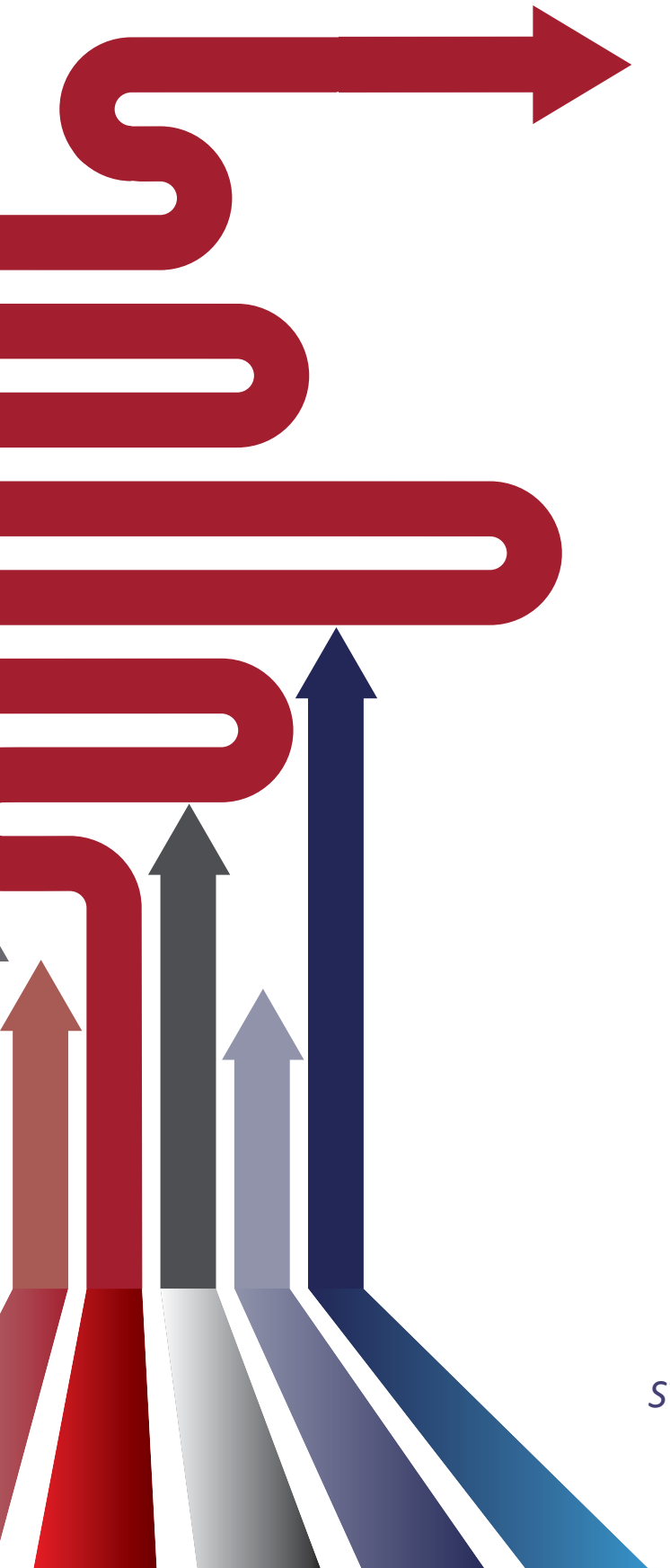

STEM2.0

An Imperative For Our Future Workforce

A Publication by
STEMconnector's Innovation Task Force

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Publication Abstract: *STEM 2.0-An Imperative For Our Future Workforce* is a collection of articles outlining and supporting STEM 2.0™, an initiative of STEMconnector® and its Innovation Task Force. STEM 2.0 is focused on identifying, defining and inculcating in students several new key capability platforms, or skill sets, the future workforce will need to become successful STEM professionals in tomorrow's economy. The first five articles define the core capability platforms (CPs) of the initiative: Employability Skills 2.0™; Innovation Excellence; Digital Fluency; and Hard Skills. The publication continues with different viewpoints in support of STEM 2.0™ ranging from the education community, industry, and other important stakeholders. STEMconnector has adopted and plans to integrate the STEM 2.0™ initiative into its various programs.

STEMconnector's Innovation Task Force (SITF): is comprised of more than thirty leaders from industry, government, education, and the non-profit sectors working on collaborative approaches to address the STEM talent pipeline. The group has agreed on a grand vision of *"accelerating sustainable STEM careers and wealth through innovation science and excellence in tomorrow's new economy."* In 2014, the group has prioritized STEM 2.0™, STEM Career Accelerator Day™, and the Global Talent Summit.

About STEMconnector®: STEMconnector® is a consortium of companies, non-profit associations and professional societies, STEM-related research & policy organizations, government entities, universities and academic institutions concerned with STEM education and the future of human capital in the United States. STEMconnector® is both a resource and a service, designed to link "all things STEM" through a comprehensive website that connects national, state and local STEM entities. The STEMconnector® website contains profiles of more than 20 categories of STEM-related entities and details 'Who is Doing What' on over 6,000 STEM-related organizations for all 50 states.

Disclaimer: The ideas and opinions expressed in this publication belong to the respective authors, unless otherwise credited in citations and/or credits. The information reflects the opinions of STEMconnector® and the authors notes.

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preface

Preface to the 2nd Edition

Preface to the 2nd Edition of STEM 2.0 - An Imperative For Our Future Workforce

In June of this year, STEMconnector's Innovation Task Force (SITF) released its first publication, STEM 2.0—An Imperative For Our Future Workforce in digital and print editions. The publication is a collection of articles written by senior-level STEM leaders from corporations, education, non-profit, and government sectors outlining and supporting the STEM 2.0TM initiative. STEM 2.0 is a strategic program that seeks to identify several critical STEM career capabilities that are not being addressed through today's STEM 1.0 ecosystem.

STEM is one issue that almost every single politician and policy-maker in America can agree upon. Every major company, government department and educational institution has prioritized STEM education. Thousands of programs are being implemented to encourage and prepare students for STEM careers, from Arizona to West Virginia, STEM is everywhere! Still, far too many students are unprepared when they arrive to the workplace.

STEM 2.0 seeks to find programmatic solutions that helpprepare future generations with the specific skills neededvfor a successful STEM career. Based on research from a demand-side perspective, the initiative has selected three foundational capability platforms (CPs) to focus on in 2014-2015: Employability Skills 2.0; Innovation Excellence; and Digital Fluency. Additionally, the initiative will work on a fourth CP, that will work to identify and findsolutions for industry-specific capabilities in fields like advanced manufacturing, food and agriculture, and information technology.

