children.

I look forward to hearing from today's panel.

Mr. BOUSTANY [presiding]. Thank you, Mr. Miller, for your opening statement. The committee is privileged to have a very distinguished panel of witnesses today. I would like to begin by welcoming all of you.

The Honorable Tom Luce was confirmed as Assistant Secretary for the Office of Planning, Evaluation and Policy Development at the U.S. Department of Education in July 2005. His past experience includes being appointed five times to a major post by Texas Governors, including as Chairman of the Texas National Research Laboratory Commission, Chief Justice pro tempore of the Texas Supreme Court and delegate to the Education Commission of the States.

Mr. Luce is perhaps best known for his role in 1984 as the Chief of Staff of the Texas Select Committee of Public Education, which produced one of the first major reform efforts among public schools.

Our second witness is Ms. Cornelia Ashby. She has served in numerous capacities since joining the U.S. Government Accountability Office in 1973. Currently, Ms. Ashby serves as Director of Education, Workforce and Income Security, directing studies in numerous areas. Prior to this position, Ms. Ashby was GAO's Associate Director for Tax Policy and Administrative Issues.

Last but not least, we have Mr. Bill Archey, who is President and CEO of the American Electronics Association, the AEA, the Nation's largest industry association representing the electronics and information technology industry. AEA represents about 2,500 companies that span the spectrum of high tech technology products from semiconductors in computers to telecommunications in software. From 1986 to 1994, Mr. Archey was with the U.S. Chamber of Commerce.

Prior to joining the Chamber, Mr. Archey held a number of high level government positions, including Assistant Secretary for Trade Administration in the Department of Commerce from 1983 to 1986.

Before we start, I would like to remind the members that we will be asking questions of the witnesses after testimony. In addition, committee rule II imposes a 5-minute limit on all questions. For the witnesses, I know you are all experienced in doing this, but I will remind you about the lighting system. We will put the green light on when you begin. You will have 5 minutes. When it hits yellow you will have 1 minute left. Red means to wrap it up.

We will begin now with the Honorable Mr. Luce.

STATEMENT OF TOM LUCE, ASSISTANT SECRETARY, OFFICE OF PLANNING, EVALUATION AND POLICY DEVELOPMENT, U.S. DEPARTMENT OF EDUCATION

Mr. LUCE. Thank you, sir. I appreciate the opportunity to be here today with this committee as it considers this important topic. As you know, the President in the State of the Union message laid out an agenda for what he referred to as the American Competitiveness Initiative. I think it is very important that we in Congress take a real strong look at that, because we believe we have presented a balanced program that will address the desperate need in the K-12 pipeline to increase the flow of students who are prepared to have a foundation in life that they are going to need in math and science.

This is not only to ensure the next generation of Nobel Prize winners, but it is also to ensure that my children, my grandchildren, will have an opportunity to have a well-paying job. I think we have a cultural and communication issue to communicate within the country that unlike when I graduated from high school, it is an absolute essential today that someone have a very solid math and science background if they are to succeed at all in life.

That is because jobs today, such as an automobile mechanic, a welder, whatever, Intel chip factory floor worker, they are going to need a foundation in algebra. They have to think critically. They have to read technical manuals. I heard an alarming statistic last week from the college board and that is that there are 500,000 stu-

dents across the country today who took the PSAT test in the eighth, ninth and tenth grades, 500,000 who are qualified, based upon previous testing, to take and pass advanced placement calculus that do not take that subject.

That is low-hanging fruit, if you will. Despite weaknesses in the system, we have 500,000 students that we are not attracting that could be the future innovators in our country.

Second of all, you specifically asked me to address the Academic Competitiveness Council, which Congress created. I have been serving under that piece of legislation. Secretary Spellings is the chair of that cabinet level council, and I have been chairman of that working group that has already begun its work.

It started with President Bush convening the council in March. We have had three subsequent working group meetings. We have divided into three different subgroups, one covering all K-12 math and science programs, one covering all post-secondary math and science programs, and a third covering outreach and awareness programs.

Unlike the GAO report, or process, the Defense Department is also in this process. I suspect we will end up with an even larger number of programs and an even larger amount of money that we find is being spent across the government.

I would add that we already know that we have 1,000 flowers blooming in those programs, probably some weeds, but of immediate concern is that none of these programs are coming to scale, which is what we desperately need in the country.

We have lots of demonstration projects, lots of pilot programs, and what we need to do is to find the best and bring those to scale in our judgment. We have a tight time line, we are on schedule, the committees are working. Inventories from each civilian agency were due on May 1st.

We have some of those in, some will be in by the end of this week. Each subgroup will study each of the programs, with a goal of trying to come to at least common metrics for each of these programs so that we really could have some comparative data as to how these programs are impacting student achievement.

Unfortunately, most of these programs do not have student achievement data attached to them. Usually they are done on a more general evaluation technique, and one of the goals we hope to do is to agree upon and derive a consensus as to common metrics as to how these programs should be measured and also to make sure that we have specific goals for each of these programs.

As you might expect, the goals for these programs vary across agencies. Some are addressed to meeting the needs of the top 1 percent of our students. Others are designed more generally. One of the things I am most concerned about that I think Congressman Miller would share this concern is that there are a lot of No Child Left Behind principles that are not being applied in these programs.

In other words, a lot of the grant programs are not specifically addressed to teachers who are not highly qualified. What we know, based upon our department, the Education Department's own programs, often the teachers who sign up for those programs are the ones who already have content knowledge and are highly qualified.

We need to do a better job of directing certain programs, not all of then, but certain programs to the needs of highly qualified teachers.

We need to also direct programs specifically to schools that are not making adequate yearly progress as opposed to general guidelines in a program so that we are ensuring that we are following the principles of No Child Left Behind.

I think we have a big opportunity here to really make a difference in how we approach math and science. One thing that we know right now is that we are telling the public school community various ways to do various things without any study of which are the best, which are producing the best results, which one, which programs are scalable. We will always have pilot programs. We will always have demonstration projects, but we need to bring a lot of things to scale.

We will be on time in finishing the report that is due to Congress in January. We have already, as I said, broken into subgroups. We are working already from an outline of what we hope to submit to Congress. So we will be on time. We have had cooperation of every agency, and we look forward to reviewing with you what we find.

[The prepared statement of Mr. Luce follows:]

Prepared Statement of Tom Luce, Assistant Secretary, Office of Planning, Evaluation and Policy Development, U.S. Department of Education

Good morning. Thank you for inviting me here today to discuss the Administration's efforts to evaluate and coordinate federal math and science education programs, and in particular the role of the Academic Competitiveness Council in this important task. With over a dozen Federal agencies operating math and science education programs under the jurisdiction of multiple Congressional committees, it will come as no surprise to the Members of this Committee that the federal government has not had a coordinated approach to math and science education that ensures minimal duplication, maximum coordination, and rigorous and consistent standards of evaluation. For this reason, an important part of the President's American Competitiveness Initiative (ACI) is taking a close look at existing efforts and resources, figuring out what works and what doesn't, and developing recommendations to ensure that future investments support programs and strategies with the greatest promise for success.

Our budget proposal for the ACI includes a $5 million request for fiscal year 2007 to help improve the evaluation of federal math and science programs that focus on elementary and secondary education, with an emphasis on identifying programs that have proven effective and should be taken to national scale. Shortly after we announced this proposal, Congress created the Academic Competitiveness Council, chaired by the Secretary of Education, which is charged with the related, if broader, task of identifying federal math and science programs, determining their effectiveness, and recommending ways to integrate and coordinate these programs.

With these developments in mind, I would like to take a few minutes to describe the context for the Council, which is part of our overall effort to further strengthen American competitiveness in the global economy of the 21st century through the President's American Competitiveness Initiative.

Let me begin by acknowledging the work this Committee has already done on the President's Initiative in winning House approval of the College Access and Opportunity Act. As you know, this Act included an amendment sponsored by Congresswoman Cathy McMorris that helps advance the President's ACI proposals on Advanced Placement, Adjunct Teacher Corps and critical foreign languages. On behalf of the Administration, I want to commend Representative McMorris and the other Members of this Committee who worked on this amendment. We look forward to working with you and the Members of the Senate to move this important bill forward.

Innovation is the Key to Our Prosperity

If you think back over the past century, the world has made truly astounding progress in science, technology, engineering, and mathematics. And in virtually

every field—ranging from agriculture, transportation, and energy to medicine, communications, and computers—American innovation has led the way. More than any country on earth, our economic system rewards the ambition, imagination, and hard work that generate new ideas and new inventions.

But another key to innovation is education, and I don't think it's a coincidence that the world leader in technology, with just 6 percent of the world's population, continues to graduate more than one-fifth of the world's doctorates in science and engineering. Or that 38 of the world's 50 leading research institutions are in the United States.

At the same time, there is no doubt that the world is catching up. The spread of political freedom across the globe with the end of the Cold War, combined with the communications revolution brought by the Internet, have quickened the pace of innovation and dramatically increased global economic competition. As Commerce Secretary Carlos Gutierrez has said to me, "We've won the Cold War. Capitalism prevailed, and we have three billion more competitors. Now we just need to run faster!"

Increased global competition benefits both the United States and the world. But it does present new challenges. Evidence of these new challenges is not hard to find. In 2005, a majority of the top 10 recipients of patents from the U.S. Patent and Trademark Office were foreign-owned companies. In addition, as other countries expand their university infrastructure and graduate programs, America's share of the world's science and engineering doctorates could fall from 22 to 15 percent by 2010.

Moving further down the educational pipeline into our elementary and secondary schools, the U.S. needs to do better. Even though the 1983 Nation At Risk report recommended a minimum of three years of math and three years of science for all high school students, today just 22 States and the District of Columbia require at least this much math and science of their graduating seniors. And there are plenty of data suggesting that we are paying a high price for this delay in putting a stronger emphasis on math and science in our schools.

Nearly half of our 17-year-olds do not score at the Basic level on the National Assessment of Educational Progress—the minimum level of math skills required to apply for a production associate's job at a modern automobile plant. American 15-year-olds ranked 24th out of 29 developed nations in mathematics literacy and problem-solving on the most recent Program for International Student Assessment test. And just 7 percent of America's 4th- and 8th-graders reached the Advanced level on the 2003 Trends in International Math and Science Study (TIMSS). By comparison, 38 percent of Singapore's 4th-graders and 44 percent of its 8th-graders scored at the Advanced level on TIMSS. Our students are not just failing to keep up with their international peers; they also are not getting the preparation they need to succeed in the workforce or in our colleges and universities. Less than half of our high school graduates are ready for college-level math and science.

These data make a strong case that if we want to maintain our competitive edge in the global economy, we need to take action now. As the U.S. Chamber of Commerce recently noted, in its State of American Business report describing the challenge of remaining competitive in a global economy, "These are not academic questions for think tank futurists in ivory towers. They are 'here and now' questions that demand serious attention this year."

American Competitiveness Initiative

I believe the Chamber, the Business Roundtable, the National Association of Manufacturers, and others in the business community have got it exactly right. We need to improve math and science education right now, this year, so that in the future, all students have the skills they need to succeed in higher education and the workplace. And we need to ensure that all students have the skills they need to enter the pipeline of future scientists, engineers, and mathematicians. This is why President Bush has proposed his American Competitiveness Initiative, which includes $380 million in new funding to improve the quality of math and science education in our elementary and secondary schools, bringing the total the Department spends on math-science to almost $1 billion.

Within the Department of Education, the ACI would fund several activities designed to strengthen math and science education from kindergarten through grade 12. The Math Now for Elementary School Students initiative would provide $125 million in competitive awards to implement proven practices in math instruction that focus on preparing students in elementary school for more rigorous courses in middle and high school. In particular, our proposal emphasizes the importance of teaching and learning algebraic concepts in elementary school, so that students have the foundation they need to take and pass Algebra. Algebra is a true "gateway" course for students going into postsecondary education, and ultimately the work-

force, as demonstrated by Department data showing that 83 percent of students who took Algebra and geometry went to college within two years of high school graduation, while only 36 percent of students who did not take these critical math courses enrolled in postsecondary education.

A companion proposal, Math Now for Middle School Students, would focus $125 million on identifying and implementing research-based interventions for middle school students who have fallen behind in mathematics. This competitive grant initiative is similar to the Striving Readers program, and reflects the President's determination that struggling students receive the extra help they need to succeed in math.

Both Math Now proposals would be informed by the work of the National Mathematics Advisory Panel, which President Bush established through an Executive Order signed two weeks ago, on April 18, 2006. The Panel will work to identify research-based principles, practices, and components of effective mathematics instruction, and its recommendations will be a key consideration in making awards under the Math Now proposals. In addition, our 2007 request includes $10 million to help disseminate the Panel's findings and put its recommendations to work in K-12 classrooms nationwide.

Advanced Placement

At the high school level, the key ACI proposal is $90 million in new funding to expand teacher training under the Advanced Placement Incentive program, with an emphasis on AP instruction in math, science, and critical foreign languages. In combination with State and private matching funds, the proposal would train 70,000 teachers over the next five years to teach math, science, and critical foreign languages in AP and International Baccalaureate (IB) programs. New awards would be targeted to schools with high concentrations of low-income students that otherwise typically do not offer AP or IB courses, helping these schools to train the next generation for the global economy of the 21st century.

The potential impact of expanded AP and IB offerings is demonstrated by a College Board study of students whose scores on the Preliminary SAT (PSAT) suggest they have the potential of earning a 3, 4, or 5, which is generally considered a "passing score," on an AP exam if they had the opportunity to take one. These data suggest that the number of students in Tennessee who would be likely to pass AP tests in subjects like Calculus, Chemistry, Physics, and Biology is 5 to 10 times greater than the number of students currently achieving passing grades in these subjects. This is why, for example, the College Board estimates that in 2004 there were nearly 500,000 high school students whose PSAT scores indicated that they were ready for AP Calculus but who did not take the course for whatever reason.

This is strong evidence that the President's AP proposal could help significantly increase the number and percentage of high school graduates who not only are prepared for college-level math and science, but also have already passed college-level exams in high school. Our long-term goal is to increase the number of students taking AP-IB exams in math, science, and critical foreign languages from 380,000 today to 1.5 million in 2012, and to triple the number of students passing these tests to 700,000 by 2012.

Another ACI proposal that would help strengthen math and science education in our high schools is the request for $25 million to create an Adjunct Teacher Corps. This initiative would encourage experienced professionals with subject-matter expertise, particularly in math and science, to teach in secondary schools through such arrangements as part-time instruction, teaching while on leave from their regular jobs, or providing instruction online. There is no question that there is tremendous demand from schools for the kind of expertise that could be made available immediately through the Adjunct Teacher Corps. Department data show, for example, that nearly two-thirds of all school districts report that recruiting qualified science teachers is a significant challenge, and over 90 percent of districts with high percentages of minority students reported difficulty in attracting highly qualified applicants in math and science.

Focusing Existing Resources on the Competitivenss Challenge

In addition to these new activities, a key goal of the ACI is to use existing resources more effectively to help fill the pipeline of teachers and researchers in science, technology, engineering, and mathematics that we need to maintain America's competitive position in the technology-driven global economy. We know from last fall's report by the Government Accountability Office that estimates we have 13 different civilian government agencies spending about $2.8 billion on 207 different programs for math and science education. I think we all would agree that

we should look closely at the effectiveness of all of these programs, and that is exactly what the Academic Competitiveness Council will do.

On February 8, President Bush signed into law the Deficit Reduction Act of 2006, which authorized the Academic Competitiveness Council (the Council) for the purpose of evaluating and coordinating federal math and science education programs. The Council is chaired by Secretary Spellings, and includes officials from the major federal agencies that fund math and science education programs.

The Council is charged with identifying all federal programs that focus on math or science education, as well as the target populations served by those programs; assessing the effectiveness of these programs; and recommending ways to integrate and coordinate overlapping or duplicative activities.

Secretary Spellings responded quickly to this legislative mandate, and the Council held its first meeting on March 6, 2006. Initial activities include creating a broad inventory of math and science education programs across the federal government. This effort will include all federal agencies, as well as verification of program and funding information by the Office of Management and Budget. A Council working group, composed of program-level agency representatives, began meeting in April.

One early Council decision involves the recognition that there can be no single approach to evaluating the diverse types of math and science programs administered by the various agencies. Different types of programs, with different goals and target populations, may require different evaluation designs. Experts from the Department's Institute of Education Sciences, together with representatives from the Council on Excellence in Government, will work with agency representatives to identify effective evaluation strategies and to determine common metrics that may enable comparisons across programs.

The work of the Council is well started, then, and we expect to transmit a report of its findings, along with recommendations, to the Congress early next year, as required by the authorizing statute.

Conclusion

In conclusion, we believe the President's American Competitiveness Initiative is well designed to jumpstart improvement in math and science education through a combination of targeted new initiatives and more effective use of existing program resources. The ACI represents a comprehensive, measured approach to improving math and science education in our public schools and building a competitive workforce for our 21st century economy. It would draw on proven instructional methods to prepare elementary school students for more rigorous courses in middle and high school, help students who have fallen behind in middle school to catch up, raise expectations for high school students to take and pass challenging AP and IB courses, and expand the use of rigorous evaluations so that future investments can be targeted on activities that will strengthen the impact of the federal math and science education activities.

The Academic Competitiveness Council is an important component of this Initiative. The Council will tell us more about the efficacy of our current programs while giving us insight into how we move forward with the President's key Competitiveness proposals.

Thank you, and I will be happy to answer any questions.

Mr. BOUSTANY. Thank you. Ms. Ashby, you may now begin your testimony.

