innovate + educate

Public-Private Collaboration to Transform Education

New Mexico STEM Design Team
BRIEFING REPORT
June 3-4, 2010

"This new generation will have the opportunity to solve many global issues: healthcare, energy security and the global food crisis to name just a few. Given this, the missing ingredient is a better knowledge (and understanding of) STEM and its power to provide solutions to these problems. Technology can and will change the world. For this younger generation to be the force for good they want to be, they need to understand that the new literacy of the 21st century includes STEM."
Tom Luce, CEO, National Math and Science Initiative

The Status of STEM Education

Much has already been written about the current state of STEM education in the US and how we compare to students across the globe, but this quote from a recent Business Higher Education Forum report sums it up well, "The average US student begins on top of the world in mathematics and science in elementary school, slips to the near middle of the pack by grade 8 and has sunk to the bottom by grade 12. **Even America's best and brightest aren't near the top.** For example, students in AP Physics finished below the international average when compared to all advanced science students in other nations" (Responding to the Crisis in Math and Science Education, 2010).

The Need for a STEM Workforce

The need for a STEM workforce has been well defined: the fastest growing occupations in the country will require math, science and technology skills. Paul Saffo, a Silicon Valley based technology calls it a "brain race." Tomorrow's employers will put a premium on skilled and semi-skilled workers, especially in computers, health care, science and technology.

In 2003, for example, a quarter of American workers were in jobs that were not even listed among the Census Bureau's Occupation codes in 1967, and technological change has only accelerated since then. Environmental-related occupations – which are expected to experience tremendous growth over the next decade – did not exist in comparable data

prior to 2000. As we build a new foundation for economic growth in the 21st century, the nation's workers will be better prepared for ever-changing opportunities if they have strong analytical and interpersonal skills (Preparing The Workers Of Today For The Jobs Of Tomorrow, Executive Office of the President, Council of Economic Advisors, 2009).

The Need for STEM Teachers

In NM, the oncoming shortage of teachers for math and science, as well as the need to continue training existing teachers, has been well laid out in the Math and Science Bureau's 2012 report: currently NM is graduating 26 high school math and 27 high school science teachers each year. With nearly half the current workforce being 50 or over, we are facing a teacher shortage in these critical areas. And the demand for teachers will be a problem confronting every state: It is estimated that education, training, and library occupations will add more than 1.3 million jobs, representing a growth rate of more than 14.4 percent. As the U.S. population grows, large numerical increases will be seen for primary, secondary, and special education teachers, occupations which, together, are projected to contribute 647,300 jobs. In addition, as a larger share of adults seeks educational services, a substantial number of jobs for postsecondary teachers will also arise (NM Dept. of Workforce Solutions, Employment Projections 2008-2018).

The Need for Strong Leadership

While many reports have focused on the need for a qualified teaching workforce, less has been written about the need for education leadership at every level to support STEM education. The past 30 years of education research has established significant correlations between instructional leadership provided by **school administrators** and student achievement (Devereaux, Guidotti, Knapp, Wagner "Leaders Creating the Capacity for Excellence in STEM Education," 2009).

In fact, some argue that without a new generation of "STEM focused leaders" efforts by policymakers, teachers, parents, community members and universities to build and sustain K-12 STEM programs have little chance of succeeding over the long term (CA Space Education and Workforce Institute, 2008).

Where Our Students are Now

We are all likely aware of the test scores nationally and in NM measured by National Assessment Governing Board (NAEP), that paint a dismal picture of the state of US students to perform at even basic levels in math, science, reading and writing.

While scores for student performance are low across the United States compared to other nations, scores measured by NAEP for NM are even lower than the national average. Only 17% of students scored at the proficient level in math, while 41% are basic or below basic, 3% are scoring at the advanced level. In science, 18% are proficient. 46% are basic or below and 1% are advanced. "Proficient" as defined by NAEP, is the degree of

academic achievement that all students should reach and represents solid academic performance. In contrast, "basic" denotes partial mastery of the knowledge and skills that are fundamental for proficient work at a given grade. (For a full discussion of these issues, see http://www.fas.org/sgp/crs/misc/RL33434.pdf).

Many in education worry that high-stakes accountability in general and No Child Left Behind (NCLB) in particular, has reduced the instructional time schools devote to science because science was not tested at the same level as math and English. Instruction hours in science have decreased in many states since the implementation of NCLB.

Finally, beyond test scores or education trends, there is how students themselves view future careers. A 2006 national survey by Public Agenda found that nearly half of the high school students surveyed would be "really unhappy" if they ended up working in an occupation that required "doing a lot of math and science."

The Need for a STEM Workforce in New Mexico

It will not be possible to sustain a first-class economy with a second-class workforce, especially one that lacks expertise in key science and technology fields. According to the Bureau of Labor Statistics Monthly Review, many of the fastest growing occupations in New Mexico are STEM-related. Of the highest growth, Network Systems and Data Communications Analysts are expected to grow over 45% between 2008-2018, and Application software engineers expected to grow by 34% between 2008 and 2018 (NM Dept. of Workforce Solutions).