Whereas STEM 1.0 focused, rightly, on STEM content, the next stage for our students and future workforce to master is context. This context will be explored through an exciting new initiative, STEM 2.0, which seeks to define and find solutions for future critical beyond a STEM 1.0 education, that our future workforce must possess.

STEM 2.0 doesn't seek to reform the entire education system or 'recreate the wheel,' rather it will leverage existing programs and initiatives and add new elements from an employer perspective.

STEM 2.0 - As a preface to the second edition of the STEM 2.0—An Imperative For Our Future Workforce, STEMconnector's Innovation Task Force provides an update on several achievements made in 2014 and our plan for the future of STEM 2.0.

EVENTS: Next Steps for STEM 2.0 in 2014-2015

1. **Advancing a Jobs-Driven Economy (STEM 2.0) A National Summit. Presented collaboratively by higher education and corporations focused on aligning education with labor market demand. This Summit is the first initiative presented by STEMconnector's Higher Ed Council October 7-8, 2014 in Washington, DC. –** University and corporate partners come together to advance the education to Jobs and Demand for Jobs supplied by Higher Ed. A book on the Jobs-Driven Economy with result and the release is set for Feb. 24, 2015.

2. **STEM Food and Ag Council – Des Moines, IA – October 16-17, 2014 –** A sister initiative to the STEM Innovation Task Force, the STEM Food and Ag Council is a group of stakeholders in the Food and Ag industry and educational ecosystem. The Council's purpose is to examine workforce demand for the industry, identify key skills areas required and share this information broadly. The desired outcome of this work is to increase awareness of careers among young people and their parents, encourage communication between various stages of human capital development and encourage industry engagement in this process. Three committees are leading this work: Youth Engagement, Workforce and Communications. Chairs are Iowa Lt. Governor Kim Reynolds and Paul Schickler, President of DuPont Pioneer. The Council aims to provide content to the SITF for CP4 in the Food and Ag Industries as well as to promote CP1-3 as frameworks for youth development for secondary and post-secondary students.

3. **Close It Summit – Washington, DC – October 28, 2014 –** During this year's 2014 Close It Summit, the chair of STEMconnector's Innovation Task Force (SITF), Dr. Heidi Kleinbach-Sauter of PepsiCo, will deliver a keynote address highlighting the STEM 2.0 initiative with a particular focus on Innovation Excellence. The Close It Summit is a national call to action for industry, education, workforce, government, youth innovators, foundations and social impact organizations actively engaged in creating new pathways from education to employment. Jane Oates of Apollo Education Group will also speak on STEM 2.0 and jobs and how perfect with respect for her as our former Assistant Secretary of Labor. In addition we will participate with a session on October 27th called MASH UP where we are integrated some of our STEM Higher Education Leaders to focus on jobs and the matching process. Key to this effort will be discussion led by eight leaders from community colleges and minority serving institutions to lead this MASH UP.

4. **Employability Skills 2.0 Roundtable Boston, MA – November 6, 2014–** As a part of the STEM 2.0 roundtable series, the SITF will convene the Employability Skills 2.0 Roundtable in Boston, MA with 20 employability skills experts. The objective of the roundtable is to identify and explore solutions for ***Employability Skills 2.0,*** and specifically their application within the STEM fields from an employer perspective.

5. **STEM Innovation Task Force meeting Boston, MA – November 7-** Update on all four of the STEM 2.0 Capability Platforms (CP). This meeting will review **CP1- Employability Skills** Results and plans including recent roundtable. A recap of **CP2-Innovation Excellence** and the immediate outcomes of the Roundtable held in July 2014. **CP3-Digital Fluency** will focus on plans for the future including the upcom-

ing white paper release by Tata Consultancy services (TCS) in New York City on October 31st. Review of **CP4- Hard Skills,** Business Specific skills with different industries. Note that our STEM STEM Food & Ag Council progress is working on this Capability platform; and our links with Manufacturing, Financial Services and other industries. In addition, there will be updates continuing initiatives like **Career Accelerator Week** effort to be executed in March 2015.

6. **Global Action Summit—November 18, 2014—Nashville, TN –** The SITF will be featured during a panel discussion, moderated by Fareed Zakaria at the 2014 Global Action Summit. The focus of the panel will be the application of STEM 2.0 at the global level, specifically with relation to the conference theme of *creating abundance through food, health, and prosperity.*

2015

7. **Global Talent Summit – Washington, DC – January 14, 2015** The 2015 Global Talent-Summit aims to discuss the applicability of the STEM 2.0 initiative in an international context, through high-level conversations with private-sector leaders from a variety of global industries. Panel discussions and keynotes will feature a broad range of representatives from industry discussing the capability platforms in relation to the needs of their respective businesses. The summit will take place one week before the annual World Economic Forum meeting in Davos with the ultimate goal to inform discussions in Davos.

8. **Davos World Economic Forum –** Davos, Switzerland – January 21-24, 2015 - Building upon the conversations from the 2014 Global Talent Summit, SITF member companies will brief their respective CEOs on STEM 2.0, in hopes of continuing the discussions at the World Economic Forum in Davos, Switzerland. Talks are underway to host a CEO-led panel hosted at the PepsiCo pavilion.

9. **STEM Innovation Task Force Meeting – February 19-20 in Phoenix hosted by ASU.**

10. **STEM Innovation Task Force Meeting – June 8-9 – Midland, MI - hosted by Dow Chemical**

11. **STEM Career Accelerator Day® October 19-23, 2015, events to take place over a week at different sites across the US.**

12. **STEM Innovation Task Force meeting October 29-30, 2015 (Location to be announced)**

Highlights on Two Capability Platforms and their sessions:

CP 2 Innovation Excellence Roundtable - Executing our STEM 2.0 Vision- Innovation Excellence Roundtable, July 22, 2014 – As part of executing and accelerating the STEM 2.0 agenda, STEMconnector's Innovation Task Force hosted a roundtable on the importance of empowering students and the next-generation workforce with Innovation Excellence capabilities, with a specific focus on what skills are in demand from an employer perspective. A distinguished group of more than 20 experts from industry, education, government and the non-profit sectors gathered for a one day workshop style meeting to develop recommendations and roadmaps to answer the following question:

From an employer perspective, how can we best strengthen the presence of Innovation Excellence in education and workforce development to drive economic growth?

A critical driver of any economy is the strength of its ability to foster innovation – the process of transforming ideas into new and improved systems, services, or products that enhance the value of existing resources or create new ones. Innovators identify opportunities and use them to drive change.