STATEMENT OF CORNELIA M. ASHBY, DIRECTOR OF EDUCATION, WORKFORCE, AND INCOME SECURITY, U.S. GOVERNMENT ACCOUNTABILITY OFFICE

Ms. ASHBY. Thank you. Mr. Chairman, and members of the committee. Thank you for inviting me here today to discuss to discuss STEM issues. My testimony will focus on trends and degree employment in STEM fields and Federal education programs intended to support study and employment in these fields. My comments are based primarily on our October, 2005 STEM report. We have, however, updated information on degree attainment and Federal legislation.

While post-secondary STEM enrollment and degree attainment have increased over the past decade, the proportion of students obtaining degrees in STEM fields has fallen from about 32 percent in academic year 1994-95 to about 27 percent in academic year 2003-2004. Stated another way, over the 10-year period, the number of STEM graduates, the solid line on the graphic, has changed less than the number of non-STEM graduates. This relationship is shown in the graphic by the relative slopes of the STEM and non-STEM lines.

Despite the overall increase, degree attainment in several STEM fields, including the biological sciences, the physical sciences, engineering and technology-related fields, declined over the same period, particularly at the doctoral level. Also the proportion of domestic minorities enrolled in STEM fields increased at the bachelor's level, but it did not change at the master's or doctoral level, and international students continued to earn about one-third or more of the degrees at both the master's and doctoral levels, engineering, mathematics, computer science and the physical sciences.

From 1994 to 2003, overall employment in STEM fields increased by an estimated 23 percent, compared to an estimated 17 percent in non-STEM fields. However, in certain STEM fields, including engineering, the number of employees did not increase significantly. While the estimated number of women employed in STEM fields increased, there was not a significant change in the percentage they comprised.

The number of African-Americans and Hispanic Americans employed in the STEM fields increased, but they remained underrepresented relative to their numbers in the civilian labor force. The number of foreign workers declined in STEM fields, due in part to difficulties with the U.S. visa system.

Further, according to a 2006 National Science Foundation report, about two-thirds of employees with degrees in science or engineering were employed in fields only somewhat or not at all related to their degree. As shown in the second graphic, the Federal Government spent approximately $2.8 billion in fiscal year 2004 to fund seven programs designed to increase the number of students in STEM fields and employees in STEM occupations, but little is known about the extent to which most STEM programs are achieving their designed results.

Thirteen Federal civilian agencies operated these programs, with two agencies, the National Institutes of Health and the National Science Foundation, administering nearly half of the programs. Most of the STEM programs either provided financial support to individuals, particularly to students and scholars, or equipment, building or other infrastructure support to institutions.

Most STEM programs were funded at $5 million or less, but 13 programs were funded at more than $50 million. Only half of these programs had been evaluated or had evaluations under way, and coordination amongst STEM education programs was limited.

However, in 2003, the National Science and Technology Council formed a group to address STEM education and workforce policy issues across Federal agencies. In addition, since our report was issued in October 2005, Congress established National Science and Mathematics Access to Retain Talent, SMART grants, to encourage

students from low-income families to enroll in STEM fields and an Academic Competitiveness Council to identify, evaluate and coordinate Federal STEM programs.

In conclusion, we have two observations. First, given some of the trends in STEM degree attainment and employment, it is uncertain whether the number of STEM participants will be sufficient to meet future needs.

However, women now outnumber men in college enrollment, and minority students are enrolling in post-secondary education at record high levels. Although historically underrepresented in STEM fields, these populations provide a valuable source for future STEM participation.

Second, it is important to know the extent to which existing STEM programs are appropriately targeted and making the best use of Federal resources. In other words, these programs must be evaluated.

In light of the Nation's large and growing long-term fiscal imbalance, information about the effectiveness of these programs can help policymakers and program managers in coordinating and improving existing programs as well as determining areas of unmet need.

Mr. Chairman, this concludes my statement. I would be happy to answer any questions.

[The prepared statement of Ms. Ashby follows:]

Prepared Statement of Cornelia M. Ashby, Director, Education, Workforce, and Income Security Issues, U.S. Government Accountability Office

Mr. Chairman and Members of the Committee: Thank you for inviting me here today to discuss U.S. trends in the fields of science, technology, engineering, and mathematics (STEM) in relation to the changing domestic and global economies. The health of the U.S. economy is directly tied to our science and technology industries, and the U.S. is a world leader in scientific and technological innovation. Since 1995, for example, the U.S. has generated the largest share of high-technology manufacturing output of any country in the world. Concerns have been raised, however, about the nation's ability to maintain its technological competitive advantage, especially in light of other nations' investments in their own research infrastructures, the aging and changing U.S. workforce, and the fiscal challenges facing the nation. From 1990 to 2003, research and development expenditures outside the U.S. have more than doubled, from about $225 billion to over $500 billion. According to the Census Bureau, the median age of the U.S. population in 2004 was the highest it had ever been, and the growth of the labor force is expected to slow considerably, becoming negligible by 2050. Further, as the U.S. becomes a more diverse society, minorities, in addition to women, will continue to represent a continuously increasing share of the workforce, yet women and minorities have tended to be underrepresented in STEM education programs and career fields. These factors, concurrent with the nation's large and growing long-term fiscal imbalance, present significant and difficult challenges for policymakers as they tackle how best to ensure that our nation can continue to compete in the global marketplace.

My testimony today will focus on three key issues: (1) trends in degree attainment in STEM and non-STEM related fields and factors that may influence these trends, (2) trends in the levels of employment in STEM and non-STEM related fields and factors that may influence these trends, and (3) federal education programs intended to support the study of and employment in STEM-related fields. My comments are based on the findings from our October 2005 report, Higher Education: Federal Science, Technology, Engineering, and Mathematics Programs and Related Trends.[1] Those findings were based on our review and analysis of data from a variety of sources. For that report we (1) analyzed survey responses from 13 federal departments and agencies with STEM education programs;[2] (2) analyzed data on students and graduates from the Department of Education's (Education) National Center for Education Statistics (NCES) and on employees from the Department of Labor's (Labor) Bureau of Labor Statistics (BLS); (3) interviewed educators and admin-

istrators at eight colleges and universities, federal agency officials, and representatives from associations and education organizations; (4) conducted interviews via e-mail with 31 students from five universities we visited; and (5) reviewed reports on various topics related to STEM education and occupations.[3] For this testimony, we provide updated information concerning the number of graduates in STEM and non-STEM fields as well as congressional legislation related to STEM education programs. Our work was conducted in accordance with generally accepted government auditing standards.

In summary, our findings are as follows:

• While postsecondary enrollment has increased over the past decade, the proportion of students obtaining degrees in STEM fields has fallen. In academic year 1994-1995, about 519,000 students obtained STEM degrees, about 32 percent of all degrees awarded. More students—approximately 578,000—obtained STEM degrees in academic year 2003-2004, but such degrees accounted for only 27 percent of those awarded. While the number of degrees obtained in some STEM fields increased, the number of degrees obtained in engineering, biological science, and certain technical fields declined. Further, despite increases in the overall enrollment and degree attainment by women and minorities at the graduate level, the number of graduate degrees conferred fell in several STEM-related fields in academic year 2003-2004. College and university officials and students cited sub-par teacher quality at the high school and college levels, poor high-school preparation, more rigorous and expensive degree requirements for STEM majors, and lower pay of STEM occupations relative to such fields as law and business as factors that discouraged students from pursuing degrees in STEM fields. Suggestions to encourage more enrollment in STEM fields include increased outreach at the kindergarten through 12th grade level, increased mentoring, and a greater federal presence.

• Coinciding with the spread of the Internet and the personal computer, the past decade has seen an increase in the overall number of STEM employees, particularly in mathematics and computer science. From 1994 to 2003, overall employment in STEM fields increased by an estimated 23 percent, compared to an estimated 17 percent increase in non-STEM fields. Mathematics and computer science showed the highest increase in STEM related employment—estimated at 78 percent—while employment in science-related fields increased an estimated 20 percent. However, in certain STEM fields, including engineering, the number of employees did not increase significantly over the 1994 to 2003 period. Further, while the estimated number of women employed in STEM fields increased, there was not a significant change in the percentage they comprised. While the number of African Americans and Hispanic-Americans employed in STEM fields increased from 1994 to 2003, they remained underrepresented relative to their numbers in the civilian labor force. Although foreign workers have filled more than 100,000 positions annually, many in STEM fields, through the H-1B visa program, employment levels declined in 2002 and 2003 after several years of increases.[4] Key factors affecting STEM employment decisions include mentoring for women and minorities and opportunities abroad for foreign employees.

• The federal government spent approximately $2.8 billion in fiscal year 2004 to fund over 200 programs designed to increase the numbers of students in STEM fields and employees in STEM occupations and to improve related educational programs. Thirteen federal civilian agencies operated these programs, and most programs either provided financial support to individuals, particularly to students and scholars, or equipment, building, and other infrastructure support to institutions. The funding reported for individual STEM education programs varied significantly, from $4,000 for a U.S. Department of Agriculture-sponsored program to $547 million for a National Institutes of Health (NIH) grant program. However, only half of these programs had been evaluated or had evaluations underway, and coordination among STEM education programs was limited. As we note in our 2005 report, it is important to know the extent to which existing STEM education programs target the right people and the right areas and make the best use of available resources before expanding federal support.

Since our report was issued in October 2005, several initiatives to improve federal support have taken place. For example, Congress established National Science and Mathematics Access to Retain Talent (SMART) Grants to encourage students from low-income families to enroll in STEM fields and foreign languages critical to the national security of the United States. In addition, Congress established an Academic Competitiveness Council, chaired by the Secretary of Education, to identify, evaluate, coordinate, and improve federal STEM programs. Further, according to Education, the department plans to determine which federal programs work best for students and how to use taxpayers' dollars more efficiently, as well has how to align

programs with the accountability principles of the No Child Left Behind Act of 2001 (NCLBA).[5]

Background

STEM fields include a wide range of disciplines and occupations, including agriculture, physics, psychology, medical technology, and automotive engineering. Many of these fields require completion of advanced courses in mathematics or science, subjects that are first introduced and developed at the kindergarten through 12th grade level. The federal government, universities and colleges, and other entities have taken steps to help improve achievement in these and other subjects through such actions as enforcement of NCLBA, which addresses both student and teacher performance at the elementary and secondary school levels, and implementation of programs to increase the numbers of women, minorities, and students with disadvantaged backgrounds in the STEM fields at postsecondary school levels and later in employment.

The participation of domestic students in STEM fields—and in higher education more generally—is affected both by the economy and by demographic changes in the U.S. population. Enrollment in higher education has declined with upturns in the economy because of the increased opportunity costs of going to school when relatively high wages are available. The choice between academic programs is also affected by the wages expected to be earned after obtaining a degree. Demographic trends affect STEM fields because different races and ethnicities have had different enrollment rates, and their representation in the population is changing. In particular, STEM fields have had a relatively high proportion of white or Asian males, but the proportion of other minorities enrolled in the nation's public schools, particularly Hispanics, has almost doubled since 1972. Furthermore, as of 2002, American Indians, Asians, African Americans, Hispanics, and Pacific Islanders comprised 29 percent of all college students.

Students and employees from foreign countries have pursued STEM degrees and worked in STEM occupations in the United States as well. To do so, these students and employees must obtain education or employment visas.[6] Visas may not be issued to students for a number of reasons, including concerns that the visa applicant may engage in the illegal transfer of sensitive technology. Many foreign workers enter the United States annually through the H-1B visa program, which assists U.S. employers in temporarily filling specialty occupations. Employed workers may stay in the United States on an H-1B visa for up to 6 years, and the current cap on the number of H-1B visas that can be granted is 65,000. The law exempts certain workers from this cap, including those in specified positions or holding a master's degree or higher from a U.S. institution.

The federal government also plays a role in helping coordinate federal science and technology initiatives. The National Science and Technology Council (NSTC) was established in 1993 and is the principal means for the Administration to coordinate science and technology policies. One objective of NSTC is to establish clear national goals for federal science and technology investments in areas ranging from information technologies and health research to improving transportation systems and strengthening fundamental research.

The Proportion of Students Obtaining Degrees in STEM Fields Has Fallen, and Teacher Quality and High-School Preparation Were Cited as Influential Factors

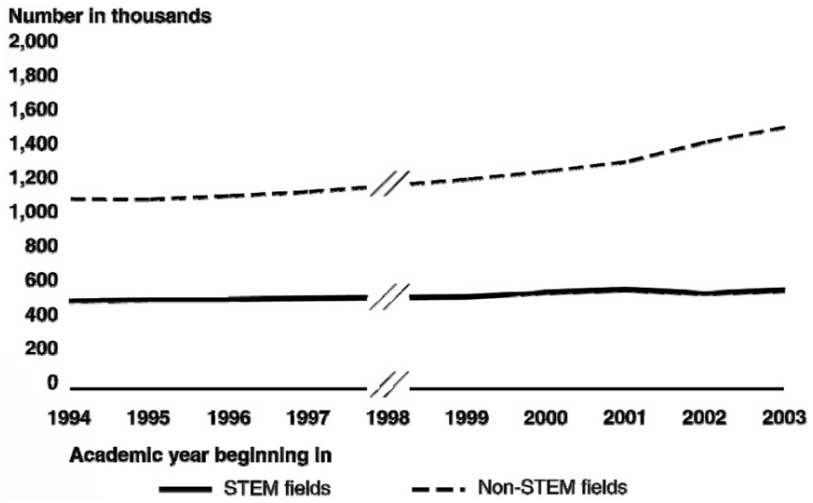
From the 1994-1995 academic year to the 2003-2004 academic year, the number of graduates with STEM degrees increased, but the proportion of students obtaining degrees in STEM fields fell. Teacher quality, academic preparation, collegiate degree requirements, and the pay for employment in STEM fields were cited by university officials and Education as factors affecting the pursuit of degrees in these fields.

Total Number of Graduates With STEM Degrees Increased, but Numbers Decreased in Some Fields, and Proportions of Minority Graduates at the Master's and Doctoral Levels Did Not Change

The number of graduates with degrees in STEM fields increased from approximately 519,000 to approximately 578,000 from the 1994-1995 academic year to the 2003-2004 academic year. However, during this same period, the number of graduates with degrees in non-STEM fields increased from about 1.1 million to 1.5 million. Thus, the percentage of students with STEM degrees decreased from about 32 percent to about 27 percent of total graduates. The largest increases at the bachelor's and master's levels were in mathematics and the computer sciences, and the largest increases at the doctoral level were in psychology. However, the overall number of students earning degrees in engineering decreased in this period, and the number of students earning doctoral degrees in the physical sciences and bachelor's degrees in technology-related fields, as well as several other fields also declined. Fig-

ure 1 shows the number of graduates for STEM and non-STEM fields in the 1994-1995 through 2003-2004 academic years.

FIGURE 1: NUMBER OF GRADUATES IN STEM AND NON-STEM FIELDS, 1994-1995 THROUGH 2003-2004 ACADEMIC YEARS



Source: GAO calculations based upon Integrated Postsecondary Education Data system data.
Note: Information for academic year 1998-1999 was not reported by IPEDS.

From the 1994-1995 academic year to the 2003-2004 academic year, the proportion of women earning degrees in STEM fields increased at the bachelor's, master's, and doctoral levels, and the proportion of domestic minorities increased at the bachelor's level. Conversely, the total number of men graduates decreased, and the proportion of men graduates declined in the majority of STEM fields at all educational levels in this same period. However, men continued to constitute over 50 percent of the graduates in most STEM fields. The proportion of domestic minorities increased at the bachelor's level but did not change at the master's or doctoral level. In the 1994-1995 and 2003-2004 academic years, international students earned about one-third or more of the degrees at both the master's and doctoral levels in engineering, math and computer science, and the physical sciences.

Teacher Quality, Mathematics and Science Preparation, and Other Factors Were Cited as Key Influences on Domestic Students' STEM Participation Decisions

University officials told us and researchers reported that the quality of teachers in kindergarten through 12th grades and the levels of mathematics and science courses completed during high school affected students' success in and decisions about pursuing STEM fields. University officials said that some teachers were unqualified and unable to impart the subject matter, causing students to lose interest in mathematics and science. In 2002, Education reported that, in the 1999-2000 school year, 45 percent of the high school students enrolled in biology/life science classes and approximately 30 percent of those enrolled in mathematics, English, and social science classes were instructed by teachers without a major, minor, or certification in these subjects—commonly referred to as "out-of-field" teachers.[7] Also, states reported that the problem of underprepared teachers was worse on average in districts that serve large proportions of high-poverty children.

In addition to teacher quality, students' high school preparation in mathematics and science was cited by university officials and researchers as a factor that influenced students' participation and success in the STEM fields. For example, university officials said that, because many students had not taken higher level mathematics and science courses such as calculus and physics in high school, they were immediately behind other students. A study of several hundred students who had left the STEM fields reported that about 40 percent of those college students who left the science fields reported some problems related to high school science preparation.[8]

Several other factors were cited by university officials, students, and others as influencing decisions about participation in STEM fields. These factors included the relatively low pay in STEM occupations, additional tuition costs to obtain STEM degrees, and the availability of mentoring, especially for women and minorities in the STEM fields. For example, officials from five universities told us that low pay in STEM occupations relative to other fields such as law and business dissuaded students from pursuing STEM degrees. Also, in a study that solicited the views of college students who left the STEM fields as well as those who continued to pursue STEM degrees, researchers found that students experienced greater financial difficulties in obtaining their degrees because of the extra time needed to obtain degrees in certain STEM fields.[9]

University officials, students, and other organizations suggested a number of steps that could be taken to encourage more participation in the STEM fields. University officials and students suggested more outreach, especially to women and minorities from kindergarten through the 12th grade. One organization, Building Engineering and Science Talent (BEST), suggested that research universities increase their presence in pre-kindergarten through 12th grade mathematics and science education in order to strengthen domestic students' interests and abilities. In addition, the Council of Graduate Schools called for a renewed commitment to graduate education by the federal government through actions such as providing funds to support students trained at the doctoral level in the STEM fields and expanding participation in doctoral study in selected fields through graduate support awarded competitively to universities across the country. University officials suggested that the federal government could enhance its role in STEM education by providing more effective leadership through developing and implementing a national agenda for STEM education and increasing federal funding for academic research.