Dr. Karin Wiburg, a key researcher in higher education and co-chair of the NMSU STEM Education Working Group, conducted a study in 2008 and found a gap between what New Mexico policy and structure provided and the number of students with the skills necessary to enter the STEM workforce. While 94% of those who graduate from New Mexico colleges and universities in STEM fields do stay in the state, there are not enough graduates to fill the STEM-related workforce opportunities that are becoming available.

SOLVING THE PIECES OF THE STEM PUZZLE: WHAT WORKS

Beyond examining the challenges, there are a number of promising methods, programs and research demonstrating what works in STEM education. New Mexico is fortunate to have a strong core of programs, and support from the two national labs based here—all work that can be built upon to develop a thriving and effective STEM network.

Much of the current research on education for the 21st Century has demonstrated that project and inquiry-based methods are effective at teaching important skills and work for students from a range of different income levels and cultural and linguistic backgrounds.

How are we defining STEM and what it means to be STEM-literate? STEM literacy is an interdisciplinary area of study that bridges the four subject areas of science, technology, engineering and mathematics. STEM literacy is a shift in the educational process that

moves away from students learning discrete pieces of material and creates an emphasis on design and problem-solving situations that weave together the disciplines through relevant real world topics (DuBois, Farmer, Gomez, Messner, Silva, "Increasing STEM Capacity through 'Learn-by-doing' Pedagogy" 2009).
Additionally, secondary school goals and curriculum must be aligned with the goals and curricula of post-high school institutions. This alignment can occur through rigorous academic standards and accountability. Programs that either allow students to acquire college credit while still in high school or to start a four-year (often technical) program during the last two years of high school and then continue through two years of community college can help to bridge the gap between secondary school and post-secondary education and training. Many individuals go through multiple spells of attendance at various post-secondary institutions and the resulting credits frequently do not add up to a meaningful credential or degree. One approach to helping students put together courses that generate marketable skills even if the student is not continually enrolled is "career pathway" (or "career cluster") programs. These programs typically involve a careful map of required courses and training, designed to be internally coherent and linked to the demands of specific jobs. Career pathways can begin as early as middle school and can include accelerated programs that blend basic skills and occupational training ("Preparing the Workers of Today for the Jobs of Tomorrow" Executive Office of the President, Council of Economic Advisors, 2009).

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DESIGN FOR A NEW STEM PARADIGM

Many of the current STEM arguments are focused on what we are losing--competitiveness, opportunities for continued growth, national security, etc. A focus on fear-based arguments is not going to motivate our students (or our educators) to start focusing on math and science careers and outcomes. What have we gained from new technologies that are motivating our young people? What gets students excited to learn now? How can we engage students in ways that they relate to….through the power of technology and in solving real-world issues. Most students say that schooling (and STEM) is only engaging when students can see how STEM is applied to real world problems and solutions.

The Case for Computing

New Mexico is unique with two of the three largest national laboratories in our home state. In addition, we are home to several large space assets in the southern part of the State including the NASA White Sands Test Facility, White Sands Missile Range, Spaceport America and the NM Space History Museum. Ranked #2 in the U.S. for number of scientists and engineers in the workforce and 8th in the nation in high tech jobs (jobs in electronics manufacturing, software and computer-related services, telecommunications, and biomedical industries as a share of total employment), New Mexico is not lacking in intellectual capacity and workforce opportunites.al

A fundamental understanding of computation and computational or algorithmic thinking is increasingly important to success throughout the State. Computing education will benefit all students in New Mexico, not just those interested in pursuing computer science or information technology careers. And, students who participate in high school computing classes and have previous experience with technology demonstrate improved readiness for post-secondary studies.

Innovations in technology are transforming our ability to measure, monitor and model how the world behaves. The implication for research is profound, and it will transform the way out students face their futures, in energy, health care, new businesses and new industries that do not exist yet. Companies such as Google and Microsoft are realizing the power of computing. Microsoft recently announced modeling efforts to discuss trends, challenges and shared opportunities (www.modelingtheworld.com). Throughout recorded history, science has been driven by the desire to understand. It has been carried out by theory, experimentation and the collection of data--lots and lots of data. The scientific and technical computing community will collect more data in the next five years than has been collected in all of human history. How do we as a community harness the full power of technical computing to model the complex world around us, with a deeper level of understanding and potentially solve some of the greatest challenges of our time?

New advances in supercomputing and digital technology are transforming our ability to measure, model and monitor how the world behaves. This has profound implications and is changing the way global challenges like energy, climate change and health are understood and addressed. It will also have a huge impact on engineering and business, delivering breakthroughs that can lead to new products, new businesses and even entirely new industries.