Innovation Excellence Roundtable Outcomes—BIG IDEAS

- *Innovation Excellence Requires A "Holistic" Multi/Trans Disciplinary Skill Set*
  - » Online Platform that hosts IE tools, processes, and techniques that showcase the multidisciplinary nature of Innovation Excellence.
  - » Simulations/Case Studies that teach the importance of the multi-disciplinary nature of Innovation Excellence

- *Project-Based Learning & Public-Private Partnerships Are Critical for Innovation Excellence at Every Level of Learning*
  - » Develop a playbook for public-private partnerships in Innovation Excellence

- *Innovation Excellence can be Taught & Learned*
  - » Innovation Excellence competency framework
  - » Marketplace of innovation training and public private partnerships available
  - » Public-private partnership playbook for STEM 2.0

- *Workforce Training & Mentorship are Critical Success Factors*
  - » Private Sector Commitment to teach Employability Skills

Following the roundtable and under the leadership of the STEMconnector Task Force, the parties will continue to lead the dialogue, raise awareness for the importance of Innovation Excellence as a critical skill set for the future STEM talent pipeline and support the implementation of a select set of strategic actions. We are deeply grateful for our world leading innovation experts to have actively engaged in the roundtable and are looking forward to continuing the dialogue within a strategic series of white papers, panel discussions and public-private partnerships to enable our future STEM talent to develop best in class expertise in Innovation Excellence. For a brief recap video of the Innovation Excellence roundtable, please visit the STEMconnector YouTube page at (https://www.youtube.com/user/STEMconnectororg).

CP3 – Digital Fluency – Executing our STEM 2.0 Vision – Digital Fluency Roundtable, May 16, 2014

Across industries, businesses are expecting the next generation of employees to be "digitally fluent": which means having a mastery of digital technology beyond the classroom, to solve real-life problems. Yet education is currently not delivering the skills needed to go from college to career, or from "skills to jobs". With 73 percent of new science, technology, engineering, and mathematics (STEM) jobs created from 2010 to 2020 projected to be in computer science (CS), a serious skills shortage is developing. The progression in education and the progression in technology are out of synch in both methodology and rate of change.

As part of executing and accelerating the STEM 2.0 agenda, the STEM Innovation Task Force under the leadership of Tata Consultancy Services and STEMconnector®, hosted a computer science roundtable. The focus

was on how states and cities are advancing computer science education, what industry is doing to advance computer skills, and how we can identify, replicate and scale best practices resulting from these efforts. This dynamic event held at the

New York Academy of Sciences brought together business executives, government officials, educators, national agencies, nonprofits and thought leaders to examine how states and cities are advancing CS education by providing new ways to create a digitally fluent workforce. The roundtable built on the success of the executive roundtable on Computer Science Education and Careers held at Washington, D.C., on September 6, 2013 and the release of a white paper, *"Education & Careers in the U.S.: The Future of Computer Science,"* which created a blueprint for addressing the key issues through cross-sector collaboration.

The goal of the May 16 roundtable was to address the national need for technology talent by identifying high-impact state, city and local programs that are also scalable and replicable. Representatives from across the country shared the progress of their efforts to improve K-12 Computer Science (CS) education while engaging in a frank exchange on **ways to maximize scarce funds, boost cross-sector collaboration and strengthen partnerships linking formal CS courses with informal education.** Major themes that were identified to be covered throughout the day included:

1. **Effective Industry Engagement –** How is industry using both its financial capital and human capital to catalyze improved outcomes in Computer Science education?

2. **State and Regional Policy Frameworks –** What are the policy initiatives that encourage more students to learn coding skills, digital fluency and teacher excellence among other goals? How does policy negotiate structural constraints that exist in the educational

system? What are some models of effective public-private partnerships that integrate industry in meaningful ways into this issue?

3. **Implementing Solutions –** What are some replicable and scalable practices that are occurring to support effective CS education? Where do the formal and informal sectors intersect? How can we create positive feedback loops between both sectors?

The roundtable discussion touched on a variety of CS challenges, including:

- **Defining CS –** There is a need for a strong, universal definition of CS to effectively designcurricula that addresses the skills required at the university level and in the workforce.

- **Supplying trained CS teachers –** There are not enough CS teachers in the U.S., and in many schools teachers are alone in their departments, isolated from the broader CS space. With the field rapidly evolving, teachers need training to not only initially enter the CS field and meet the demand for CS educators, but to constantly adapt to new developments in the industry.

- **Prioritizing CS and addressing inequity–** While some states and cities are facing budget constraints limiting their access to resources, other states feel that education is not under-funded, but under-prioritized. Participants called for policies that enable schools and districts to prioritize CS coursework so that all students have access to quality CS education.

Key scalable resolutions from the day's dialogue included the following:

- ***Industry and CS educators to work hand-in-hand:*** Skilled computer professionals must collaborate with CS educators to train teachers and empower them with the resources they need, thus ensuring that the students are adequately prepared to succeed in jobs in CS.

- ***Students deserve clear communication about the value of a CS degree:*** Teachers, non profits, and industry need to showcase to students the tremendous career opportunities and earning potential.

- ***CS education needs to start earlier:*** Utah students are learning math skills through virtual tutors, which provide immediate feedback and solidify students' math skills. Programs like this improve math proficiency and expose students to computer skills at a younger age, so that coursework can shift from digital literacy to digital fluency.

- ***Connect CS teachers to each other:*** Move from a culture of isolation to one of inclusion.

- ***Match CS supply with demand and address equity issue:*** Put a focus on serving girls and low-income and underrepresented minority populations, directly connect young people with industry mentors to help them overcome obstacles and pursue STEM education and careers.

2nd White Paper Release – Computer Science Roundtable and the States October 31st .

Note the plans for other Capability platforms results will be released in the fall, 2014.

one

SECTION 1

The Core Capability Platforms of STEM 2.0

STEM 2.0: An Imperative for Our Future Workforce

Heidi Kleinbach-Sauter and Edie Fraser

Where is STEM Today?

Across government, industry, the non-profit community, and educational institutions, a consensus has been reached; the United States must develop a sustainable system that develops human capital equipped with knowledge and expertise in the fields of science, technology, engineering and mathematics (STEM). The commitment and passion for STEM transcends both political party and state lines, as it is the one public-policy issue Americans can generally agree upon. There is a unique opportunity to seize upon the momentum built in recent years and transform discourse into solutions.