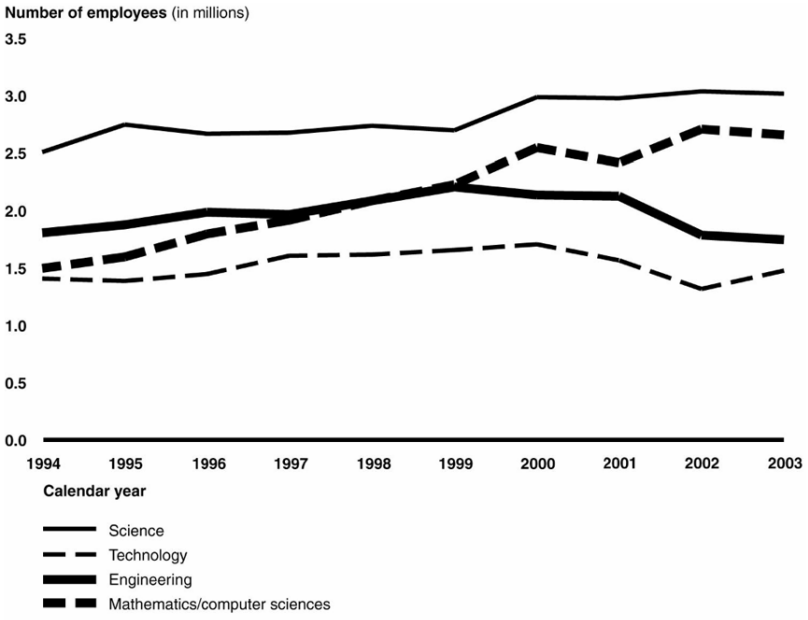
STEM Employment Rose in Math and Science but No Evidence of Increase in Engineering or Technology

Although the total number of STEM employees increased from 1994 to 2003, particularly in mathematics and computer science, there was no evidence that the number of employees in engineering and technology-related fields did. University officials, researchers, and others cited the availability of mentors as having a large influence on the decision to enter STEM fields and noted that many students with STEM degrees find employment in non-STEM fields. The number of foreign workers declined in STEM fields, due in part to declines in enrollment in U.S. programs resulting from difficulties with the U.S. visa system. Key factors affecting STEM employment decisions include the availability of mentors for women and minorities and opportunities abroad for foreign workers.

STEM Employment Rose Relative to Non-STEM Employment, but in STEM Fields the Proportion of Women Remained About the Same, Minorities Continued to be Underrepresented, and the Number of Foreign Workers Declined

From 1994 to 2003, employment in STEM fields increased from an estimated 7.2 million to an estimated 8.9 million—representing a 23 percent increase, as compared to a 17 percent increase in non-STEM fields. While the total number of STEM employees increased, this increase varied across STEM fields. Coinciding with the spread of the Internet and the personal computer, employment increased by an estimated 78 percent in the mathematics/computer sciences fields and by an estimated 20 percent in the sciences. There was no evidence that the number of employees in the engineering and technology-related fields increased. Further, a 2006 National Science Foundation report found that about two-thirds of employees with degrees in science or engineering were employed in fields somewhat or not at all related to their degree.[10] Figure 2 shows the estimated number of employees in STEM fields.

FIGURE 2: ESTIMATED NUMBERS OF EMPLOYEES IN STEM FIELDS FROM CALENDAR YEARS 1994 THROUGH 2003



Source: GAO calculations based upon CPS data.

Note: Estimated numbers of employees have confidence intervals of within +/− 9 percent of the estimate itself.

Women and minorities employed in STEM fields increased between 1994 and 2003, and the number of foreign workers declined. While the estimated number of women employees in STEM fields increased from about 2.7 million to about 3.5 million in this period, this did not result in a change in the proportion of women employees in the STEM fields relative to men. Specifically, women comprised an estimated 38 percent of the employees in STEM fields in 1994 and an estimated 39 percent in 2003, compared to 46 and 47 percent of the civilian labor force in 1994 and 2003, respectively. The estimated number of minorities employed in the STEM fields as well as the proportion of total STEM employees they constituted increased, but African American and Hispanic employees remained underrepresented relative to their percentages in the civilian labor force. For example, in 2003, Hispanic employees comprised an estimated 10 percent of STEM employees compared to about 13 percent of the civilian labor force. Foreign workers traditionally had filled hundreds of thousands of positions, many in STEM fields, through the H-1B visa program. In recent years, these numbers have declined in certain fields. For example, the number of approvals for systems analysis/programming positions decreased from about 163,000 in 2001 to about 56,000 in 2002.[11]

Key Factors Affecting STEM Employment Decisions Include Mentoring for Women and Minorities and Opportunities Abroad for Foreign Employees

University officials and congressional commissions noted the important role that mentors play in encouraging employment in STEM fields and that this was particularly important for women and minorities.[12] One professor said that mentors helped students by advising them on the best track to follow for obtaining their degrees and achieving professional goals. In September 2000, a congressional commission reported that women were adversely affected throughout the STEM education pipeline and career path by a lack of role models and mentors.[13]

University officials and education policy experts told us that competition from other countries in educational or work opportunities and the more strict U.S. visa process since September 11, 2001, affected international employee decisions about studying and working in the United States. For example, university officials told us that students from several countries, including China and India, were being re-

cruited by universities and employers both in their own countries and other countries as well as the United States. They also told us that they were also influenced by the perceived unwelcoming attitude of Americans and the complex visa process.

GAO has reported on several aspects of the visa process and has made several recommendations for improving federal management of the process. In 2002, we cited the need for a clear policy on how to balance national security concerns with the desire to facilitate legitimate travel when issuing visas.[14] In 2005, we reported a significant decline in certain visa processing times and in the number of cases pending more than 60 days, and we also reported that in some cases science students and scholars can obtain a visa within 24 hours.[15] However, in 2006, we found that new policies and procedures since the September 11 attacks to strengthen the security of the visa process and other factors have resulted in applicants facing extensive wait times for visas at some consular posts.[16]

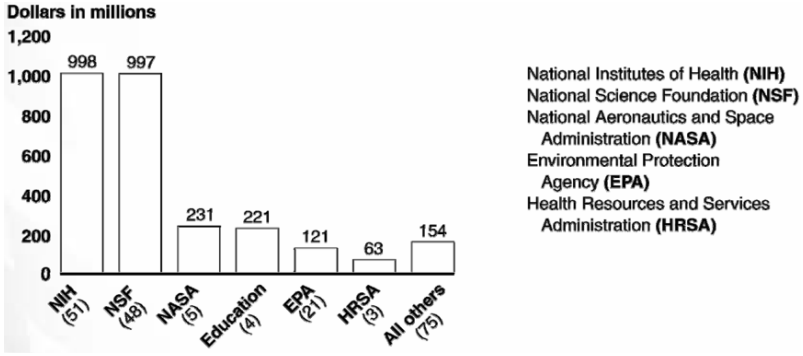
More Than 200 Federal Education Programs Exist to Promote STEM Careers, but Evaluation and Coordination Are Lacking

Officials from 13 federal civilian agencies reported spending about $2.8 billion in fiscal year 2004 for 207 education programs designed to support STEM fields, but they reported little about the effectiveness of these programs.[17] Although evaluations had been done or were under way for about half of the programs, little is known about the extent to which most STEM programs are achieving their desired results. Furthermore, coordination among the federal STEM education programs has been limited. However, in 2003, the National Science and Technology Council formed a subcommittee to address STEM education and workforce policy issues across federal agencies, and Congress has introduced new STEM initiatives as well.

Federal Civilian Agencies Reported Spending Billions for Over 200 STEM Education Programs in Fiscal Year 2004 and That Evaluations Were Completed or Under Way for About Half

Officials from 13 federal civilian agencies reported that approximately $2.8 billion was spent in fiscal year 2004 on 207 STEM education programs.[18] The funding levels for STEM education programs among the agencies ranged from about $998 million for the National Institutes of Health (NIH) to about $4.7 million for the Department of Homeland Security, and the numbers of programs ranged from 51 to 1 per agency, with two agencies—NIH and the National Science Foundation—administering nearly half of the programs. Most STEM education programs were funded at $5 million or less, but 13 programs were funded at more than $50 million, and the funding reported for individual programs varied significantly. For example, one USDA-sponsored scholarship program for U.S. citizens seeking bachelor's degrees at Hispanic-serving institutions was funded at $4,000, and one NIH grant program designed to develop and enhance research training opportunities was funded at about $547 million. Figure 3 shows the funding and number of STEM education programs by federal civilian agency.

FIGURE 3: FEDERAL STEM EDUCATION PROGRAMS AND FUNDING BY AGENCY, FISCAL YEAR 2004



Source: GAO survey responses from 13 federal agencies.

According to the agency responses to GAO's survey, most STEM education programs had multiple goals, and one goal was to attract students or graduates to pursue STEM degrees and occupations. Many STEM programs also were designed to

provide student research opportunities, provide support to educational institutions, or improve teacher training. In order to achieve these goals, many of the programs were targeted at multiple groups and provided financial assistance to multiple beneficiaries. STEM education programs most frequently provided financial support for students or scholars, and several programs provided assistance for teacher and faculty development as well. U.S. citizenship or permanent residence was required of the majority of programs. Table 1 presents the most frequent program goals and types of assistance provided.

TABLE 1: MOST FREQUENT FEDERAL PROGRAM GOALS AND TYPES OF ASSISTANCE PROVIDED

Most frequent program goals (in descending order)	Most frequent types of assistance (in descending order)
• Attract students to pursue degrees (2-year through Ph.D.) • Attract graduates to pursue careers in STEM fields • Attract and prepare students at any education level to pursue coursework in STEM areas • Provide growth and research opportunities for undergraduate and graduate students in STEM fields • Improve or expand the capacity of institutions to promote or foster STEM fields • Improve teacher education in STEM areas	• Financial support for students or scholars • Support for teacher and faculty development • Institutional support to improve educational quality • Institutional physical infrastructure support

Source: GAO survey responses from 13 federal agencies.

Note: Information on program goals and types of assistance was not provided by the Department of Defense.

Agency officials reported that evaluations—which could play an important role in improving program operations and ensuring an efficient use of federal resources—had been completed or were under way for about half of the STEM education programs. However, evaluations had not been done for over 70 programs that were started before fiscal year 2002, including several that had been operating for over 15 years. For the remaining over 30 programs that were initially funded in fiscal year 2002 or later, it may have been too soon to expect evaluations.

Federal Coordination Has Been Limited, but a Federal Group Was Established in 2003 to Help Coordinate STEM Education Programs Among Federal Agencies

Coordination of federal STEM education programs has been limited. In January 2003, the National Science and Technology Council's (NSTC) Committee on Science (COS) established a subcommittee on education and workforce development. According to its charter, the subcommittee is to address education and workforce policy issues and research and development efforts that focus on STEM education issues at all levels, as well as current and projected STEM workforce needs, trends, and issues. The subcommittee has working groups on (1) human capacity in STEM areas, (2) minority programs, (3) effective practices for assessing federal efforts, and (4) issues affecting graduate and post-doctoral researchers.

NSTC reported that as of June 2005 the subcommittee had a number of accomplishments and had other projects under way related to attracting students to STEM fields. For example, it had surveyed federal agency education programs designed to increase the participation of women and underrepresented minorities in STEM studies, and it had coordinated the Excellence in Science, Technology, Engineering, and Mathematics Education Week activities, which provide an opportunity for the nation's schools to focus on improving mathematics and science education. In addition, the subcommittee is developing a Web site for federal educational resources in STEM fields and a set of principles that agencies could use in setting levels of support for graduate and post-doctoral fellowships and traineeships.

Congress Created New Grants to Help Needy Students Obtain STEM Degrees and Established a Council to Determine the Effectiveness of Federal STEM Programs and Provide Coordination

In passing the Deficit Reduction Act of 2005,[19] the Congress created a new source of grant aid for students pursuing a major in the physical, life, or computer sciences, mathematics, technology, engineering, or a foreign language considered critical to the national security of the United States. These National Science and Mathematics Access to Retain Talent Grants—or SMART Grants—provide up to $4,000 for each of two academic years for eligible students. Eligible students are those who are in their third or fourth academic year of a program of undergraduate education at a four-year degree-granting institution, have maintained a cumulative grade point average of 3.0 or above, and meet the eligibility requirements of the federal govern-

ment's need-based Pell grant program.[20] Education expects to provide $790 million in SMART Grants to over 500,000 students in academic year 2006-2007.

Congress also established an Academic Competitiveness Council in passing the Deficit Reduction Act of 2005. The council is comprised of officials from federal agencies with responsibilities for managing existing federal programs that promote mathematics and science and is chaired by the Secretary of Education. Among the statutory duties of the council are to (1) identify all federal programs with a mathematics and science focus, (2) identify the target populations being served by such programs, (3) determine the effectiveness of such programs, (4) identify areas of overlap or duplication in such programs, and (5) recommend ways to efficiently integrate and coordinate such programs. Congress also charged the council to provide it with a report of its findings and recommendations by early 2007. In an April 2006 hearing before the House Committee on Education and the Workforce, the Secretary of Education testified that she and President Bush convened the first meeting of the council on March 6, 2006.

Concluding Observations

While the total numbers of STEM graduates have increased, some fields have experienced declines, especially at the master's and doctoral levels. Given the trends in the numbers and percentages of graduates with STEM degrees—particularly advanced degrees—and recent developments that have influenced international students' decisions about pursuing degrees in the United States, it is uncertain whether the number of STEM graduates will be sufficient to meet future academic and employment needs and help the country maintain its technological competitive advantage. Moreover, although international graduate applications increased in academic year 2005-2006 for the first time in three years, it is too early to tell if this marks the end of declines in international graduate student enrollment. In terms of employment, despite some gains, the percentage of women in the STEM workforce has not changed significantly, minority employees remain underrepresented relative to their employment in the civilian labor force, and many graduates with degrees in STEM fields are not employed in STEM occupations. Women now outnumber men in college enrollment, and minority students are enrolling in record-high levels at the postsecondary level as well. To the extent that these populations have been historically underrepresented in STEM fields, they provide a yet untapped source of STEM participation in the future.

To help improve the trends in the numbers of graduates and employees in STEM fields, university officials and others made several suggestions, such as increasing the federal commitment to STEM education programs. However, before expanding the number of federal programs, it is important to know the extent to which existing STEM education programs are appropriately targeted and making the best use of available federal resources—in other words, these programs must be evaluated—and a comprehensive evaluation of federal programs is currently nonexistent. Furthermore, the recent initiatives to improve federal coordination, such as the American Competitiveness Council, serve as an initial step in reducing unnecessary overlap between programs, not an ending point. In an era of limited financial resources and growing federal deficits, information about the effectiveness of these programs can help guide policy makers and program managers in coordinating and improving existing programs as well as determining areas in which new programs are needed.

Mr. Chairman, this concludes my prepared statement. I would be pleased to respond to any questions that you or other members of the Committee may have.

ENDNOTES

[1] GAO, Higher Education: Federal Science, Technology, Engineering, and Mathematics Programs and Related Trends, GAO-06-114 (Washington, D.C.: October 12, 2005).

[2] The Department of Defense (DoD) did not submit a survey. According to DoD officials, DoD needed 3 months to complete the survey and therefore could not provide responses within the timeframes of our work

[3] For the purposes of this testimony, we will use the term "agency" when referring to any of the 13 federal departments and agencies that responded to our survey.

[4] H-1B visas allow non-citizens to work in the United States.

[5] Pub. L. No. 107-110 (2002). NCLBA amended and reauthorized the Elementary and Secondary Education Act—the largest and most comprehensive federal education law—and focused on improving students' academic performance.

[6] There are several types of visas that authorize people to study and work in the United States. F visas ("student visas") are for study at 2- and 4-year colleges and universities and other academic institutions; J visas ("exchange visitor visas") are for people who will be participating in a cultural exchange program; L visas ("intracompany transferee visas") are for managerial positions and for those with specialized skills; and M visas are for nonacademic study, such as at vocational and technical schools. In addition, H-1B visas allow non-citizens to work in the United States.

[7] National Center for Education Statistics, Qualifications of the Public School Teacher Workforce: Prevalence of Out-of-Field Teaching 1987-88 to 1999-2000, May 2002, revised August 2004, Washington, D.C.

[8] The student study results are from Seymour, Elaine, and Nancy M. Hewitt, Talking about Leaving: Why Undergraduates Leave the Sciences, Westview Press, 1997, Boulder, CO.

[9] Ibid.

[10] National Science Foundation, Science and Engineering Indicators 2006, Volume 1, National Science Board, January 13, 2006.

[11] GAO, H-1B Foreign Workers: Better Tracking Needed to Help Determine H-1B Program's Effects on U.S. Workforce, GAO-03-883 (Washington, D.C.: September 10, 2003).