Computer science provides an important skill set for students entering any career area, including other sciences where innovation and breakthroughs increasingly depend on the contributed knowledge of computer scientists. Computer and mathematical occupations are expected to add 785,700 new jobs from 2008 to 2018, and, as a group, **they will grow more than twice as fast** as the average for all occupations in the economy, according to projections. It is anticipated that computer specialists will account for the vast majority of this growth, increasing by 762,700 jobs. In New Mexico in 2009, 63 students sat for the AP Computing exam, while 685 students sat for the AP Calculus exam. In addition, surveys showed that intended majors of the NM high school seniors surveyed indicated that engineering was their selected occupation over computing/CS by almost threefold. (240 Computer Science versus 672 Engineering). **However, projected job growth in New Mexico forecasts a need for 1110 engineers by 2016 versus 2280 computing majors. In addition, middle skill jobs in New Mexico are also forecasted require high technical and computing skills.** These are important statistics to focus on, as the need for computing and computational thinking is projected to continue to increase. Demand for computing knowledge will be driven by the continuing need for businesses, government agencies, and other organizations to adopt the latest technologies. It is projected that computer software applications engineers will increase by 175,100 jobs in

the U.S.—more than the projected increase for any other type of computer specialists. Network systems and data communications analysts are projected to see an increase of 155,800 jobs across the nation. New computer specialist jobs will arise in almost every industry, but roughly half will be located in the computer systems design industry, which is expected to employ more than one in four computer specialists in 2018.

Jobs of the Future and NM

In New Mexico, we have some unique occupation sectors that are aligned with those projected to grow by the US Labor Bureau:

- While manufacturing overall is projected to continue to decline as a share of total employment, several manufacturing subsectors – such as **aerospace** and drugs, along with other similarly-advanced manufacturing industries – are anticipated to grow. The jobs in these industries are varied. For example, the major occupations in aerospace include assemblers (aircraft structure, surfaces, rigging, and systems), service technicians, and mechanical drafters. Other areas of advanced manufacturing expected to grow will employ industrial machinery mechanics and mechanical drafters.

- Jobs devoted to environmental improvement grew far faster than other occupations from 2000-2006 and the BLS projects fast relative growth through 2016. These environmental jobs account for only a small fraction of a growing list of occupations and industries that are becoming increasingly devoted to clean energy production, energy efficiency, and environmental protection ("Preparing the Workers of Today for the Jobs of Tomorrow," Executive Office of the President, Council of Economic Advisors, 2009).

Policy Initiatives Supporting Alignment of STEM and Workforce

New Mexico is in many ways positioned to thrive in the 21st economy. The work of Project 2012 has laid the groundwork for policies that are critical to advancing science and math education. We must continue to focus on the gaps in the skills of our workforce and in our training and education policies that threaten to undermine our strengths (New Mexico's Forgotten Middle-Skill Jobs report, April 2010). While high school and college educational attainment is growing, it is still below national averages. Education and workforce policies will be critical for the future of New Mexico's economy. A truly comprehensive innovation agenda must address the demand for both highly educated innovation professionals and the middle-skill workers needed to implement their innovations. Middle-skill workers are at the roots of a successful STEM strategy, nationally and in New Mexico. In a recent solicitation for grant proposals, the U.S. Department of Labor emphasized the importance of the middle-skill STEM workforce:

"The STEM workforce pipeline challenge is not just about the supply and quality of the baccalaureate and advance degree earners. A large percentage of the workforce in industries and occupations that rely on STEM knowledge and skills are technicians,

including others who enter and advance in their field through sub-baccalaureate degrees and certification or through workplace training. Creating interest and preparing more citizens to be productive in STEM-related jobs will require attention to segments of the workforce that are often overlooked in STEM discussions. Incumbent workers who need skills upgrading, dislocated workers who are trying to find new jobs in industries with a future, and individuals from groups traditionally underrepresented in STEM fields"(U.S. Department of Labor, Catalog of Federal Assistance Number: 17.268, Washington, DC, 2009).

Innovate+Educate's role

Innovate+Educate was created to play a significant role in aligning industry needs and workforce initiatives while advancing the state of public education, particularly STEM education. The National Board is made up of key education directors from Fortune 500 companies including the co-founder and Chairman of the Board, Jami Grindatto, Intel Corporation.(http://innovate-educate.org) The Innovate+Educate Board of national and global education leadership is focused on New Mexico as its pilot state for this industry alignment and engagement in STEM and workforce.

Event Name: **Innovate Educate New Mexico's New Mexico STEM Design Team Meeting**

Date/Time: Thursday, June 3, 1:00p.m. -5:00p.m.
Friday, June 4, 8:00a.m. -12:00 continued discussion and work on design principles.
Approximate number of attendees 75

Location: Santa Fe Community College
Board Room
6401 Richards Avenue, Santa Fe, New Mexico

Purpose: Convene New Mexico's STEM and STEM Education stakeholders to begin the envisioning process and design thinking around a statewide STEM network that will become part of the national network of States. *Participants will hear about other statewide STEM networks and their processes/results as well as consider the importance of the current computing work in play throughout the state and its role in thinking about what New Mexico can do in STEM education to advance STEM literacy for all students.*

THANK YOU FOR YOUR LEADERSHIP IN STEM IN NEW MEXICO