Individuals and institutions are implementing thousands of STEM-focused programs, initiatives, and campaigns, which seek to propel students through degree programs and into STEM careers. Within the STEM-ecosystem there are also multiple verticals that focus on specific topical areas including: encouraging women, girls and other underrepresented minorities to enter STEM fields; informal out-of-school programming; common core and next generation science standards; education technology; career and technical education; and several others. It has taken a great deal of time, investment and energy to reach this critical juncture, and the leaders and organizations that have brought STEM to the forefront deserve recognition.

While this momentum—which is defined as STEM 1.0—was necessary and useful, its content was more thematic than tactical. Whereas STEM 1.0 focused, rightly, on STEM content, the next stage for our students and future workforce to master is context. This context will be explored through an exciting new initiative, STEM 2.0, that seeks to define and find solutions for future critical career capabilities, beyond a STEM 1.0 education, that our future workforce must possess. STEM 2.0 doesn't seek to reform the entire education system or 'recreate the wheel,' rather it will leverage existing programs and initiatives and add new elements from a demand-side perspective to turbocharge progress.

From STEM 1.0 to STEM 2.0™

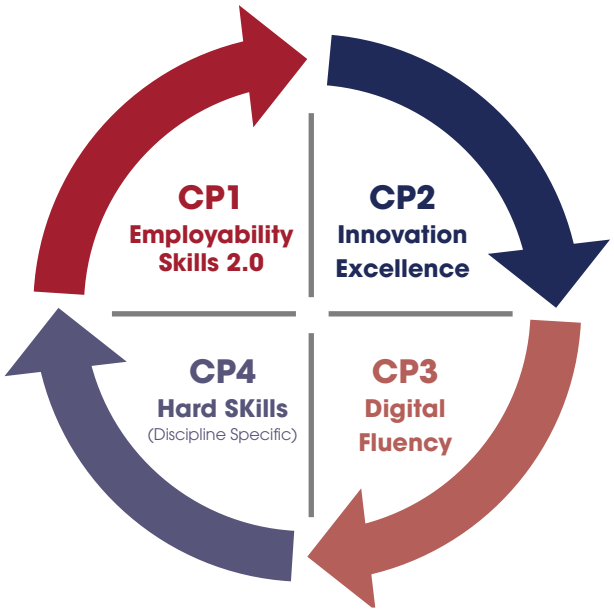
STEMconnector's Innovation Task Force (SITF), a thirty-plus member consortium working to develop new pathways to STEM careers, conceived the STEM 2.0 initiative. The SITF includes major corporations, important government departments, educational institutions, and non-profit organizations, all of which are major proponents and supporters of STEM education. STEM 2.0 is focused on identifying, defining and inculcating in students several new key capability platforms, or skill sets, the future workforce will need to become successful STEM professionals in tomorrow's economy. STEM 2.0 is a strategic, actionable, scalable and sustainable approach to help

solve STEM skills deficits from a demand side perspective.

New Capabilities

Tomorrow's STEM 2.0 jobs will place increased demands on workers. To that end, the task force has identified four new capability platforms (CPs) our educational ecosystem must inculcate in students: CP1 Employability Skills 2.0, CP2 Innovation Excellence, CP3 Digital Fluency and identifying a framework for defining Hard Skills, CP4.

Figure 1. Wheel Graphic of STEM 2.0 Capability Platforms



- ***CP1 Employability Skills*** are the behaviors above and beyond technical skills that enable STEM employees to create stakeholder momentum to commercialize ideas, or in short career skills. It is the ability to present and "sell" their ideas to others; to function in teams; to develop business acumen; to develop leadership skills; to navigate across a complex matrix of global organizations.
- ***CP 2 Innovation Excellence*** requires a re-framing of the collective thinking about invention and innovation. Across all industries, executives are looking for innovators—not simply inventors. The distinction may sound minor, but it's not. Whereas invention is often pegged to inspiration, profitable and sustainable innovation is a process. This evolution requires a shift from focusing on solving complex technical problems to defining and redefining the right problem before solving it and doing this in the context of the market and business environment of the future.
- ***CP 3 Digital Fluency*** can be defined as the application of STEM learnings to specific "real world" problems through digital technology. Learning the basics of mathematics is STEM 1.0; leveraging a STEM education to solve stubborn problems in the banking world, or modeling data to predict consumer behavior, is quite another. In short, it is a skills evolution—from how to apply skills to what to do with those skills.
- ***CP 4 Hard Skills*** are the industry-specific skills that must be mastered in order for students to excel in new careers in industries in fields like: advanced manufacturing, energy, food & agriculture, information technology, and many others.

The Pathway to STEM 2.0 is Basic Math

Figure 2. The STEM 2.0 Equation

The formula for STEM 2.0 success is deceptively simple. While most participants in the STEM discussion would agree the adop-

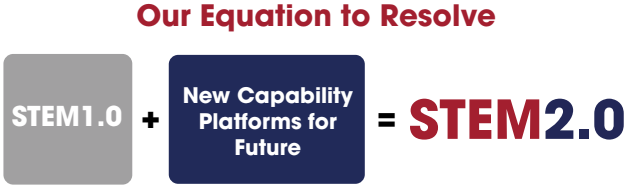
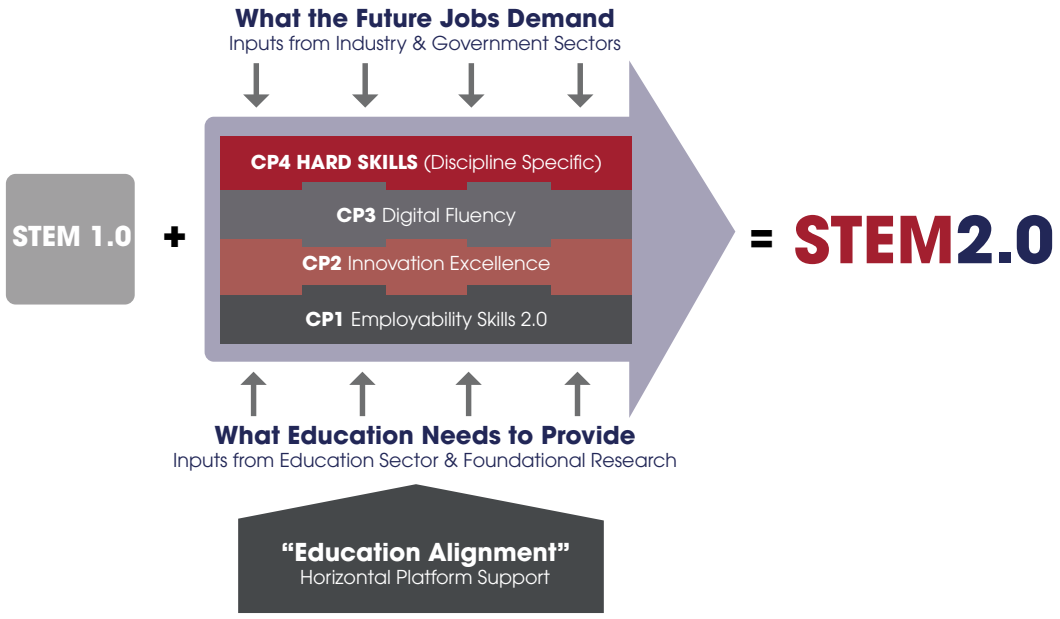


Figure 3. STEM 2.0 Framework with Capability Platforms 1-4



tion of these four capabilities are common sense, that doesn't mean they are common practice. Because in addition to our STEM 1.0 problem (a labor shortage), among the limited cohort of people who possess the baseline skills, the gap between content and context mastery is still too wide (STEM 2.0).