[12] GAO, Gender Issues: Women's Participation in the Sciences Has Increased, but Agencies Need to Do More to Ensure Compliance with Title IX, GAO-04-639 (Washington, D.C.: July 22, 2004).

[13] Report of the Congressional Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development, Land of Plenty: Diversity as America's Competitive Edge in Science, Engineering, and Technology, September 2000.

[14] GAO, Border Security: Visa Process Should Be Strengthened as an Antiterrorism Tool, GAO-03-132NI (Washington, D.C.: October 21, 2002).

[15] GAO, Border Security: Streamlined Visas Mantis Program Has Lowered Burden on Foreign Science Students and Scholars, but Further Refinements Needed, GAO-05-198 (Washington, D.C.: February 18, 2005).

[16] GAO, Border Security: Reassessment of Consular Resource Requirements Could Help Address Visa Delays, GAO-06-542T (Washington, D.C.: April 4, 2006).

[17] GAO asked agencies to include STEM and related education programs with one or more of the following as the primary objective: (1) attract and prepare students at any education level to pursue coursework in STEM areas, (2) attract students to pursue degrees (2-year degrees through post-doctoral degrees) in STEM fields, (3) provide growth and research opportunities for college and graduate students in STEM fields, (4) attract graduates to pursue careers in STEM fields, (5) improve teacher (pre-service, in-service, and postsecondary) education in STEM areas, and (6) improve or expand the capacity of institutions to promote or foster STEM fields. The Department of Labor's (Labor) programs did not meet our selection criteria for STEM programs, and, as noted above, the Department of Defense (DoD) did not submit a survey.

[18] The program funding levels, as provided by agency officials, contain both actual and estimated amounts for fiscal year 2004.

[19] Pub. L. No. 109-171 (2006).

[20] The Federal Pell Grant Program promotes access to postsecondary education by providing need-based grants to low-income students.

Mr. BOUSTANY. We thank you for that testimony.

Mr. Archey, you are now recognized.

STATEMENT OF WILLIAM T. ARCHEY, PRESIDENT AND CHIEF EXECUTIVE OFFICER, AMERICAN ELECTRONICS ASSOCIATION

Mr. ARCHEY. Thank you very much, Mr. Chairman. This hearing is timely for both AEA and the high tech industry, because 2 weeks ago today we published our annual volume called Cyberstates, which is a look at high tech employment, wages, exports, and various other data for all 50 States and nationally.

I would like to just note why it is germane. First of all, for the year 2005, for the first time since the year 2000, the high tech industry actually added jobs, 61,000 jobs. Included in that is for the first time since also the year 2000 high tech manufacturing employment actually went up.

The other thing or one of the other important data points in that is that this is Bureau of Labor Statistics. The unemployment rate for the year 2005 for electrical engineers is 1.5 percent, and for overall engineers 2.3 percent. I would submit no matter what school of economics you come from that is probably full employment.

I would also note that our data shows, and, again, using BLS data, that the average high tech salary in the United States pays 85 percent higher than the average private sector salary. In some States, by the way, such as California, it is 106 percent differential between the average high tech salary and that of the rest of the private sector.

I would like to note just a two-prong problem that is germane to this hearing. The first is it is obvious we do not have enough Americans with the proper science, math or engineering background, and the problem is becoming more acute because of what I suggest, which is the first time high tech companies are actually hiring. In fact, there are thousands of jobs out there. They are not going filled.

The second problem that compounds the error, the compounding problem is that for the last 60 years one of the great safety valves for not having enough American workers has been the ability to attract the best and the brightest from elsewhere in the world. The post-9/11 immigration policy has greatly curtailed that and continues to be a problem.

I would just note that if you were to talk to a high tech executive a year and a half ago and said what are the single biggest problems you are facing the first would be Sarbanes-Oxley, section 404, and the second one would be what are we going to do about stock option expensing.

If you talk to a high tech exec today, there are two issues and they are basically equal in priority. The first is Sarbanes-Oxley, section 404, and the second one is how do we attract qualified workers, particularly from America, and how do we deal with the problems we are having with visa reform.

The overall problem as we see it is that it is not just a problem for business, and it is not just a problem for the educational establishment. I met with Tom Luce's boss a few months ago, and Secretary Spellings made an interesting observation that most of the pressure for reform, particularly in math and science education, was coming from the business community, but not from parents and teachers.

The interesting thing about that is that there was a national survey about 2 months ago that confirmed that, that basically said that parents don't see the problem, math and science as being a problem. In fact the biggest problem they cited was kids have too much homework.

One of the things that we would note is that we are doing a whole series of regional summits on competitiveness with a major emphasis on getting to papers and teachers not about per se math and science education reform, but rather to talk about what the competitiveness challenges are facing America, the number of engineers from China, all of those kinds of data points.

We have come to conclude that most parents don't understand what that challenge is. Therefore, the urgency of math and science to them is not of great moment. I was mentioning to Tom before we came up here that I have got a son who is a freshmen in college, I said, you know, your generation versus mine—this is the point that Tom had made—the difference is that your generation, you have got to know an awful lot about math and science just to understand your life, let alone, you know, actually going to a career in it. Whereas I could have been an absolute Luddite back in 1964 when I graduated from college. It wouldn't have mattered.

So our point is that the issue of getting qualified workers has now become a major, major problem for high tech companies. It is a major problem in a period of time where the high tech industry

right now, overall, is quite healthy and has a lot of job openings and cannot fill them.

Thank you very much, Mr. Chairman.

[The prepared statement of Mr. Archey follows:]

Prepared Statement of William T. Archey, President and Chief Executive Officer, American Electronics Association

Good morning. My name is William T. Archey, and I am the President and CEO of the AeA, the nation's largest high-tech trade association. On behalf of AeA's 2,500 members that span the spectrum of electronics and information technology companies, from semiconductors and software to mainframe computers and communications systems, I would like to thank you for this opportunity to testify before your Committee on the current and future educational needs of America's high-technology industry.

I would like to start off my testimony this morning with a number for the committee to remember: 1.5 percent. One point five percent is the 2005 unemployment rate for electrical engineers. One point five percent is dramatically lower than the overall unemployment rate in this country. For all practical purposes, 1.5 percent is full employment by whatever metric you use.

Now this may shock many people because it goes against the conventional wisdom about the state of the high-tech industry, specifically about the job situation. There are thousands of high-tech jobs available in the tech industry. In fact, the most recent data from our Cyberstates 2006 report, published just two weeks ago, showed that U.S. tech employment was up in 2005 by 61,000 jobs, the first increase since 2000, for a total of 5.6 million. Even the high-tech manufacturing industry added jobs.

However, the key to this job growth is the skills of the workforce. These jobs are only available to those with the proper education and up-to-date training. In talking with the CEOs of my member companies, this 61,000 net increase of U.S. tech jobs would have been much higher if more skilled labor was available to our tech companies. Many of my larger companies have literally thousands of job openings in the United States that remain unfilled.

We as a nation need to address this critical shortage of homegrown high-skilled talent. We need to face up to the long-term challenge of our education pipeline, which is failing to prepare tomorrow's workforce for an economy that is knowledge based and driven by technology.

When comparing U.S. K-12 students to their international counterparts, a disturbing trend emerges, particularly in math and science. While U.S. students in the 4th and 8th grades score in the top percentile, our 12th graders score at the bottom in math and science. This same trend occurs whether you examine TIMSS[1] data or OECD[2] data. It even occurs when examining U.S. Department of Education data.

The Department of Education reports in their NAEP's test that our 4th and 8th grader have improved their math and sciences scores, yet our 12th graders' scores in math and science have declined.[3] And, even while 4th and 8th grade scores are improving, only 32 percent of 4th graders and 29 percent of 8th graders tested proficient in math. This does not bode well for a knowledge-based economy than runs on talent and technical skills.

The challenge is that without this foundation in math and science, we are closing doors for our children. Without this foundation, our children face tremendous hurdles for careers as doctors, engineers, scientists, computer programmers, or any technically-based profession.

And, more fundamentally, this is a challenge for our entire population. In a world in which technology is increasingly ingrained in every aspect of our lives, all Americans need to be technically proficient. Otherwise, they risk falling behind.

As I talk with technology executives, the number one problem that they repeatedly identify is that of competitiveness and of access to a qualified workforce. They are increasingly frustrated by what they see as a decline in the importance of math and science education in our K-12 school system. The tech industry sees K-12 math and science education as the building block on which all future tech workers will

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[1] The Third International Mathematics and Science Study compares math and science achievement in 21 different countries at the 12th grade.

[2] The Organization for Economic Cooperation and Development's Programme for International Student Assessment examines the knowledge and skills of 15-year-olds in the 30 member nations.

[3] The National Assessment of Educational Progress examines student achievement across the United States at the 4th, 8th, and 12th grade level.

be based, and as such they spend considerable time and money promoting these skills.

Interestingly enough there is a consensus in the tech industry about the need to do something. There is also a consensus in our colleges and universities about the need to do something. But this message has yet to reach the constituency that most needs to hear it: our parents, teachers, and children in the K-12 system.

I recently met with Secretary of Education Margaret Spelling who reinforced this very point to me. She told me that all the pressure for education reform-particularly for improvements in math and science education-are coming from business and our universities. She hears very little from the parents and teachers about the need for change. A recent national survey by Public Agenda reinforced this fact. It found that parents do not see a problem with math and science education, despite the statistics that I gave earlier.

To address these concerns AeA is mobilizing its nationwide grassroots organization to communicate the urgency of these issues to the American people. We have convened a series of regional seminars to address this skill shortage and to inform communities about the importance of math and science education at the K-12 level and about the need for a technically savvy workforce. The competitiveness debate cannot remain inside the beltway. This is not only about the future of the U.S. tech industry, but about our children's future. It is their jobs, their prosperity, and their standard of living that are at stake.

We as an industry and a nation have to improve the perception and attraction of careers in science, technology, engineering, and math. All too often, these careers are seen as the domain of nerds and geeks, instead of inventors and leaders. This is tragic. This type of attitude embraces ignorance, and ignorance is poison to an economy that runs on technology and innovation.

Let's face it, we are asking more from our students. We are asking more from our parents and teachers. We are asking for everyone to recognize the new world out there. In educating our children, we would be wise to exalt the accomplishments of America's great inventors and innovators. Instead of enticing our children to pursue science and engineering with statistics about how hard the classes are or how likely they are to flunk out, we would be better served by focusing on how scientists and engineers make life changing contributions to our society. And, if personal fulfillment isn't enough, there is more. Jobs in the high-tech industry pay on average 85 percent more than the average private sector job.

The competition we now face comes not only from the neighboring school district or state, but from the entire, increasingly flat world.

This search for qualified workers is compounded by a visa policy that is badly broken. For the past 60 years America has been the beneficiary of an influx of many of the most talented minds on the planet. This period could grind to a halt given the post 9/11 restrictive visa policies, tremendous opportunities abroad, and the perception by foreign nationals that they are not wanted.

When 40-50 percent of our graduate students in math, science, and engineering are foreign nationals, we cannot afford a visa policy that kicks them out of the United States. These individuals graduate from U.S. colleges and universities and often represent a critical pool of qualified talent.

By kicking them out, we lose their intellectual abilities and innovations. By kicking them out, we force our companies to follow them abroad. By kicking them out, we lose the new companies, wealth, and, ultimately, the hundreds of thousands of high-paying jobs they would have created. By kicking them out, we are only helping our competitors in other nations enhance their talented labor pools by chipping away at our own.

And, beyond the economics, consider what happens even when they do go home. Foreign nationals who return with an American education tend to retain positive impressions of the United States as they become leaders in their own countries, fostering strong friendships and linkages. I saw this firsthand recently in Shenzhen, China when a group of high-tech executives met with the vice-mayor who proudly told us about earning his Ph.D. at UCLA. His experience there gave him a profoundly favorable view of the United States.

I fear that we are losing these linkages. These people become members of the business and political elite in their countries. We cannot afford to lose these ties.

America's dirty little secret is that high-skilled immigration has for decades been a critical safety valve for attracting and retaining the best and the brightest from around the world. We as a nation tend to underestimate their contributions. By kicking skilled immigrants out, we are kicking out tomorrow's Albert Einstein, Andy Grove, or Sergey Brin.

So, while the need to act is strongly recognized by many here in Congress on both sides of the aisle, the legislative action that could began to address these issues lies

dormant. Too many people, including Members of Congress and the national media, remain distracted by more immediate and visible concerns.

Unfortunately, by the time this issue overtakes all other issues in Congress, it will already be too late. The education of our workforce is a long-term process, with long-term consequences for our businesses and for our nation.

The irony is that the United States already has proven it can compete, but often needs fear to motivate it. In the 1950s, the Soviet Union challenged American leadership in technology by launching the world's first satellite, Sputnik. Americans feared the Soviets would use this space technology as a weapon. The United States met this challenge by launching a national program to improve math and science education, ultimately winning the space and technology race. In the late 1980s and early 1990s, fear abounded that Japan would become the world's dominant economy. U.S. businesses responded to the challenge by refocusing their efforts, adopting new technology, and innovating their products and processes.

America can certainly compete. It has the flexibility, pioneering spirit, and capital to win the race; but to do this America needs to recognize that future innovation is not predetermined to occur in the United States. Even if we were doing everything right, we still face unprecedented competition from abroad. Rather than face the new global economy unprepared, America needs to confront this competition head-on by preparing our pipeline and building a strong foundation of math and science education. If we don't, America faces the erosion of its lead in knowledge-based industries.

Thank you for this opportunity to testify before you this morning. For more about the competitiveness issues facing the technology industry and our country, please read AeA's Competitiveness report at: www.aeanet.org/competitiveness.

Chairman MCKEON [presiding]. Mr. Miller.

Mr. MILLER. Thank you, Mr. Chairman. Thank you to the panel.

We have discussed this in the past, the idea—Bill, I know you have been out talking to parent and teacher organizations, but you touched on it at the end of your remarks, sort of reconfiguring the idea what it means to be engaged in math and science education, and what possibilities that holds at the end of your educational attainment that the people don't really see the connect of and the necessity of math and science education, to, as you said, to know your life or to figure out your life or to participate in a career that is going to reward you in a fashion to provide for your family in the near future and the rest of that.

A lot of studies look, and they have suggested, and I have alluded to in my testimony, that we have people teaching math and science who really don't know very much about it, so it is hard for them to inspire these students because they really can't take them to the next place in that learning process about the excitement of this.

I spent a lot of time in classrooms where you do see a teacher that is thoroughly versed in the subject matter, whether it is biology or whether it is computer languages, you see a different attitude with those students and the engagement and maybe thinking about taking a second or third course of the sciences, whatever it is.

But I am really worried that we are taking a lot of potential talent in these classrooms, and we are turning them off. Because we don't have people who are competent enough to then take education, as we like it to be, whether it is history, math or science, to excite students about the possible continued learning in that field. I don't know what feedback you are getting from your forums, whether parents sense this or they don't believe it is true or not accurate?

Mr. ARCHEY. I would say it is a very mixed bag, Mr. Miller. The other side of that is our regional summits are also showing something else.

We are an immensely insular society. We are not particularly interested in what the hell is going on in the rest of the world, when you start to convey the notion about what the challenge is, and that it has not been predetermined that America is going to be No. 1, technologically or economically. The last 60 years we earned it.

But the point I would make is that most people don't see it that way. I used to joke about the fact that my hometown in Pittsfield, Massachusetts, they didn't care about what was going on in Lanesborough in the next town let alone what was going on in Beijing. I think this is one of the problems we are seeing.

We do get the parents audiences, and we start talking to them about certain competitiveness indices. A lot of them do wake up and then they get very concerned. Because what we are talking about for the most part is let us get rid of the word competitiveness, even innovation, let us talk about really good jobs for your kids and your grandkids.

Mr. MILLER. Tom.

Mr. LUCE. I would simply add to that. I really do think it is a cultural factor we have to address with education. Our Secretary, for instance, has a way of saying when then Governor Bush talked about every child reading at grade level by the end of the third grade in Texas, every head would nod.

If we said today, every student needs to take and pass algebra in the eighth grade, every head would go like this. That is because we haven't communicated that—for instance, we have proposed a parallel program to reading first, math now, which would follow the same guidelines of trying to better form the teaching of math. We started to call the program Striving Mathematicians till we realized not many people would say there are striving mathematicians.

We have to convince people that it is the key to a job whether you are a mathematician or a scientist. She would also point if you were at a reception and you visited very long somebody might come up and brag to you that they can't balance the checkbook. They wouldn't brag to you that they couldn't read. So we have to address and bring it to a level that everybody understands that math and science is important to their kids' future.

I will also agree on content knowledge. What we had to do in reading was develop sound principles and retrain teachers. We have to do the same thing in math. We are just going to announce the end of this week, the executive order was signed creating a National Math Panel. We have to look at how are we instructing youngsters in elementary school and middle school so they are prepared to move into high school with better fundamentals.

That is going to take content help to those teachers. We have to bring instructional help and content help. We have to do it on a national scale. We can't do it with pilot programs.

Mr. MILLER. Mr. Archey, if I might, over the last couple of years, there has been sort of a raging debate that if you did create these new engineers, if you did create new computer scientists, if you did create people in those fields, those jobs are being outsourced so

they will not get the advantage of this education. So why would you pursue this education?

In the last several weeks I had an opportunity for different reasons to spend time with the companies who would hire these individuals, where they are CEOs. They have now indicated this is a matter of competition to find engineers today for jobs here in the United States. It is not a question that he is being outsourced, this is now companies openly competing against one another.

If you hear about someone who is thinking about a job, you want to see if you can pursue that individual to see if you can lure them away. Has it changed that much because of this? Do you believe it has?

Mr. ARCHEY. I believe it has. Again, as I cited with the data, the industry didn't really start hiring big time until 2005. There was a 5-year lag in terms of serious recruitment. Then it really geared up in 2005. Then I think that there is a problem of getting American workers. The other problem you have got is you have got 57 percent of all PhDs in engineering who are foreign nationals graduating from U.S. universities.

The problem is that it is more and more difficult to get access to them through the H-1B program because the H-1B program basically fills its allotment basically the second day of the fiscal year.

I will give you one quick anecdote from a CEO of a company in California, a very large company. I was with him a couple of weeks ago, and he made an interesting, interesting observation. He said, I have always considered some of the government stuff is not terribly crucial to the bottom line of my company. He says you know, right now, I am hitting it two ways.

I said, how so? He said, we cannot get the kind of engineers that we want. They have a particular emphasis in a particular kind of technology that requires very interesting engineering skills, and they can't get Americans. But he said, I can't get foreigners either because I can't get the visas.

I said, where do you want to go then? He made an interesting comment for this particular specialty. The best engineers in the world were in Bulgaria and Romania, but a very difficult time in getting them. He said I am in a situation right now where government policy or the lack thereof really is affecting my ability to run this company.

Mr. MILLER. Thank you.

Chairman MCKEON. Mr. Boustany.

Mr. BOUSTANY. Thank you, Mr. Chairman. It has been mentioned that half of high school graduates are not ready for college level math and science. It has also been mentioned that 22 States require only 3 years of math and science for high school work. This is problematic, and we know that science and math education follow a sequential pattern. If you lose out in one particular year or lose out along the way, you get lost and get turned off to it.

What can we do from the Federal level? Since most of the curricula are designed at the State level, what is our role? What can we do to encourage sequential tracking as opposed to horizontal tracking to make sure that we are getting good, we are not losing kids along the way, and we are actually truly scientifically tracking the students' progress?

Mr. LUCE. I think you have raised a very important point. In our National Math Panel, we hope that we can come out with the principles, components, that should guide mathematics instruction, not the curriculum. We are not in the curriculum business but just like in reading we develop some principles and components.

We then had grants to encourage States to retrain their teachers. We need to do the same thing in math. In that charge to that panel, we said, what do we have to do in elementary school, in prealgebraic concepts to actually prepare a student to take and pass algebra in the eighth grade or the ninth grade? Because if they don't do that, they said you can't follow on the path.

Every study ever done by the U.S. Department of Education says the No. 1 indicator of college readiness is Algebra 2. You know, it is a difficult concept to sell to people. As I said, there are cultural issues but it is an absolute necessity in today's world. We believe we need that national math panel, and we need the Math Now Program to ensure that we get on with it.

We just, it was mentioned earlier that the academic competitive grants, we announced the policy on rigor for the first year. We are trying to encourage Pell student aid toward the completion of Algebra 1, hopefully 2 years from now Algebra 2, so we can encourage and incentivise students to do these things.

Mr. BOUSTANY. The other part of the equation is qualified teachers in math and science. We just passed the higher ed reauthorization. In that bill we have the teacher incentive fund. Can you comment on that? Do you feel like that is going to have an impact?

Mr. LUCE. Yes, sir, we do. We hope it does. We have published the competition proposals, I think it was in the register Monday of this week for the $100 million that Congress appropriated. We hope we will continue to fund that program. We think it is very important to have programs that are piloted that can show how we can successfully deal with differentiated pay, for instance, for math and science teachers in our schools. How can we create incentives for teachers to teach in our high-need schools who have content knowledge?

I think incentives are an issue that have to be addressed. The advanced placement incentive program that we have proposed has been supported by every teacher group where it has been implemented because it gives bonuses for teachers for additional duties and also to receive professional development from the college board people, and it rewards students who take and pass AP courses.

We believe that is a program that has been proven, it can be taken to scale in 50 States. So we believe we need to address elementary, middle and high school, and the way to address high school is with advanced placement incentive programs, where today approximately 40 percent of our high school, most of them in high-need areas, don't offer advanced placement courses.

Mr. BOUSTANY. Thank you, Mr. Chairman. I yield back.

Chairman MCKEON. Mr. Tierney.

Mr. TIERNEY. Thank you, Mr. Chairman. I want to thank the distinguished members of the panel for your testimony here today.

Mr. Archey, I appreciate what you said about Massachusetts and the relationship that people have to one another on that. But I wanted to ask you in particular a question. We hear a lot in my

district about people that are in the engineering field, engineering-related fields who tell me that they can't get a job in an existing company because their skills or their education may vary slightly or to a significant degree from what is being requested in the job offered.

What are we going to do to accommodate those people the to try to get them to fill jobs? Do you agree with that assessment, there is an issue there, and what is being done or what can be done to make sure those people don't fall by the wayside while we are trying to figure out our H-1B visa situation?

Mr. ARCHEY. I think that is correct, there is. That is an issue when a lot of companies are trying to hire someone in a particular field with certain digitals issues and things like that. A lot of times you may have an engineer who may have an EE degree but their knowledge is not at all up to date as to what have been some of the major changes, because there has been some very significant changes in the engineering curriculum, for example, in many of the engineering schools.

So I think that the one thing that that brings home, and it has become, perhaps, somewhat trite, but no kid who is graduating from a college these days is going to be able to rely on what he learned in college for the rest of his career. People don't like to hear it any more, but this is lifelong learning now. Engineers are going to have to stay up with what the state-of-the-art is and things like this or they are not going to be able to get or retain the jobs.

Mr. TIERNEY. Do you feel we have people out there with resources like this in our education or college program?

Mr. ARCHEY. It is a mixed bag. It is a mixed bag. In fact I would argue some of the most innovative programs—not for engineers but for technical workers—some of the most innovative programs in the country are occurring at the community college level, particular in Massachusetts, the Middlesex College, which still does most of the training for Raytheon under a contract.

On a related point that Mr. Miller raised, I just don't buy this notion that kids don't go into certain engineering fields because they think it will be outsourced. I look at what happened in the 1990's. The high tech industry went from 4 million to 6 million employees, a 50 percent increase in employment. We had a 2 percent decrease decline in engineering enrollments by our students during that same point of time. It was also the same point of time when the high tech differential versus the rest of the wages in the private sector was 94 percent.

You know, the interesting thing is, I am not saying there aren't some jobs being outsourced. For example, in software, the higher level outsourcing, for lack of a better word, strategic software and programming, there is a lot of open jobs. Those are very high paying jobs.

I would submit last that a part of the problem that Mr. Miller surfaced is that we have done a very poor job in explaining what people do in these kinds of jobs. Instead, what we have talked about is that only geeks and dorks take engineering and math, and really cool people don't do that. I think that is the problem.

Mr. TIERNEY. You hit on something that was my next question on that. We made a concerted effort in our district to get high school groups, junior groups and Girls, Inc., and groups like that out to industry. So two questions on this. One for Mr. Archey, what is your job doing to make sure that they make those opportunities available for those groups? What is the outreach on that?

Mr. Luce, we had a program called School to Career. I think it was a pretty successful program, but it has sort of gone by the way. But it is at least in my district's experience, a lot of kids got out, and got the feel of what was going on in the industry and then decided to stay on in school and continue on in that area, many of them technology related. A number of teachers did the internships and were able to bring back to the classroom a different attitude about lighting these kids up with math and science.

Why did we let that program go away? Should we look at starting to reintroduce it? If each of you would answer those questions, I would appreciate it.

Mr. ARCHEY. I will answer the first one. High tech companies spent an enormous amount of money on reaching out to school systems and to kids in terms of trying to enhance the attractiveness. I don't know if they have found the magic bullet, but I will just tell you in the last year, this is not on the basis on a systematic or systemic study, but on heavy anecdotal information. Companies have even increased the amount of money they are trying to spend now on trying to make the idea of a career in high tech far more attractive, and also in improving how local schools deal with getting those kids ready for those jobs.

Mr. LUCE. Congressman, with respect to your question posed to me, what we have tried to do is increase the flexibility of high schools to receive money and decide how to best apply the money. I think there are many instances where school to career programs have worked very well, and there have been others that haven't worked very well. Our attitude has been let us try to get the flexibility to the schools so they can do what is working.

However, we are also starting an initiative within the Department, in addition to scientifically based evidence by IES, to promulgate a set of transparent criteria where we could say to schools here is evidence, it is not the gold standard, but here is evidence that shows X program has a very promising outlook. Until we get further research, you may want to consider doing this.

I think we have to supply more information to schools, not mandates, but information that says we find, you know, this type of program is working, and my Department is starting that initiative so we can get more information as you have just laid out.

But, clearly, we are also looking in the Academic Competitiveness Council to see what type of programs across the government are speaking to career-to-school awareness, relevance, things of that nature, that we can help spread.

I think one problem is we have all of these programs in all of these different agencies. We actually have the distribution network to funnel what we are learning. Somehow we have got to coordinate that in a better way so that the Department of Education is able to say to States, here is evidence of programs across the government that you may not be aware of. I mean, not everybody is

tuned into what the National Science Foundation is doing. We need to let our schools know so that we are giving them that help.

Mr. TIERNEY. Thank you, Mr. Chairman. If I could have one editorial note, Dean Kamen, who was the inventor of the Segway, I understand, where you just stand up on it and toodle around town, just sponsored a contest, internationally, on robotics.

I have to tell you, I went to the regional thing. It was in the University of Massachusetts—Boston again, Agannis Arena. The place was packed, you would think it was a football game with the attention and the energy people were showing on that as they developed their own programs.

One of the schools in my district won rookie of the year award on that, wound up going to Atlanta. Those types of things are incredibly effective and those are initiatives by people in the industry, working together with the education community being entirely successful. I think we should all appreciate that.

Thank you.

Chairman MCKEON. Mr. Tierney, this is all schools. I am sure we all do. I see some exciting things happening. We don't focus a lot on them. It seems we mostly focus on problems but there are a lot of great things happening at all levels, all pockets.

As the Secretary says, if we can get those distributed so other people can look at them and share them, that is a great idea.

Mrs. Biggert.

Mrs. BIGGERT. Thank you, Mr. Chairman, following up on that. Maybe we need a national strategy like we have had with other programs to really tout them like, you know, going to the Moon or something. Because we don't seem to be getting the message out. A recent poll showed that 52 percent of parents think that their kids are getting enough education in math and science, and 66 percent of the students don't think that they need math and science to succeed after school.

I think we are going to find an economy, living in a global economy, we are going to find that that really is not going to bode well for us in the future. Maybe you will come up with this after you finish your reforms that you are looking at. I know many committees in Congress are looking at math and science reforms now. In fact there is another hearing in the Science Committee, on which I serve too, on the same issue of math and science.

I think we are all really concerned about this. I go into schools when I am home in the district, and to go in particularly to the middle schools and talk to the seventh and eighth—sixth and seventh and eighth graders and say how many want to be engineers, and how many want to be scientists? It is always the young boys that raise their hands. I am always saying, you know, that women can do this just as much as men. We have got to encourage the young women to take this up too.

So as we look at it, though, I think that in some cases it is going to be where we maybe make some legislative reforms before your report comes out in February of 2007.

So, Mr. Luce, I was just wondering how you are planning on dealing with any legislative proposals that may be introduced or considered before your report is issued. Do you have a process in place which you will coordinate with the committees or members

working on the math and science reforms over the period that you are working on your report?

Mr. LUCE. Yes, ma'am. Let me start with the last point. We obviously do. There is a lot of interest in math and science, as you have indicated. My personal concern, and, I think, the Secretary's, is that so many different committees are looking at different things. I hope we don't end up with 1,000 more flowers blooming as opposed to deciding what needs to be taken to scale, because that is the issue that is facing the country is how do we take something to scale.

Second, with respect to your gender question, the Secretary is having a national summit for girls in math and science that is going to be attended by some of the leading female engineers and scientists in the country. They are interested in beginning a promotional campaign—the women who are attending, not the agency, but the women attending—to promote more female involvement in math and science. That is also a critical issue.

With respect to coordination with committees, we obviously look forward to giving any technical assistance we can. We think it is terribly important these things be coordinated. Our Secretary is testifying before science committees, education committees, various committees, and we—again, I think it is very important that we somehow come together and not end up with a diffused effort here, which would not accomplish what I think everybody knows we need to accomplish.

Mrs. BIGGERT. Thank you.

Ms.—is it Ashby? With your—the GAO report, I notice that there are 207 different programs in existence right now. And really, the Department of Education only has four, which kind of surprised me, versus what all the other agencies or NSF and the Department of Energy have. Does the—in looking at that, did the Department of Education, did they coordinate with these other agencies as far as the programs?

I know, like, my son went to—when he was in high school, he went to a program at Fermi Lab on Saturday mornings; but we were just lucky just to learn about it. We didn't know that it was there; but he, you know—of course, two lawyers having this engineer who blew up things in the driveway, we didn't know what to do with him either.

How would you suggest we coordinate all these programs?

Ms. ASHBY. I am sorry, I missed the last——

Mrs. BIGGERT. How would you suggest that we coordinate all these programs?

Ms. ASHBY. Well, as Mr. Luce said in his opening and has referred to since, there is the National Academy of Science Council, which has been tasked in coordinating programs at the Federal level and executive branch.

Mrs. BIGGERT. Do you think they have done a good job?

Ms. ASHBY. I think they are making progress. We did not make an assessment per se of what the Council was doing. We did note the things Mr. Luce referred to are happening, and they seem to be reasonable and certainly initial steps that one would have to take. Of course, that will take more time to see what is actually going to occur.

Mr. LUCE. Could I give you at least I hope some assurance in this Academic Competitiveness Council, we have had the active involvement of the OMB, the Office of Science and Technology Policy. We have had great entries from all the agencies in figuring out how could we better coordinate and distribute and disseminate; and I think heretofore, we really haven't focussed on that.

As you say, the Department of Education was the second smallest civilian agency in terms of spending on math and science, and yet, you know, we are the ones that are in contact with all the schools who are saying, Secretary Spelling says every time she comes back from out of town, the schools are just saying, tell me what to do.

And we need to disseminate more what is happening across the government and, again, bring things to scale. I hope—I hate to sound repetitious, but that is—you can't solve the quantity problem and thus the quality problem unless we bring programs to scale.

Ms. ASHBY. And in that regard, we need to have an evaluation of existing programs to know which programs need to be brought to scale, to use Mr. Luce's terminology. And that is one of our main points.

Mrs. BIGGERT. Thank you very much. I yield back.

Chairman MCKEON. Thank you.

Ms. McCollum.

Ms. MCCOLLUM OF MINNESOTA. Thank you, Mr. Chair.

I have a couple questions. I think it is probably best just to go through them and then sit back and listen. One is how important is it to our higher education institutions to have access to international students? In other words, in order for a university to offer an engineering program, be successful at doing it, they need so many students enrolled. So that does have an impact in supporting our higher education institutions for having the equipment, ongoing faculty and the support from our government to do that.

And then just talking to whether it is a tourist business or student working with the Department of State for getting a visa to come to the United States at all, it is cumbersome, it is expensive, it is awkward. And there are a lot of other countries which have high security standards, and some of them have even higher security standards than what we had in place for a while, and they don't seem to be having quite the barriers.

And then what I found alarming—and, Mr. Chairman, I will submit this report to the committee—it's Minnesota Private College Research Foundation. It has changes in demographics, challenges and opportunities in higher education.

In 1991, the United States ranked second in college participation, and this is among industrialized nations. In the year 2000, we ranked 15th. So we have fewer students attending, and part of that is the cost in that.

The other part of my question is kind of three-part. As was pointed out by one of the other Members on the other side of the aisle, only 22 States have math and science, high-level math and science. One of the goals of No Child Left Behind was to have high standards; and if we have 22 States not meeting those standards, how can we say we have really achieved having high standards with Leave No Child Behind?

One of the things that you said was that we didn't want to get involved in curriculum at a Federal level; but if we are not involved at some level, especially with the hard sciences, math and science, with curriculum, how do we know we are really achieving our goal of leaving no child behind? And so to that end, has the Department looked at, for example, ACT scores versus the number of schools in the State that might be on not meeting adequate yearly progress?

For example, Minnesota has extraordinarily high ACT scores. We know we have much work to do with bringing every child forward to achieve those high standards, yet if you look at the number of schools that we have not made adequate yearly progress because of our standards being so high, the two of them would not match up.

So has the Department done anything like that? Has the Department looked at schools that have strong after-school support programs for students in math and science, school districts that have tried to provide those kinds of programs for after school for students, and how were they achieving moving forward with students in math and science? Those are being cut in both statehouses and here. And what is the impact of programs such as TRIO for reaching out to that minority student who may be kind of toward the industry; kind of figured, I need to get my math and science brushed up, but it is the first student who is ever going to apply for college, and maybe it is a step of doing a community college to do that?

Are we—I mean, I know we are looking at all these other programs, but are we really looking to see how we have integrated everything else?

Mr. LUCE. We are trying. I would respond in several ways. One, with respect to—of course, under No Child Left Behind, every State sets their own standards. There are lots of organizations outside the Department of Education that rank the rigor of those standards. Also in No Child Left Behind is a requirement that every State participate in the NAPE test. So an observer has a chance to look at NAPE scores, compare them with State scores, and begin to ask questions.

We have also asked in the American Competitiveness Initiative that science in high school be added to the assessment system. I think that would help what we are trying to do because what gets reported gets done. What gets measured gets done.