Expanding the STEM 2.0 Ecosystem

STEM 2.0 is a multi-year strategic program of STEMconnector's Innovation Task Force, aimed to actively accelerate STEM careers. The ability to pivot from STEM 1.0 to STEM 2.0 will be crucial both for individual job security and institutional viability in tomorrow's economy. And the stakes are high: If we are successful in filling the pipelines with a high innovation potential R&D workforce, companies can realize 14% higher sales in new product launches, says data from The Corporate Executive Board Company.

Accordingly, in an effort to increase impact and accelerate adoption of the new capabilities presented above, STEMconnector, in partnership with its STEM Food & Ag and STEM Higher Education Councils are partnering with the SITF to leverage the STEM 2.0 framework among key stakeholders as subject matter experts that will develop, drive and action impactful solutions.

STEM 2.0 is a coordinated, multi-year effort to accelerate STEM careers. If STEMconnector's Innovation Task Force is to build and expand a powerful STEM 2.0 ecosystem, we will need to engage and activate all of our colleagues over the short-term as well as the mid-term.

In the short-term, we will raise awareness for STEM 2.0 through:

- White paper releases about the four new capabilities we have identified: Digital Fluency, Innovation Excellence, Employability Skills 2.0, and Hard Skills. This white

paper series is intended to align and activate stakeholders, guide government and policy experts, and inform educators, parents and students keen to build a STEM 2.0 competency portfolio.
- Expert roundtables with world class STEM thought leaders are planned in 2014 to discuss tangible details and develop action plans and teaching models around all four capability platforms.
- STEMconnector's Innovation Task Force will host a series of events and drive actions to raise awareness for STEM 2.0 on the education side, especially engaging teachers through Teach for America and other organizations, including linking with a least 20 of the major STEMconnector partners.
- Major events, including the 2015 Global Talent Summit hosted in partnership with the Diplomatic Courier with a STEM 2.0 focus.
- A STEM 2.0 section at STEMconnector.org.
- Use of national media outlets and social media campaigns.
- Development of communications toolbox content, which will help colleagues disseminate the STEM 2.0 message in a turnkey fashion.

Our mid-term objectives and impact for 2015 are equally ambitious as we evolve STEM 2.0 to a concrete learning framework. The Task Force will:

- Build plans for encouraging adoption of framework.
- Raise global awareness about STEM 2.0.
- Start building learning networks.
- Identify pilot projects to teach STEM 2.0 new capabilities platforms.
- Broaden the STEM 2.0 ecosystem.

Beyond 2015, our long-term vision includes exploring the impact of a virtual Global Academy for certified STEM 2.0 education and training.

The Global Academy will need to include no/low tuition requirements to unlock careers for economically disadvantaged young talent. And the business model most likely would need to be funded by a co-partnership between public and private organizations, as well as governmental support.

Because STEM 2.0 has global relevance and reach, we believe that this is an investment in our future that's worth making in North America—as well as other major growth regions outside of U.S., particularly in emerging markets.

STEM 2.0 is a necessity that can capture and propel all of us to get involved, engaged and change the landscape for young people and existing jobs as well. Join us in this imperative!

About the Authors:

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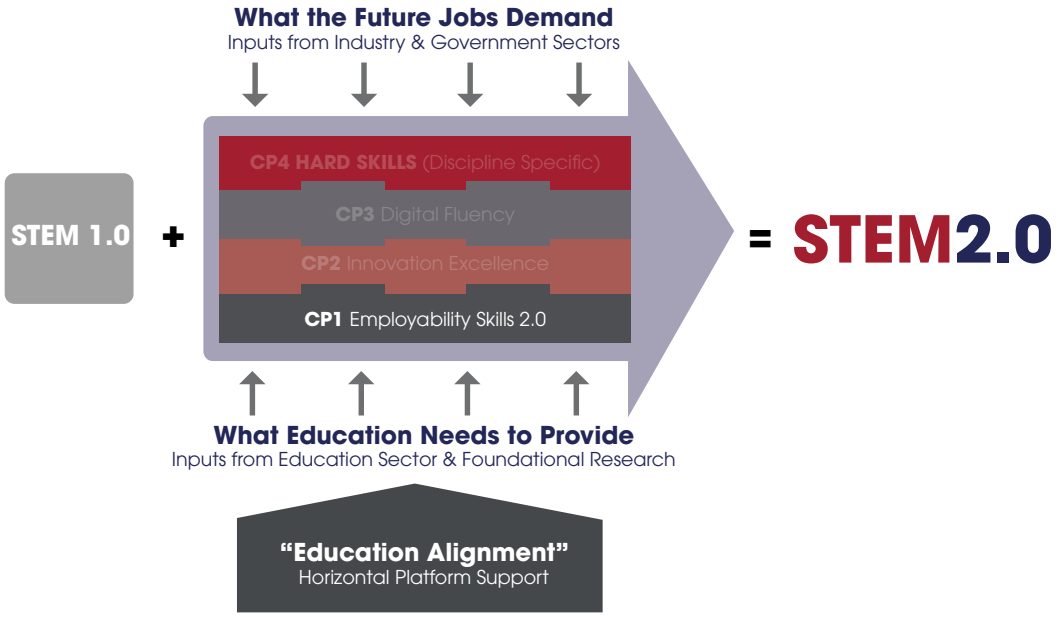
Employability Skills 2.0: Identifying and Developing Next-Generation Skills For Tomorrow's STEM Professional

Al Bunshaft

Employability skills provide an essential foundation for success in any career. They are basic, discipline-independent skills and behaviors that all employers expect of their employees. Through the work of STEMconnector's Innovation Task Force, we seek to propose and elevate a set of specific, next-generation employability skills that STEM (science, technology, engineering, and mathematics) students must possess in order to be successful in tomorrow's economy. We refer to this advanced skill set as the Employability Skills 2.0 Capability Platform, a foundational component of the STEM 2.0 framework. In this article, we will outline the current literature and employability skills models, identify exemplary organizations focused on imparting these skills, and discuss alternative measurement systems for assessing their mastery.