Third, with respect to academic competitiveness grants, which Congress appropriated $2.5 billion, we just released a definition of rigor that deals with courses of study. It doesn't deal with curriculum, but it deals with courses of study, and we hope—that is a significant amount of money that will go to a significant number of students. And I would hope and think that every high school would try to make sure that every youngster they serve has the opportunity to meet these courses of study so they can get this enhanced student aid. If you major in science or math under this program, in your junior year you get an additional $4,000, senior year an additional $4,000. That is a significant financial incentive.

Now, we need to make sure that the youngster who goes to college is prepared so that they stay in school. As you point out, we need to do better on college readiness. The ACT scores reflect this

across the country. Those ACT scores are reported. A lot of notation is given to those. ACT themselves publishes State-by-State results of ACT. There are four tests. They show what it means on college readiness, and we pay a lot of attention to who is doing a top job on various external measures like that.

And again, under promising practices, we hope to disseminate and draw attention to the States that are doing well because there is not enough. As the Chairman said, I don't think there is enough publicity in terms of what we do know is working.

I think what I can show you in any State, in any economic condition, you can imagine a top-performing school, and the issue is, can we replicate? Well, I know we can't replicate if we don't know what is working; and we don't have time to reinvent the wheel, and so I believe very strongly we must increase how we are disseminating knowledge, not as the mandate, but disseminating knowledge.

Mr. ARCHEY. Responding to your first questions very quickly. On the decline of foreign students coming to the United States in 2004, a 28 percent decline in foreign students enrolling in graduate programs, that is partly a function of visas. It is partly a function of a feeling of, are we wanted, which is very strong. And then the third, which is not getting much attention in the United States, is how much money other governments have put into graduate programs of engineering and science all over the world, particularly in Australia, particularly in Western Europe where they also talk about how we are going to teach in English and all of that, and that is something we never had to deal with.

I mean, we were uncontested in terms of graduate programs. Other countries have said, you know, we are going to take a page out of the United States' notebook or plan over the last 50 years, and we are going to buildup our graduate programs in science and engineering and compete against the United States. So that is another reason for the decline.

And on the one, problems in visas, a very quick anecdote. I have a CEO for a company that has a fairly significant operation in China. He wants to bring back his Chinese engineers and managers to the States for American culturation.

So there first was going to be 19 Chinese workers. Not 1 of the 19 could get a visa. So he went again the second time, 15. Not 1 of the 15 got a visa. He said he doesn't think he has got a bad group of people.

So what has he done? And he said this to me directly, he said, I am not saying this a lot of jobs, it is 12, 15 jobs; but I now do all of my training for all my foreign workers, particularly for China, in Toronto, Canada. Those jobs ought to be in the United States.

Mr. LUCE. I would add——

Chairman MCKEON. Time has expired.

Mr. Price.

Mr. PRICE. Thank you, Mr. Chairman. I appreciate the opportunity, and I thank you for holding this hearing. This is, I think, one of the most important issues that we need to address as a Nation.

I am a physician, and I am not sure what lit that bug in me years and years ago, but I do know that there were more folks who

were interested in the sciences at that time, and the data is foreboding. Our pipeline is not full at all. So whatever we do, we have got a long way to go until we see results of what we do.

Somebody told me the other day that we are graduating more undergraduates with a degree in sports management than we are engineering. And I am not—I don't know the validity of that, but even the fact that somebody could say that and have us believe that it is credible is frightening.

Mr. Luce, you have talked about identifying those Federal programs, and you have as well, Ms. Ashby, that focus on math and science education and their success. Is anybody looking at private programs that encourage math and science education?

Mr. LUCE. Yes, sir. We are. And I would like to commend one of the members of AeA, Texas Instruments. For instance, Congressman Johnson represents them. They noticed a void in the State of Texas that there was no high school offering a course in engineering, and they developed an engineering curriculum, which has now been approved by the State of Texas, so actually high school youngsters had a way of learning math and science. But understanding its relevance could take an engineering course. And they are collecting result data, and we hope to have that soon to share with the country.

So we have—I have met personally with the GE Foundation, the Shell Foundation, Exxon, Gates; we are looking at all the private programs and, again, taking inventory of those, because, again, we don't have time to reinvent the wheel.

Mr. PRICE. I had the opportunity last Friday—and I am pleased Mr. Tierney talked about the robotics competition. I had an opportunity in Atlanta to go to the national competition finals, which was thousands of kids. This was started by Dean Kamen, as you mentioned, who invented the Segway. 15th annual national competition. These kids are incredible, and the results are phenomenal.

There was a study that was commissioned by Dean or asked for by Brandeis University and theFord Foundation and found the participants in this math, science, robotics competition were twice as likely to major in science and engineering, and that was across all demographics, including low-income and urban schools. They were more than three times more likely to major specifically in engineering.

He does this all for a fee of about $6,000 per school, per high school; and then you get mentors and community volunteers and the like. But that kind of program seems to me to have incredible benefit and bang for the buck, if you will.

Are we as a government looking at that kind of program that has proven itself time and time again over the past 15 years? Anyone?

Mr. LUCE. Well, I would say, yes, we are looking at the programs. What we are also, though, looking at is how do we instill in more youngsters the basics so they can develop into that student who is interested in robotics? And I think we face a huge issue on the quantity side, the relevant side, the excitement side of getting more youngsters interested so they can compete.

We are still—as you discussed in that program, we have a lot of amazing youngsters who are doing fabulous things, but we need more of them. And I think that is the issue we face as a country.

Mr. PRICE. Ms. Ashby, have you looked at that program specifically?

Mr. LUCE. Yes, ma'am. We have.

Ms. ASHBY. No, we have not.

Mr. PRICE. I would encourage you to do so. I have seen regional and then went to the national competition. These kids are as excited as they can be about it, and the numbers are really undeniable.

Let me ask one final question, if I may, and I would be interested in each of your comments. We have got lots of programs that the GAO report, you pointed out—207-odd programs. When there are lots of programs, oftentimes that means that we don't know which one works.

Do any of you have a sense about the most appropriate—where we are getting the biggest bang for the buck? And in those programs and how we might—how you might recommend that we do our job better and focus the resources that we have available on where we can get the biggest bang for the buck?

Mr. LUCE. Well, I feel like it is absolutely essential that we develop better evaluation, focusing on student achievement. What we already know is in those existing programs, there is very little student achievement data; and I think we must improve looking at output results from programs. We need to understand which programs—if a teacher has been trained in X program, what happens to student achievement of that teacher?

We don't have those common metrics in place today. They need to be in place today. We need the data to get that done, and I think it is an absolute necessity to have that done, and we hope to put that in, in Academic Competitive Council, without taking away an NSF program. We have got to make sure that we get metrics to determine what is working, and that has got to be based upon student achievement data.

Ms. ASHBY. I would certainly agree with that and go a step further and hope it is not just semantics. I don't know whether it is or not.

In addition to outputs of programs, if there is any kind of evaluation with most programs, you would at least have some listing of the things they have done; but to go beyond that and look at the outcomes, and these things having been done, what has been the ultimate results in terms of increased number of students graduating from high school, going on to colleges, universities, majoring in STEM fields, and then going into those fields, because, of course, one of the things we are reporting in our October 2005 report and also in this current testimony is a number of people trained in STEM fields don't actually work in those fields.

So we need to understand what is happening in terms of the dynamics in addition to the training. But certainly for each program look in terms of, yes, what are its outputs, what are the outcomes; and in terms of coordination, I hope—and what your group is doing that it is going beyond—I don't want to say the surface, because it sounds like I am belittling it, and I am not, but you need to know what is going on on the ground in the local communities over 200 programs. We don't know whether there is overlap or not, and the only way you can really find out is to look at the ground level and

find out what kind of coordination is going on at that level for people seeking services, and that is hard, that is difficult, it is labor-intensive, it is costly, but until that is done, you really don't know whether you have the fabric of programs that are most needed.

Mr. ARCHEY. Dr. Price, I will defer to my two expert colleagues on that.

Chairman MCKEON. Thank you.

Mr. Holt?

Mr. HOLT. Thank you, Mr. Chairman and Mr. Luce, Ms. Ashby, Mr. Archey. As one who—maybe my colleague from Illinois was referring to who used to blow things up and drive away and nearly electrocuted myself and nearly burned down the house; and in my passage through the realms of geekdom and dorkdom, and after now 7-1/2 years in Congress, and several decades before that arguing and advocating and agitating for science for all Americans, not just for future scientists, I am glad to see the attention paid to this. And I hope it is not just a lot of talk.

The attention in recent months is quite encouraging. However, I should point out that still teacher professional development, funding for teacher professional development in STEM fields is not yet back at the level that it was when this administration took office.

You know, in the budget request for 2007, there is good emphasis on the Math Now program, but nothing comparable in science education that I can find. And I hope we will put high priority on science education as well, but I don't find it there.

I like the idea, Mr. Luce, of finding programs that we can bring to scale and to remove redundancy, but it seems to me that the problem we face now is not having too many weeds in our garden, but having just tiny little plants sprouting. And clearly we have needs for more teachers, for more mentoring, for more professional development research in teaching methods; and, you know, we need to determine some priorities maybe even before we begin evaluating the programs.

But in any case, since the problem is we are making a much, much smaller effort in science education than we should be, I don't—I certainly don't want to see any effort at evaluation and use to delay and discourage programs. It is not that we have too many programs at this point, I don't think.

And, you know, with regard to evaluation, I am struck by the fact that the Department of Education, in the best figures that I can find here, spends certainly less than 1 percent of its budget on research and development and statistics, and this is a $700-plus billion industry, education, where we are spending maybe 3/100 of a percent, pennies on the hundreds of dollars, on research and development and how people learn and how to teach. I think—well, that is something that deserves our attention.

Well, let me get to a couple of specific questions and leave them with any of you who care to answer them.

Well, one is, I guess, for Mr. Luce. The America Competitive Council effort to evaluate programs. How do you expect to work or how are you now working with the National Science Board to evaluate NSF's programs, because those are already going under way?

And let me just throw out another question and then be quiet for a little while. The effort to bring highly qualified teachers into the field is sometimes interpreted to mean, let's bring highly qualified scientists in the field. It certainly is one path to follow, but they don't necessarily make highly qualified teachers.

You know, what are you putting in place to see that these teachers really will become highly qualified, these scientists and other alternate route people will become truly highly qualified classroom teachers?

Mr. LUCE. Let me see if I can respond to each of the questions as I recall them.

One, with respect to specifics of math and science funding, the fiscal year 2006 appropriation for math and science was $635 million. The fiscal year 2007 request in the President's budget is for $961 million, which is a substantial increase in our budget in these times.

Second of all, as you know, and we can always—I know there is always a debate about total amount of resources, but No Child Left Behind funding has increased 40 percent from 2001 to 2007, increasing the amount of funds which can be spent on math and science; and I think it is our job to convince schools that priorities were reading first, math now, science next, and I think that is the program that we have launched.

With respect to the National Science Foundation, we are working closely with the National Science Foundation. I have met with the National Science Board representatives. National Science Foundation is at the table in the Academic Competitiveness Council. They are completing the inventory forms now, telling us what evaluation techniques they have utilized, and then as a group we are going to be discussing the possibility of moving toward common metrics so that we can know the best programs.

So we are working closely within NSF to accomplish this, and we have had—I have met with the Director of the National Science Foundation, the Secretaries met with him. We have testified together before, and we have a close working relationship.

Chairman MCKEON. The gentlemen's time has expired.

Mr. Johnson.

Mr. JOHNSON. Thank you, Mr. Chairman.

Appreciate you bringing up the TI thing. You know, it started—they energized one university, the University of Texas at Dallas, and now there are three or four universities involved in their engineering program. I hope we are trying to do that around the country. Do you know of other situations that are similar?

Mr. LUCE. We are trying to spread that word, and we are waiting for the outcome evidence in which we could have data to show; but I am hopeful that that will result, and I have worked closely with Texas Instruments on that program.

Mr. JOHNSON. They have been asking you questions about the Competitiveness Council. You know there are, I think, 13 Federal agencies that are involved. How do you get them to coordinate? You know, I wonder if we are making any progress. Can you tell us?

Mr. LUCE. Well, I think we are. I mean, all the agencies are at the table, including Defense. They are meeting deadlines. OMB has been active in the process, which, frankly, helps more than if Tom

Luce were asking for the data. It helps if the White House and OMB is asking for the data.

We know we have a report that is due to you in February 2007, and I think we are going to meet that deadline.

Mr. JOHNSON. They are letting the Education Department kind of help them in this——

Mr. LUCE. Yes, sir. Now, I want to make clear there are lots of independent agencies with lots of their own appropriations; and, I mean, we don't make decisions per se, the Department of Education. We chair the committee, but we are sharing information in an open way that I think will lead to more effective evaluations and more effective coordination. But this is not a one-agency-driven council. We chair it, but every agency is at the table with their own legislative requirements.

And again, I mentioned the concern that I think we need to make sure that we are working together through these various committees to try to make sure that we have some common understandings of where we are trying to go.

Mr. JOHNSON. Thank you.

Mr. Archey, to get—you know, we have foreign students that can't get an H1 visa, you just said, and China in particular. But are we getting enough H1 visas? Are they overwhelming us?

Let me ask you another associated question: Are they paid less than American scientists?

Mr. ARCHEY. The H1 quote is 65,000 a year. This year it was exhausted, I think, in the second day of the fiscal year. There are several bills in the Senate to double that and then have what is called a market test of if they are all exhausted in a certain period of time, that additional H1B visas would be made available. So I think that that is the case.

And your second question? I am sorry.

Mr. JOHNSON. Are they paid less than——

Mr. ARCHEY. That is an interesting question. I would argue data that we have, there are some instances where somebody comes in H1B, and they are paid less. I would argue that with most of our companies, not only do they pay—the word of the moment or phrase—the prevailing wage, but you would be astonished at how smart these foreign students who are graduating are in terms of knowing what the prevailing wage is.

There have been some instances of some small software firms in certain States that have tried to commit and get H1 visa to lower the prevailing wage, but the overwhelming majority of our companies, they not only pay the prevailing wage because they feel they should, they don't have much choice when it comes to whether or not they are going to hire somebody.

Mr. JOHNSON. Do you think that we are able to increase the American participation if we don't increase H1B visas?

Mr. ARCHEY. Well, that has been an issue. You mean, if there were less H1Bs, we would have more American kids doing it? History has shown that has not been the case because you have less foreign people coming in, more Americans will come up or more Americans will, for example, enroll in the University of Texas at Dallas in their engineering program. That does not correlate. There

is no tendency to see that it is a replacement of Americans for the foreigner. It doesn't happen.

Mr. JOHNSON. Do you know the percentage of foreigners that go to our higher education institutions that stay in the United States versus go home?

Mr. ARCHEY. No. That is very difficult because some of them—what we do know on data provided by the government is that it is more difficult now when a student finishes a degree program in the United States to get to stay, to get the H1B. So the numbers who have stayed has declined.

I would just, Mr. Johnson—Congressman Johnson, make one other note. One of the other things we are facing in part of this whole Competitiveness Challenge is not what is going on also in our schools, but we have now—are facing a situation with foreign nationals with very significant scientific or engineering skills who now have opportunities in their own country that didn't exist 10 years ago, and that is a huge factor in all of this in terms of the flow of people into the United States.

Mr. JOHNSON. Thank you, sir.

Thank you, Mr. Chairman.

Chairman MCKEON. Thank you.

Ms. Woolsey.

Ms. WOOLSEY. Thank you, Mr. Chairman.

First of all, I want to say on record that Congressman Holt is my favorite geek on Earth and a really good Member of Congress. Thank you very much for being who you are.

Mr. Archey, when you talk about not having enough qualified workers, what is the industry doing about retraining existing workers for new technologies? I represent Marin and Sonoma Counties, just north of the Golden Gate Bridge. It is a high-tech area surrounded by agriculture, so we are very diverse. But I have engineers who come to me and say, look, they are hiring H1B engineers, but they won't retrain any of us for the new technologies.

For example, green energy and clean energy technologies are new technologies for industry of the future in this country. What is your industry doing to retrain those that exist?

Mr. ARCHEY. The answer to that is going to depend on the company. There are some companies that have put a great deal of money and effort into retraining current workers. There are others that have made the calculus that they are better off getting somebody younger immediately out of school with very fresh knowledge of whatever that subject matter may be. So it is—it is—I don't think you can talk about what the industry itself is doing because there is no, if you will, monolithic approach to the issue of retraining.

Ms. WOOLSEY. Well, as AeA, do you have recommendations or guidelines that you help them in this regard?

Mr. ARCHEY. I think that is a task that is well above our job description to be able to tell the companies how to do it.

Ms. WOOLSEY. Well, not tell them how. I used to be an executive at a company that was a member of AeA, a telecommunications company in Marin. We depended on AeA to do training and help companies understand what was important. I just think that is the

way to fill that need, and I just would hope the industry would step up to it.

Mr. ARCHEY. I think they are in some instances; and again, I can't tell you that in others they are, but I think there is a lot going on.

Ms. WOOLSEY. OK. Thank you.

Ms. Ashby, you talk about women and minorities and the need to bring the whole population around to math and science and technology. I have legislation called Go Girl that I have introduced term after term, and pieces of it are actually in the science education bill.

My bill starts in the fourth grade, encouraging girls and their families to understand how important it is that they have the choice when they go to college of whether they want to go into a technical curriculum; but they would—as we have heard—need that background anyway no matter what they are going to do. Is there enough of that encouragement right now?

Ms. ASHBY. Well, apparently not. The numbers of women in the STEM fields are increasing, as the numbers of all the other segments of the entire population, but in terms of their number relative to the total number of students, it is not increasing, and I certainly think a start in fourth grade would help.

But with all students, you need to start probably earlier than that. You need to start with scientific and mathematic principles in early childhood development, probably, and make it natural, not something that is unusual or that you have to take as part of some type of special curriculum.

Going way back when I was in high school, I studied physics, I studied calculus, but I studied them because it was part of a college preparatory program. And although I didn't go into the scientific field, fields, I had that background. I don't think that is the case; and this is the case in schools today, that if you are in a magnet school or if you are in a special program within the public school system, then you might have the opportunity to take advanced science and math, but otherwise, there is no requirement that you take it. There is no expectation that you take it, and it may not even be available.

Ms. WOOLSEY. Well, do you see any barriers for women and minorities in these fields in education?

Ms. ASHBY. Well, No. 1, we didn't evaluate the programs to that extent, but I have worked at GAO in the higher education area for most of the last 12 years and am somewhat familiar with what goes on, and K through 12 as well.

I would not say there are barriers per se. I certainly would not say there are institutional barriers, structural barriers; but a lot of what a person does and becomes is based on what is expected of him or her. And to the extent that you have teachers who are not—not qualified to teach math and science, probably don't have a particular interest in math and science, they are not encouraging any students, including women and minorities, to go into these fields. And because there are fewer women, fewer minorities, there are fewer models, fewer role models for students.

Minorities, for example, might not grow up in a family where they know any scientists, know anyone in any of the STEM fields. So it is not a likely choice for them.

So I would not say that there are structural barriers, but I will certainly—if we had more qualified STEM professionals in the classroom—and by that I don't mean scientists who are not teachers—teachers who have both the content knowledge and the pedagogy to encourage, we would be better off.

Ms. WOOLSEY. OK. Thank you very much.

Chairman MCKEON. Mr. Kildee.

Mr. KILDEE. Thank you, Mr. Chairman.

When I was teaching high school, Sputnik grabbed our attention, but the continuing stagnation of math and science teaching, it is a continuing stagnation. We have done some things, but it is continuing. It has not really greatly got sufficient attention by educators, by teachers, by parents. We mentioned that. And business seems to be the one group most alert and concerned about this.

I can understand why, because that is the future of our economic development and scientific development, engineering development, research in this country. Business seems to have the sense of urgency more than any other group, and that has not really been felt that strongly in government.

We talk about it here, but it is going to take the executive branch and the legislative branch to come together and say, this is a crisis in this country, and we have to produce more scientists and engineers.

My question will be directed to Mr. Luce, and then anyone can join in. The State PIRGs recently released a report entitled Paying Back, Not Giving Back: Student Debt's Negative Impact on Public Service Career Opportunities. This report revealed the truth about the impact that student debt has on young adults' decision to become or not become a teacher. Many just cannot afford because there is so—they are so burdened with debt to become a teacher. And many of our bills, including 609, which I was unable to vote for when it passed the House, hopefully at some point we will resolve the differences—and 609—I think Mr. Holt played some role in doing some loan forgiveness where 30 years I have been here when we started loan forgiveness. Not that long ago, we generally directed to where the person was teaching, and I would still support that. That is very important.

But I think we have to also direct it to what the teacher is teaching. I am a Latin teacher. I don't want to be left out, but I think probably science and engineering are probably a little more needful right now than Latin.

Would the administration help within itself to have a sense of urgency of trying to make sure that in order to have sufficient output of scientists and engineers, that we have sufficient input and really do that in a significant way which will cost the government some money, Mr. Luce?

Mr. LUCE. Well, let me say, Congressman, No. 1, our Secretary says we have a crisis in math and science. So we feel very strongly there is a crisis. Our Secretary articulates there is a crisis. We believe there is a competitive crisis. We believe there is a domestic crisis in terms of the jobs that are being created.

The 90 percent of fastest-growing occupations require more in math and science. We articulate there is a crisis. We have numerous student loan forgiveness programs. I can't speak directly to the specific issue should money be reallocated from one to another, but clearly math and science both in the teacher incentive fund.

In student loan forgiveness funds, we are very focussed on trying to get more teachers with math and science content knowledge. A key ingredient in that is increasing the K-through-12 pool of students who go to college ready to major in math and science, and that is the essence of our program is increasing that pool, which is a dramatic need.

In addition, there is a dramatic need to take the existing teacher corps and give them more professional development help. But we agree there is a crisis.

Mr. KILDEE. And you know what concerns me, and one of the reasons I had a problem with 609, something that had passed before, the $12 billion cut in student aid. I mean, I think that if we really wanted to address this in a mass—well, we have to put some dollars there, too, not just a get well card. Authorization is a get well card. What math and science needs is really the Blue Cross card, which is the appropriation. And we are—we sent a great get well card to math and science, but we did not send them the Blue Cross card or give them the $12 billion. Thank you.

Chairman MCKEON. Mr. Van Hollen.

Mr. VAN HOLLEN. Thank you. Thank you, Mr. Chairman. And I would also like to thank all of the witnesses for their testimony.

And I share the views expressed by many of my colleagues on both sides of the aisle that welcomes the new national focus on this question of competitiveness and the need for the United States to do more in the education front, particularly math and science and engineering, in order to maintain our competitive edge. And I thought the report on the gathering storm was an important wake-up call.

I also share Mr. Holt's concerns, and I want to again commend him for all his leadership in this area. But I share his concerns that this not simply be a big national discussion, but that there actually be resources to back it up.

Mr. Kildee mentioned Sputnik. The missile gap was a wake-up call, and the result was lots of resources devoted to these areas by the national development. And I am afraid, despite the rhetoric, we don't see that same urgency translated into the resource side of these things.

Presidents, Republican and Democrat, Members of Congress like to announce new programs to focus on certain things. But I want to point out that I think that the big elephant in the room in many ways here is the fact that we passed a very important piece of legislation in the United States, the No Child Left Behind bill, and as of this year, the funds in the budget proposed by the administration is $15 billion less than what was authorized and what the members of this committee and others thought was needed to do the job. And cumulatively now since that bill was signed, we are talking about $45 billion short. And I mention that because a lot of the funds that we are talking about here with specific programs, these—you could use No Child Left Behind funds for that.

Mr. Luce, let me just ask you. I mean, for example, with respect to the AP teacher trainings, I think that is a good program to teach, but there is no reason that the teacher quality funds under No Child Left Behind couldn't be used for that, is there?

Mr. LUCE. No, sir. But what I might add is what we have also added is an incentive program that would ask the State to match the Federal dollar one for one and the private sector to match one for one, so we would end up with a triple bang for our investment.

Mr. VAN HOLLEN. Right. But just if you look at Title II, for example, just this year it is $288 million short of what had been authorized.

Let me just ask you with respect to math now for middle school students, this helping struggling students in middle school with math, I think that is, again, a worthy initiative. There is no reason why you can't use No Child Left Behind funds for that purpose, is there?

Mr. LUCE. No. But we have tried to increase funding for math and science, including for middle school.

Mr. VAN HOLLEN. I understand. I mean, that is $125 million. I think it is a worthy initiative, but if you compare that against $15 billion short in No Child Left Behind this year, the magnitude of the resources that I think are required just falls far short. We can wrap up new programs, and I think the added attention, as I said, is important. But I am worried, as Mr. Holt said, that it is here today, gone tomorrow, when we are not—when we are not backing this up with respect to the pipeline.

Mr. Archey mentioned what I think is a huge issue. Obviously our employers are driving this, and one of the reasons I think that we have a shortfall in skilled workers is the same reason we are having trouble getting more math and sciences teachers into the classrooms.

I mean, if you are a graduate with skills in math and science, as you say, right now there is a huge demand for your services, and you can command a lot more in terms of your salary in the private sector. So a school who is trying to compete for that same individual with that expertise is put at a very big disadvantage, which it seems to me that if we want to go from a system where instead of having the teacher who is trained in physical education doubling as the math teacher, instead have someone who is trained in math doubling as the—we need to provide these incentives.

Now, Mr. Kildee mentioned incentives in terms of loan forgiveness and that kind of thing, but Mr. Miller and some of us have introduced the Teach Act which would provide, for example, a $4,000 a year tuition assistance to those students who make a commitment to go into the math and science and teach that for a longer time.

It seems to me we have to work on that pipeline to get more teachers in an economy where, as I said, they can go into the private sector. If we want them in our classrooms, some of them, too—making sure some of those who are best skilled teaching our kids, we need to provide them with more incentives.

Mr. Luce, would the administration be prepared to support that kind of legislation where we were to provide, again, $4,000 a year

up front tuition assistance to someone who made the commitment to go into the classroom and teach math and science?

Mr. LUCE. Well, we have tried to take a very close look at our priorities and fit within a budget, and I think we have done that. We look forward to working with the committees to come up with the right solution, but we have submitted our best judgment as to where priorities should be placed.

We did just increase Pell student aid $4,000 for people who major in math and science for their junior and senior years. I think undoubtedly a number of those students will go into math and science.

Mr. VAN HOLLEN. This can be——

Chairman MCKEON. Time has expired.

Mr. VAN HOLLEN. I appreciate your testimony, but I still think there is imbalance between the resources and the rhetoric.

Chairman MCKEON. Mrs. Davis?

Mrs. DAVIS OF CALIFORNIA. Thank you. Thank you, Mr. Chairman. Thank you all for being here.

I wanted to just follow up for a second on Mr. Holt's questions as well in terms of the balance that we have to find between tax—R&D tax incentives and also research.

I am wondering specifically of the ACI proposal on how it invests in our public research institutions just if there are some specifics that you could share that you think really have exceptional promise in creating some of the pipeline that we are talking about.

The other concern is with some programs that exist, and I think you have mentioned that we have to take the existing corps of teachers, and we have to help them improve so that they are able to translate science and technology and engineering, all those concepts that kids need to have. Have you taken a look at the National Board for Professional Teaching Standards program and how we might use that in trying to particularly reach teachers in the math and sciences? It is my understanding that they have demonstrated that students who were in the classrooms of nationally board-certified teachers in those fields have demonstrated better preparedness. So have we looked at that?

And the other concern is with, again, an existing program that really reaches middle school students, which is the AVID program, which recruits university students from throughout the country. It is an international program. I hope that you are familiar with AVID. And it also helps the students if they are taking AP classes in the math and sciences, whatever it is that they are focusing on. We might be able to do much more in the math and sciences in accelerating and really enhancing that program as it relates to the AVID, which is really a mentoring program.

Could you speak to those; and also, just if you could quickly on the public research institutions as well. Sorry. I had several questions. I am in a markup, so I am trying to get a lot in at once.

Mr. LUCE. Yes, ma'am. I will do my best, although the R&D increase called for by the President does not fit within the Department of Education. The amount in his budget request, I believe, is doubled and calls for more emphasis on the physical sciences, but that doesn't fall under our administration and our Department. So I don't think I am the best person to address the specifics of that

R&D credit issue. I know there is a substantial increase, but none of it is administered by the Department of Education.

Mrs. DAVIS OF CALIFORNIA. OK. Thank you.

On the National Board and AVID program, whether those are worthwhile programs to build on and I think to really get the best bang out of those especially in these fields.

Mr. LUCE. On the National Board for Professional Teaching Standards, I am currently unaware of specific data with regard to math and science teachers being reflected by the National Board.

I met with the National Board several times in the last couple of years. Their executive director stressed the need for outcome data and also for breakdown in terms of math and science, and I have been—I have not yet seen that. To my knowledge, it doesn't exist; but I have not met with them for about a year.

Mrs. DAVIS OF CALIFORNIA. And if we could provide that, that might be helpful.

Mr. LUCE. I will do my best to contact them and see what they have.

Mrs. DAVIS OF CALIFORNIA. Thank you.

On AVID, is that something that—you don't know what that is. It is a program that actually began out of California, out of the San Diego area, that is national and international; and it uses advancement by individual determination, and they have seen an astounding number of young people the first in their family to go to college who have excelled and who have gone on to major universities. Clearly without the AVID program these students would never have the chance for college. A lot of it is focussing on some of the math and science. So I would be happy to share that with you, and I am sorry that that hasn't come to your attention. Thank you.

Chairman MCKEON. The gentlelady's time has expired.

Mr. Payne.

Mr. PAYNE. Thank you very much.

I am sorry that I wasn't able to hear your testimony. I have been browsing through it, which was not good, because I was half listening and half reading, which sometimes I have a problem doing one right. But I would—not to mention, evidently Mr. Kildee was serving as our expert on education talked about—I did hear about the Sputnik and the whole question of science and math. I was, you know, in school during that time, and it became a national priority.

Of course, it worked because unfortunately it had to be talked about as a national defense question. It is unfortunate that we can't just say our country ought to be bright. It is unfortunate that we can't say that why doesn't every kid have an opportunity to a thorough and efficient education? It is shameful that we have to put it under the guise of something that sells, you know.

As a former teacher, I just wonder why it is so difficult. Every political person talks about education, whether it is municipal, whether it is county or whether it is State. But then when it comes down to it, it just seems like we keep failing. It is not your fault. It is just something that is happening. It is a national defense loan program. It had to be in a national military context.

When kids got out of college or out of high school, they went to the bank to ask for a national defense loan. That is to go to college.

Why do you have to invoke war or defense or protection or that sort of thing in order to get our education working? But that is the way it was. However—and maybe we ought to do that today. We could get hundreds of billions of dollars. Let us call it a defense thing. I really think we could do our education a lot of good if we were able, if we were looking for funding.

I just may have a quick question. I went down to New Orleans several weeks ago with members of this committee and still struck by the devastation, you just have to see it. I imagine some of you have been there. The difficult thing is trying to explain to people what you saw, because it is just—you know, it is just mind-boggling.

There are, as you know, Historically Black Colleges and Universities, of course. We visited Southern University there and others. I had to come back. Others went to Dillard, and about a week ago we had the president of Dillard here, who talked about their problems. Many of the Historically Black Colleges are not well endowed, and they—when you are wiped out, you are wiped out. I mean, there is no tomorrow, and you have to start all over again.

But as you know, Historically Black Colleges, as many of you know, and Universities have greatly contributed to a number of scientists and engineers in the country. As a matter of fact, a large number of them happened to come from a large number of Historically Black Colleges that concentrated on science and math.

Unfortunately Hurricane Katrina had a severe impact on the ability of HCBUs in Louisiana to continue their programs and retain faculty in these areas. I was talking to Congressman Jefferson, who talked about a physicist who was at, I think, Dillard or at Southern, one of the top physicists in the country, and there is no way in the world he is going to be able to stay there. Because of the devastation of the program—and, I mean, he has already been offered positions, and I believe that he is leaving to go to Wisconsin or something. But the combination of these events will make it even harder for these schools to recruit new students, and also faculty.

My question is what efforts has the Department undertaken to help these schools rebuild their STEM program that they have had?

Mr. LUCE. Thank you, Congressman. As a matter of fact, today the Secretary of Education is probably there for her seventh or eighth trip. She is there with the First Lady.

We established contact with the officials in Mississippi and Louisiana immediately after the hurricane. I went to New Orleans myself. Representatives from the Department went to Mississippi, Louisiana, Alabama, Texas. We have already distributed close to $1.4 million from the Hurricane Education Recovery Act. It was signed into law on December 30th, and the first installment was sent out on January 5th, and the first installment of impact aid went out March 2. We had paid particular attention to the needs of the Historically Black Colleges. I believe I am correct in saying Dillard produces more math and science engineering graduates than any other Historically Black College.

We have met with Dillard, Xavier. We have given charter school grants to the State of Louisiana. We also allocated $190 million to

the Louisiana Board of Regents and the Mississippi institutions of higher learning. We have also given student loans for parents to students impacted by that, and we have given aid to colleges and universities specifically up to $1,000 per student to help defray the costs that they face.

I, too, saw it was overwhelmed by the devastation, a sea of light blue as you land, which I later learned are the tarps on tops of houses, and the devastation is horrendous. That is about all you can say.

But we have also worked with the State to come up with a brand new state-of-the-art school district plan for New Orleans, and I have hopes that it will be a national laboratory where we can help New Orleans best by helping their school system to rebuild.

As you know, it had problems prior to the hurricane, but on the other hand, they have a wonderful opportunity to start from scratch and build something unique. I am seeing movement in that regard, and I am hopeful.

Mr. PAYNE. Thank you very much. I appreciate that. Thank you.

Chairman MCKEON. Thank you.

You know, we have been hearing now for a number of years that we are facing a huge teacher shortage, a nursing shortage. I met with some local car dealers. They told me, we don't have mechanics anymore, we have auto technicians, and they are facing a severe shortage of auto technicians. I met with the head of the association of the truck drivers school. They have a huge shortage of truck drivers. They have to hire 40,000 truck drivers a year. I met with the people from the barber, hairdresser, beautician schools. They have a huge shortage of barbers and hairdressers. We have heard that we have—a lot of our government workers are facing retirement, and we are going to have a huge shortage of government workers. Our unemployment level is running, what, 4.7, something like that now. A few years ago 6 percent was considered full employment.

All of these shortages are facing us, but I have also heard over the last several years from business about the shortage of engineers, scientists, math, people that they can't hire enough, and they said you need to go to China, you need to go to India and see what is happening. I went to China last year. I agree with them, we have some real problems.

I guess the difference between the shortage in the math and science compared to the teachers and nurses, all the others that I mentioned, is that all of our research and development comes from these people that go into math, science, engineering. They are the ones that drive the economy into the future. So that is why that, I believe, is so important.