Figure 4. STEM 2.0 Framework Featuring Capability Platform 1: Employability Skills 2.0



What are Employability Skills?

Employability skills focus on essential qualities to perform well in and retain a regular, full-time job. They are alternately called by various terms including life skills, career skills and soft skills in literature outlining skills assessments and identification. The following is a basic definition, composed by the author, which provides a context for our discussion:

> ***Employability Skills*** *noun* ***(1)*** *A set of general skills that are needed to perform well in most jobs, to stay in a job and progress through one's career.* ***(2)*** *Skills that are generic in nature rather than job specific and cut across all industry types, business sizes, and job levels.* ***(3)*** *Generally divided into three skill sets: (a) basic academic skills, (b) personal qualities and (c) higher-order thinking skills.*

History and Perspective

Some would argue that employability skills are best taught in the home. However, students vary widely in their access to model behaviors and expectations in this area. Over the years, curricula have evolved to embrace the teaching of the key skills and work habits linked to career success. Organizations such as SkillsUSA, the National 4-H Council, and the National FFA Organization have prioritized and developed programming as part of their youth development agenda.

Alternatively, many private-sector companies have developed employability skills development as a part of onboarding, professional development, and leadership training. A prime example is Tata Consultancy Services, a global leader in information technology (IT) services and business process consulting, who has focused specifically on these skills as part of their BizSkills program (TCS).

There are multiple organizations that provide assessment services to employers that help to gauge the workplace competencies of potential employees as a component of the hiring process. One such organization is the ACT organization, which has formalized the testing and assessment of these skills as part of their WorkKeys program.

In late 2011, Hanover Research published a paper entitled "A Crosswalk of 21st Century Skills". In the paper, they examined the similarities and differences between six frameworks. The report looked at the Partnership for 21st Century Skills, Tony Wagner's Global Achievement Gap Seven Survival Skills, enGauge, Iowa Essential Concepts and Skills—21st Century Skills, Connecticut Department of Education's 21st Century Skills, and finally Assessment and Teaching of 21st Century Skills. The report examines twenty-seven skill themes and points out that only four of them span all of the sources; collaboration and teamwork, creativity/imagination, critical thinking and problem solving. Additionally, they identified two "up and coming" themes: global community and dynamic work environment. The Hanover Research report begins to point towards the important skills needed for success in 21st century STEM jobs (Hanover Research).

Employability Skills 2.0

As has been discussed, our STEM 2.0 objective is to identify the critical, cross-disciplinary skills that are required for success in STEM jobs. We are looking for next generation skills, beyond the basic, but still pervasively needed skills in a wide range of STEM job roles. Many of these needs are amplified by the changing nature of:

- Work (i.e. enabled by digital technologies);
- Organizations (i.e. global, distributed, new command and control structures);

- The workers themselves (diverse, wide range of education, informal hierarchies, etc.).

For example, instead of being able to communicate effectively in a traditional workplace environment, the STEM 2.0 proficient professional is able to communicate effectively with co-workers, clients, and partners through multiple, complex, and virtual platforms. The STEM 2.0 professional might also employ advanced data analytics to solve problems at work, and present them to a supervisor using an interactive dashboard or Infographic. The Employability Skills 2.0 platform will explore the critical areas that have been prioritized by organizations working in this field, and add value and applicability to the ever-changing nature of today's workplace.

As we survey those in the field and look to papers like the Hanover Research cited earlier, we see some trends emerging. Areas such as complex problem solving, collaboration with distributed/virtual teams, creativity and imagination, and sophisticated communication skills come to the fore. Our work will seek to validate and refine a list of these skills and others, focusing on the differentiating 2.0 level of these attributes.

Next Steps for Employability Skills 2.0

We have highlighted here STEMconnector's Innovation Task Force's focus on Employability Skills 2.0. Our work in 2014 will focus on defining this skill set, engaging subject-matter experts, and identifying and recommending a set of solutions for teaching and measuring these skills in the context of STEM education. It is envisioned that this education will be delivered through formal in-school education, informal/after school programs, and through employer education. We will lay out not only the skill set, but also an approach to teaching and assessing these skills. We will propose a number of organizations that might well serve their constituents by embracing this approach. We expect to engage and consult with many of these organizations throughout the development of the STEM 2.0 and Employability Skills 2.0 framework. This work will progress through 2014 and more details will be shared in the white paper on this topic planned for later this year.

About the Author

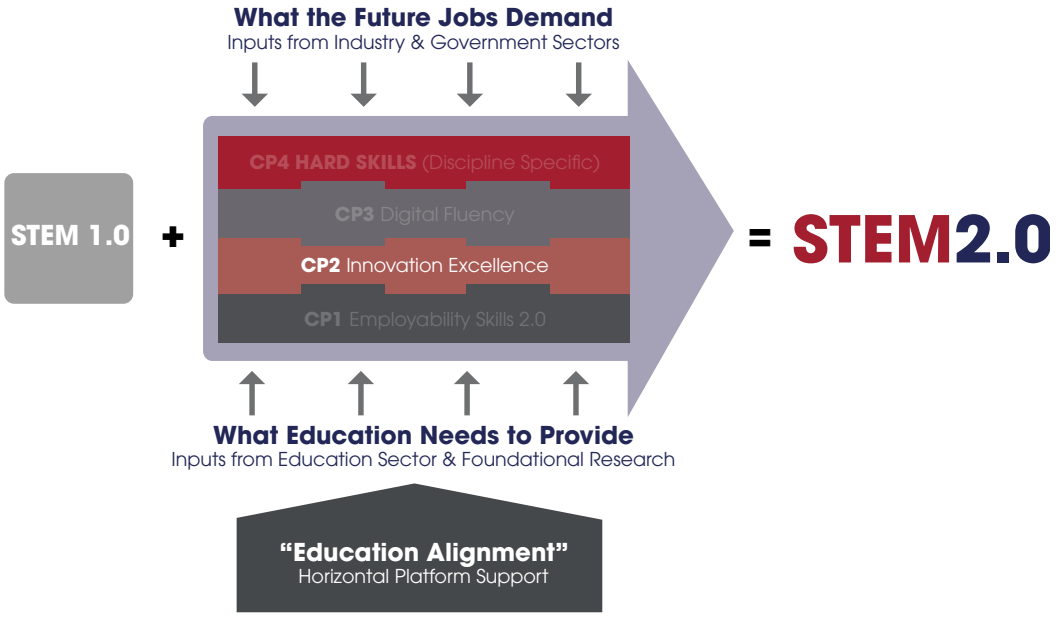
Al Bunshaft *is the Senior Vice President of Dassault Systèmes' Americas Corporation where he spearheads strategic initiatives and corporate leadership programs. He is a leading proponent of corporate citizenship and STEM education. Al leads the Employability Skills 2.0 capability platform as a member of STEMconnector's Innovation Task Force.*

STEM 2.0 Innovation Excellence: A Demand-Side View of Needed Capabilities

Heidi Kleinbach-Sauter and Mitzi M. Montoya

A new initiative developed by the STEMconnector's Innovation Task Force, a 30-plus member consortium of private sector, government, higher education and non-profit leaders, recommends we transition from STEM 1.0 to STEM 2.0. In the opening article, "*STEM 2.0: An Imperative for Our Education Ecosystem and Future Workforce*", we defined the critical new capabilities our STEM students need to be successful in solving the transformational problems of tomorrow. One of the important capability platforms that must be developed and inculcated across the spectrum of the STEM education system is *Innovation Excellence*.

Figure 5. STEM 2.0 Framework Featuring Capability Platform 2: Innovation Excellence



Innovation Excellence

A critical driver of any economy is its ability to foster innovation—the process of transforming ideas into new and improved systems, services or products that enhance the value of existing resources or the creation of new ones. One of the primary ingredients of successful innovation is an education system that embraces the development of the next generators of innovators and promotes a culture of Innovation Excellence.

Innovation Excellence, a set of standards to be developed for building innovative capacity in our schools and workforce, is a crucial driver of STEM 2.0. As we advance in this white paper, not only should Innovation Excellence be a formal discipline but also a national priority for our education system and future workforce. Strengthening the presence of innovation in education and workforce development initiatives represents a critical method to stimulate economic and social growth.

Why Innovation Excellence?

Two of the most visible STEM innovators in recent history, Apple's Steve Jobs and Microsoft's Bill Gates, have underscored the unparalleled role of innovation for STEM career success. "Innovation distinguishes between a leader and a follower," said Jobs (Gallo 23). And in testimony before the U.S. House of Representatives' Science and Technology Committee, Gates echoed the sentiment. "If the U.S. truly wants to secure its global leadership in technology innovation, we must, as a nation, commit to a strategy for Innovation Excellence" (U.S. House Committee on Science and Technology).

These sentiments have been echoed among entities across the private, public and nonprofit sectors. During recent testimony before the Senate Appropriations Committee, fifty business, higher education, scientific and patent organizations implored lawmakers to address the "innovation deficit" facing the United States. Urging lawmakers to commit to investments in research and education, the coalition of organizations highlighted the repercussions of failing to do so: a weaker economy, heightened national security risks and loss of our competitive advantage, to name a few (U.S. Senate Committee on Appropriations).

Author and *New York Times* columnist Thomas Friedman and John Hopkins University Professor Michael Mandelbaum predict in their 2011 book, *That Used to Be Us,* that the near future will entail the world's division into two distinct categories: high-imagination enabling countries and low-imagination enabling countries. High-imagination enabling countries, those that promote creativity and discovery, will flourish, while low-imagination enabling countries will struggle to remain competitive (Friedman and Mandelbaum 151).

A recent study from PricewaterhouseCoopers surveyed over 1,700 C-Suite and executive level respondents from more than 25 countries and across more than 30 sectors, revealed a powerful business case for companies demonstrating a high level of Innovation Excellence. The most innovative companies are predicting growth of 62.2% over the next 5 years vs. a growth of 20.7% predicted for the least innovative companies (PricewaterhouseCoopers).

There is also a broad consensus that Innovation Excellence is rapidly transforming from an art to a disciplined science with a well-defined strategy and process. Industry leaders increasingly manage innovation through a formalized process, while stragglers are more informal about innovation. The most innovative companies are striving for radical innovation in multiple functional areas, and will require broad capabilities in Innovation Excellence, far beyond a traditional STEM 1.0

education. Collaboration is also becoming critical, as 95% of the innovation leaders work in partnership with strategic partners to drive innovation (PricewaterhouseCoopers).

Invention vs. Innovation

The transition from STEM 1.0 to STEM 2.0 will require a re-framing of our collective thinking about invention and innovation. Across all industries, executives are looking for innovators—not simply inventors. The distinction may sound minor, but it's not.

The myth of the inventor is very alluring to STEM professionals. It's the Einstein myth, the Silicon Valley myth, the Nobel-prize winner myth. The "mad genius" in the lab or the garage. To be sure, these folks exist, but they are more the exception than the rule. The biggest breakthroughs don't come from one thinker; they come from teams—and usually these teams are housed inside large organizations. Whereas invention is often pegged to inspiration, innovation is a *process.*

It takes discipline, rigor, and determination to attack a problem or opportunity methodically, from all angles. This evolution requires a shift from focusing on solving complex technical problems to defining and redefining the *right* problem before solving it.

It's a transition from striving to develop solutions that are technologically complex to developing solutions that are easy for customers to use and adopt. Instead of depending on others to sell (market) their solutions, a STEM 2.0-proficient professional must be able to create stakeholder momentum to commercialize ideas.

Innovation Markers

Derived from Testing CEB SHL's Universal Competency Framework on R&D Survey Data, six categories of innovators were identified (2013 Corporate Executive Board company, RTEC 6101713SYN):

- ***The Results Seeker***. Persistence is key with this cohort, the largest of the group, who invest the extra hours to achieve their objectives and see projects through completion.
- ***The Customer Empathizer***. These innovators "go backwards from the customer." They solicit customer input and feedback *first*—and then build products and services to satisfy them, relating customer needs to relevant technologies.
- ***The Idea Integrator***. These are the dot-connectors, the people who have the ability to review an enormous body of data, break the information down into parts, and then understand how each of the parts may be part of a larger system.
- ***The Fast Adapter***. This person is energized—instead of threatened—by rapid change. Constantly chasing new ideas and technologies, this STEM professional recovers quickly from mistakes or when initial ideas don't work out—and optimistically keeps marching forward.
- ***The Influencer***. This is the perfect synch-up between technological acumen and communications savvy. It's the ability to listen, consult and communicate complex ideas to others. Relationship-builders, these STEM professionals can adapt their communications style depending on content and audience, enabling them to sell ideas and handle objections convincingly.
- ***The Risk Taker***. This cohort, the smallest of the six groupings, are definitive personalities. They take calculated risks rather than miss opportunities. They will initiate action alone, and believe so strongly in their ideas and projects that they're willing to put their personal reputation on the line.