I visited a fifth grade class a couple of weeks ago, and the teacher was not a science degree—I don't even remember now what his degree was in, but he was so enthused and interested in science that he had turned his whole fifth grade class into a science laboratory. Every square inch of that room was covered with pictures of astronauts or some phase of science in the classroom. The class was working on a project right now involving explaining the solar system and giving reports on the solar system. So that when they study math, or when they study English, or when they study any

other curriculum in that fifth grade, they do it around science and math and how that will benefit them.

I was asking the kids what they were going to be. Several of the girls were going into some field of science. I said, maybe you haven't heard, but girls can't do science. Girls aren't interested in science. They got a good chuckle out of that. But it is amazing what this teacher—the enthusiasm that he was producing in these young people for science.

I know we have said we need to have science more from background, teaching science, and I agree with that, but we should not preclude others that have the ability to engender excitement and enthusiasm in these young people.

It all comes back to a good principal that is going to set a proper environment in the school, a good teacher that is going to set the proper environment in the classroom, and it all starts in the home with parents that are going to inspire and motivate their young people to get as much education as they can.

I visited a doctor a few weeks ago, and it turns out he is from India. His mother was not able to go to school. His father was able to go to the fourth grade. They had seven children; their whole emphasis was on educating their children. Three of the children became physicians, three of them became Ph.Ds, and one of them has a double master's degree, all because they were motivated and inspired to get as much education as they can.

I think that the responsibility of this committee is to try to get the whole country turned on to education, because ultimately that is what is going to help us maintain our competitive edge, right? We have had that since World War II, but it is not a given, it doesn't just happen. Leadership makes a difference. All of you are helping in that.

I want to thank you for your participation here today, thank the members of the committee who were here and for their questions, and encourage you to continue to work with us to help us to find the key, or the keys—I think it is much more. I don't think there is any silver bullet, that is one thing that will make this all happen, but every time we talk about, every time we get a chance to motivate people to get more education, to inspire it culturally, it is very important. So thank you for being here, for participating.

If there is no further business, this committee stands adjourned.

[Whereupon, at 12:40 p.m., the committee was adjourned.]

[Additional testimony submitted for the record follows:]

[The prepared statement of Mr. Norwood follows:]

Prepared Statement of Hon. Charlie Norwood, a Representative in Congress From the State of Georgia

Mr. Chairman, I thank you for hosting what I expect will be the second in a series of hearings to examine the President's "American Competitiveness Initiative." I appreciate your leadership on this issue, and hope that our distinguished panel of witnesses can provide additional insight.

As we learned during the hearing you conducted on April 6th, there are several important questions we must ask before Congress plows billions into a new math and science initiative designed to beef-up the American competitive edge.

1) What works and does not work in current federal math and science programs? 2) Why are current Federal programs intended to train American students for high technology jobs failing to do the job? 3) Is the federal government making the best use of the taxpayer dollars already spent in the name of increasing Science, Technology, Engineering and Math (STEM) graduates?

The GAO reports that the federal government already funds 207 programs across 13 federal agencies to specifically increase STEM graduates; and that is to the tune of nearly $3 billion dollars. Regardless of these costs, we continue to lag behind our competition to the East in terms of producing graduate and doctoral level candidates in the STEM fields. These are fields producing the jobs of tomorrow, and increasingly, the jobs of today that American firms cannot fill with American workers.

Despite this troubling trend, there are many voices in Congress—and many of my friends on this committee—that believe our current programs are doing a great job; so great in fact that more programs are necessary to meet the challenges of the 21st Century. I understand where this conviction comes from, but believe our bureaucracy has some explaining to do first.

The Administration's proposal is well intended, but before this Committee endorses a plan that will create several new programs at a $50 billion clip over 10 years, we must get firm answers to the three questions I outlined above.

Mr. Chairman, I know you want the answers to these questions and trust that the committee will demand them. I thank you for the time and respectfully yield back.

[The prepared statement of Mr. Porter follows:]

Prepared Statement of Hon. Jon Porter, a Representative in Congress From the State of Nevada

Good Morning, Mr. Chairman. I am pleased that the subcommittee is holding today's hearing on the challenges our educational system faces, particularly in the fields of math and science. I appreciate our panel of witnesses for joining us today and the diverse perspectives that they can provide us on this important issue.

One of the building blocks of our nation's success throughout our history has been the ingenuity and invention which allow us to continually overcome the challenges we face and fill the needs that we have. This ability has traditionally been the product of a free-thinking and open society, in concert with the excellence of the education available to us. As our dynamic economy continues to grow, we must continue to rely on this ingenuity and vitality of thought. Excellence in the fields of math and science must be a priority for this to occur, as our increasingly technological society requires increased research and scientific engagement.

The basis for these abilities lies firmly in the ability of our elementary and secondary schools to provide the highest quality math and science education available. To ensure that this education is of the finest quality, Congress, in concert with States, local education agencies, and institutions of higher education, must strive to provide the necessary incentives to bring our best and brightest math and science teachers into the classroom.

In my own school district, we hire approximately 2500 new teachers per year. A significant portion of these slots are teachers of math and science. Our tremendous growth has brought significant challenges in recruiting the finest teachers. We can all work together to engender greater interest in these fields, so that we can continue our strong tradition of technological advancement.

Again, Mr. Chairman, thank you for calling this hearing today on this most important issue. I look forward to the testimony of our witnesses and am hopeful that we can work together to provide excellence in math and science education to all of our students.

[The prepared statement of Vivek Wadhwa follows:]

Prepared Statement of Vivek Wadhwa, Adjunct Professor, Pratt School of Engineering, Duke University

Thank you for the opportunity to submit this testimony.

I have been an Executive in Residence/Adjunct Professor with the Pratt School of Engineering at Duke University since September 2005. Before this I was a technology entrepreneur and co-founded two software companies.

At Duke University, I advise students on their career choices, lecture in classes, conduct research, and work with the faculty to better prepare our students for the real world. Based on my experiences as a technology CEO, there were two surprises in store for me in my discussions with students:

• The first was that some students were worried about having their jobs outsourced. They asked a question that I couldn't answer—what courses would lead to the best job prospects and what jobs were "outsourcing proof"?

• The second was that 30-40% of Duke Masters of Engineering Management students were accepting jobs outside of the engineering profession. They chose to become investment bankers or management consultants rather than engineers.

This was a surprise as I had always believed that there was a shortage of engineers. I had expected that students from top engineering schools such as Duke's Pratt School of Engineering would take their pick of the best engineering jobs. After further discussions with students, I learned that some students saw more opportunity and expected better salaries in non-engineering fields. They were headed towards the greenest pastures.

With the assistance of Dr. Gary Gereffi, Professor, Duke University Department of Sociology, we initiated research into international engineering gradation rates and globalization trends in engineering jobs. We assembled a team of five students who worked for a semester to conduct the first stage of our research. Our goal was to understand the big picture and make recommendations on what fields of education would give our engineering students a competitive advantage.

Graduation Number Comparisons of US-China-India

We started our study by analyzing the "facts". We wanted to establish a baseline for engineering graduation rates between the US, China and India. This would help us understand if there had been a trend over time for fewer graduates in US, more in India and China as more jobs are outsourced.

We published a report in December 2005, titled "Framing the Engineering Outsourcing Debate: Placing the U.S. on a Level Playing Field with China and India" (see attached). This shows that some of the most cited statistics on engineering graduates are inaccurate. Typical press articles have stated that in 2004 the United States graduated roughly 70,000 undergraduate engineers, while China graduated 600,000 and India 350,000. A press release by the National Academies in October 2005 announcing a report titled "Rising Above The Gathering Storm: Energizing and Employing America for a Brighter Economic Future" also cited these numbers.

Our study determined that the above comparison is incorrect. The commonly quoted numbers are based on reports issued by the Chinese Ministry of Education and outdated reports from the National Association of Software and Service Companies (NASSCOM) in India, who are generally considered to be the authorities on engineering graduation statistics within their respective countries. However, the statistics released by these organizations have included not only four-year degrees, but also sub-baccalaureate degrees and certificate/diploma holders. These numbers have been compared against the annual production of accredited four-year engineering degrees in the United States. Additionally, these numbers include not only engineers in traditional engineering disciplines such as mechanical, electrical, and aeronautical, but information technology specialists and technicians.

To produce an accurate comparison, we totaled the bachelors (four-year) and subbaccalaureate (three years or less) degrees awarded in engineering, computer science and information technology in the United States, China and India. We reported that in 2004 China awarded 644,106 of the aforementioned degrees, India awarded 215,000 and the United States awarded 225,925.

Looking strictly at four-year degrees and without considering accreditation or quality, in 2004 the U.S. graduated 137,437 engineers, vs. 112,000 from India. China reported 351,537 under a broader category. All of these numbers include information technology and related majors.

We were able to reach a level of comfort in comparing the US and India numbers, but noted that the Chinese numbers were suspect. We had to rely on information provided by the Chinese Ministry of Education and could not gain comfort with their method of collecting information or the rigor in validating data. The Ministry of Education told us that their aggregate numbers were obtained by adding the numbers of "engineering" graduates as reported by different provinces. These provinces were not required to report on degree by major and that there was no standard definition of engineering between the provinces.

There were also questions about what qualifies as an engineering program in China. It appeared that any bachelor's or short-cycle degree with "engineering" in its title was included in their numbers regardless of the degree's field or the academic rigor associated with it. This means that the reported number of engineers produced may very well include the equivalent of motor mechanics and industrial technicians.

After the report was published, we were told by a visiting Chinese scholar that the numbers supplied to us by the Ministry of Education for 2004 were actually 2003 numbers. The newly released "2005 Chinese Statistical Yearbook" states the combined number of 2004 bachelors and subbaccalaureate graduates was 812,148.

There was no indication what degrees or fields of education were included in these numbers, however.

We subsequently obtained a document written in Chinese from the website of the China Education & Science Research Network which contained a breakdown of degrees for 2004. When we added the engineering majors comparable to those the US and India, the total for four year bachelors came to 349,000.

Last semester we researched the Chinese numbers further. A new team of students contacted 200 of the 400 Chinese universities that graduate engineers. We were able to gather 2004 graduation data from 30 of the larger schools. We were told that these universities together graduated 29,205 in fields which they classified as engineering. Most universities could not give us detailed or usable data. We were able to get 2005 graduation data from 77 universities. The main conclusion we could draw from these data was that universities were reporting significant increases in graduation rates for engineers in 2005 over 2004.

Why Are These Numbers Relevant?

We hear repeatedly that because India and China are graduating twelve times the number of engineers as the U.S., we are at risk of losing our competitive edge. We hear demands that the US double the number of engineers it graduates to keep pace with India and China.

I believe that the US does need to significantly increase its investment in education; this is one of the most valuable investments we can make. We need to improve our math and science curriculum and find ways to get our engineering graduates to stay within the engineering profession.

I also believe that we need to be more effective in commercializing our university research and to find ways to have America corporations keep their research in the U.S. My belief is that there are many problems which need to be fixed and that some of these don't require massive investments.

By focusing just on the graduation numbers, I fear that we are coming to the wrong conclusions. All it took was a team of five students working for one semester to prove that the basic premise of a key argument was incorrect; India and China simply don't graduate twelve times the numbers of engineers that we do. If you compare engineering graduation rates to population, it is clear that the US is far ahead and will be for a few more years; and this assumes that an average American engineering graduate is equal to an average Indian or Chinese graduate.

Are We Really Comparing Apples to Apples?

There is a major difference in quality of education between the US, India and China. Our study did not analyze this, but all available data indicates that the vast majority of Indian and Chinese graduates are not close to the standards of US graduates. As India and China increase their graduation rates, it appears that educational quality may actually be decreasing. The Chinese graduation numbers seem particularly suspect as it appears that their educational focus is quantity vs. quality.

While it is clear that China is significantly increasing the number of engineers and technology specialists it graduates, the data indicates that there is a factory like approach to turning out graduates. Duke researcher, Ben Rissing notes that degree quality can't be maintained unless academic staff and facilities grow with student populations. Ris sing cites China's technical school system, which is used to educate a portion of China's highly skilled technician population. Despite a 100% increase in technical school enrollment over the past five years (over one million students enrolled in 2004), China has been decreasing its total number of technical schools and their associated teachers and staff according to the Chinese Ministry of Education (MoE). From 1999—2004 the number of technical schools in China fell from 4098 to 2884, during that same period the number of teachers and staff at these institutions fell 24% (National Bureau of Statistics of China, 2005 China Statistical Yearbook. Table 21-22).

While technical schools are designed to provide students with industry specific skill sets, institutions of higher education educate students in a variety of disciplines, including three- and four-year engineering offerings. The MoE claims that despite the last five years of significant increases in student populations, China's institutions of higher education enjoy a student to teacher ratio of just over 16:1. However, under closer inspection, the MoE acknowledges that full-time teacher numbers include teachers from "other schools" (National Bureau of Statistics of China, 2005 China Statistical Yearbook. Table 2 1-32). These statistics raise serious questions about the quality of upcoming Chinese engineering and technicians' degrees.

India's most respected educational institution is the Indian Institute of Technology (IIT). Over the years, it has graduated many successful entrepreneurs and leaders. Anecdotal evidence indicates that IIT graduates are exceptional, but so are the graduates of top U.S. schools. Biomedical Engineering Professor Barry Myers says that he has always been impressed with IIT graduates to come to study in the U.S. But these students are only as good as the average American students that he teaches at Duke. The IIT's are challenged by comparatively weaker infrastructure and have been impacted by the private sector recruiting their faculty into new research institutes. Professor Myers says that IIT Deans have visited Duke to recruit recent graduates from his program to teach at their schools.

Do We Need More Engineers?

Salary data for US engineering jobs and anecdotal evidence does not indicate any shortage of US engineers. Simply doubling the graduation rates of engineers without first understanding what types of engineers are needed to maintain our competitive edge may lead to unemployment and a reduction in salaries. This will have the effect of deterring future generations of Americans from studying engineering.

As India and China develop their infrastructure, they will need more engineers. They need more civil engineers, electrical engineers, and mechanical engineers, for example. The U.S has already developed its infrastructure and does not need to simply match the growth rates of engineers in India and China to remain competitive. There is likely to be a high demand in certain engineering professions in the US, but there does not appear to be sufficient research into what these areas are.

Engineers develop renewable energy sources, advancements in technology, solutions for sustaining the environment and improving healthcare. They also manage projects and lead innovation. There is little doubt that we need more of the right types of engineers. The question is what do we need more of? If we do graduate more engineers, how do we motivate these graduates to stay in engineering?

What Should We Do?

Education and Research

First, we should look critically at the overall education system and continually improve quality. The best way for the nation to stay competitive is to have the most educated and motivated workforce. It is clear that there are issues in K-12 education and American children don't study enough math and science.

Effective investment in research provides competitive advantage. We certainly need to invest more in research; but we also need to look at how we can gain more from our existing investments.

As an ex-technology executive in academia, I have observed a chasm between the business world and academia. The priorities are different and so are the objectives. I would not do anything to change the way research is done or to lose the freedom that our universities enjoy. I would however look into ways to bring industry and academia together and to create effective partnerships for research commercialization.

Better industry-university alliances will also provide incentives for corporations to keep their research in the U.S. Universities have a wealth of untapped talent that can make America more competitive. Focused investments can strengthen the research abilities of our universities. These are advantages that countries like China and India simply don't have—their struggle is to graduate enough engineers to keep pace with their growth.

Understand What Gives Us a Long-Term Competitive Advantage

Second, we should determine exactly what engineering skills will give us a long term advantage and focus on producing more of those.

In our study, we tried to differentiate between the skill and education level of engineers and concluded that those with higher-quality education would always stay in demand. We differentiated between "dynamic engineers" and "transactional engineers". Dynamic engineers are individuals capable of abstract thinking and high-level problem-solving. These engineers thrive in teams, work well across international borders, have strong interpersonal skills, and lead innovation. Transactional engineers may possess engineering fundamentals, but not the experience or expertise to apply this knowledge to larger problems. These individuals are typically responsible for rote and repetitive tasks in the workforce.

One of the key differentiators of the two types of engineers is their education. The capstone design course that some U.S. engineering students study in their senior year enables them to integrate knowledge gained from fundamental coursework in the applied sciences and engineering. Programs like Duke's Masters of Engineering Management take this a step further and provide engineers with the skills needed

to become "business-savvy" engineers who are better able to address the complex technical and business issues associated with technology innovation.

Contrary to the popular view that India and China have an abundance of engineers, recent studies show that both countries may actually face severe shortages of dynamic engineers. The vast majority of graduates from these counties have the qualities of transactional engineers.

Differentiating between dynamic and transactional engineers is a start, but we also need to look at specific fields of engineering where the U.S can maintain a distinct advantage. Professor Myers lists specializations such as systems biology and personalized medicine, genomics, proteomics, metabolomics that he believes will give the U.S a long term advantage.

Our education system gives our students broad exposure to many different fields of study. Our engineers learn biology and art, they gain significant practical experience and learn to innovate and become entrepreneurs. Few Indian and Chinese universities provide such advantages to their students.

Understand Corporate America Needs

The fact is that some jobs will be outsourced. We need to determine what types of jobs will not be outsourced and understand the long term needs of corporate America. If a certain type of engineering job can be done more cost effectively in India or China, why should we invest in graduating more of those types of engineers?

Extensive research is needed and surprisingly little information is available on what types of engineering graduates corporate America will need in the future. My team at Duke is presently conducting such research. This will be little more than a drop in the bucket, but we need to gather all the information we can.

Conclusion

The numbers that are at the center of the debate on US engineering competitiveness are not accurate. The US may need to graduate more of certain types of engineers, but we have not determined what we need. By simply reacting to the numbers, we may actually reduce our competitiveness. Let's better understand the problem before we debate the remedy.