Formula for Innovation

Academic and medical research overwhelmingly discredits the notion that innovation is genetic. Rather than a genetic predisposition, creative thinking is a skill that can be learned, practiced and sharpened over time. In a six-year research study involving hundreds of innovators and thousands of entrepreneurs, managers and executives from all corners of the globe, INSEAD Chaired Professor of Innovation and Leadership Hal Gregersen, Harvard Business School Professor Clayton M. Christensen and Horace Beesley Professor of Strategy Jeff Dyer outline a recipe for innovation that entails five key ingredients, or skills, common to disruptive innovators and visionaries.

These ingredients – named the *discovery skills* and practiced by innovative entrepreneurs – include the cognitive skill of association and the behavioral skills of questioning, observing, networking and experimenting. Actively practicing the five discovery skills facilitates the enhancement of creative confidence and refinement of innovation skills.

A Culture of Innovation

To produce more innovative thinkers, we must curate educational experiences that foster the development of the five discovery skills and provide ample opportunity for critical thinking and interdisciplinary, collaborative problem solving. These skills are lacking among students when they arrive to the workplace after finishing formal education. An educational system that creates innovators demands a paradigm shift in terms of teaching and learning. Author Sir Ken Robinson argues that this shift starts with a change in mindsets and contends, "at the heart of this transformation there has to be a radically different view of human intelligence and creativity" (Robinson 14).

The current education system, designed for efficiency and scalability, emerged during the industrial era. Public schools were based on a common, rigid blueprint – one that persists today. The shift from an industrial to knowledge economy has rendered this dominant archetype obsolete. The standardized, segmented curricular structure no longer equips students with the skills necessary to thrive in the 21st century, nor does it prepare students to address looming economic, social, health and technological challenges. The existing emphasis on knowledge acquisition relegates students to a passive role, when in fact students should and must be actively engaged in learning in order to develop higher order thinking skills. In today's increasingly complex world, as Tony Wagner, expert in residence at Harvard's Innovation Lab, maintains, "What you know is far less important than what you can do with what you know" (Friedman).

Cultivating a culture of innovation in our schools requires rethinking the education system. In *Creating Innovators: The Making of Young People Who Will Change the World*, Wagner identifies five key modifications, or more accurately, radical transitions, requisite to ingraining innovation in the very fabric of our education system. These paradigmatic shifts include:

- ***Individual achievement to collaboration***. Instead of touting personal accomplishments, schools should champion and reward collaborative team endeavors.
- ***Specialization to multi-disciplinary learning***. While content knowledge is both significant and necessary, students need to spend more time actively applying this knowledge, thereby developing creative confidence and divergent thinking skills. Innovation occurs at the intersection of disciplines.

- ***Risk avoidance to risk taking***. As the design firm IDEO famously proclaims, fail early and fail often. Failure is an integral component to the innovation process; thus schools need to encourage intellectual risk taking.
- ***Consumption to creation***. The majority of schools focus on the transference of information from educator to student. The goal of educational institutions should not be knowledge acquisition but rather cultivation of complex problem solving skills.
- ***Extrinsic to intrinsic motivation***. A culture of carrots and sticks prevails in our education system: students are extrinsically motivated to attend class, study and work hard in order to obtain good grades. Schools should aim to help students develop lasting, meaningful intrinsic motivation.

Instilling intrinsic motivation, or passion, in students is a critical component of an effective education system. Passion, as Jobs has claimed, is a hallmark of innovation because passion enhances perseverance, vital to solve any difficult problem.

STEM Workers in 2014 and Beyond

STEM professionals must navigate the transition from 1.0 to 2.0. For example, while tactical skills matter, understanding theory *and* "the big picture" of trend, markets and business opportunities are, increasingly, valued more than the simple application of knowledge. Likewise, innovation can't occur in a vacuum: it must always be in the service of the customer. And for that to happen, STEM professionals must work within defined processes and tools that are laser-focused on consumer needs and commercialization potential. Finally, the successful transition from STEM 1.0 to 2.0 demands a commitment to life-long learning as market needs change at the speed of light and capabilities taught today might be less relevant tomorrow. This will require a flexible and agile learning ecosystem teaching *Innovation Excellence* which is relevant to "win" the future, not manage the present.

STEM Employers in 2014 and Beyond

STEMconnector's Innovation Task Force will identify ways to operationalize and impart *Innovation Excellence* learning in 2014 and beyond. Through primary research, we are validating the issue-skill gap. We are partnering with world class Innovation Excellence experts as viewed by educators, public and private organizations, government, NGOs, and students, and we will work with them to develop recommendations to close gaps in innovation competencies from both the "supply" and "demand" sides of the STEM employment equation.

The 2014 Innovation Excellence Work Plan

Efforts are underway to operationalize Innovation Excellence, among the actions we will undertake:

- *Conduct primary research to further validate the skills gap.*
- *Identify, engage and consult world-class innovation experts. These experts will convene at a July 22, 2014 roundtable in Washington, DC, where – as an outcome – a blueprint and roadmap will be formulated to sketch out solutions for a systematic Innovation Excellence training and education ecosystem across the public and private sector.*
- *Publish white papers detailing pivotal contributions from key cross-sector stakeholders who attend the July 2014 roundtable and outlining the innovation experts' top five recommendations.*

- *Create digital communications channels, such as microsites, to disseminate learnings and continue to raise awareness.*
- *Develop mid and long-term roadmaps of action to assure a sustainable approach with measurable impact.*

Collaboration is Key

Our unique public-private coalition can solve STEM shortfalls by working collaboratively, across sectors. For universities, that will mean continuing to ensure that a strong technical foundation is developed during the formal education process. Organizations must be ready to lead, support, reward and develop technologists of the future—especially in the discovery skills crucial to unleashing innovation and fortifying business acumen.

Accordingly, we will continue to explore opportunities to forge stronger partnerships between organizations and universities.

About the Authors:

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Mitzi M. Montoya, Ph.D. *is Vice President and University Dean for Entrepreneurship & Innovation at Arizona State University. Mitzi is responsible for advancing ASU as a leader in entrepreneurship and innovation and for strategic direction for ASU's broad portfolio of entrepreneurial and innovative initiatives, including student and faculty entrepreneurship as well as advancement of the entrepreneurial ecosystem. Mitzi serves on STEMconnector's Innovation Task Force and is co-leading the Innovation Excellence capability platform.*

STEM 2.0: Digital Fluency

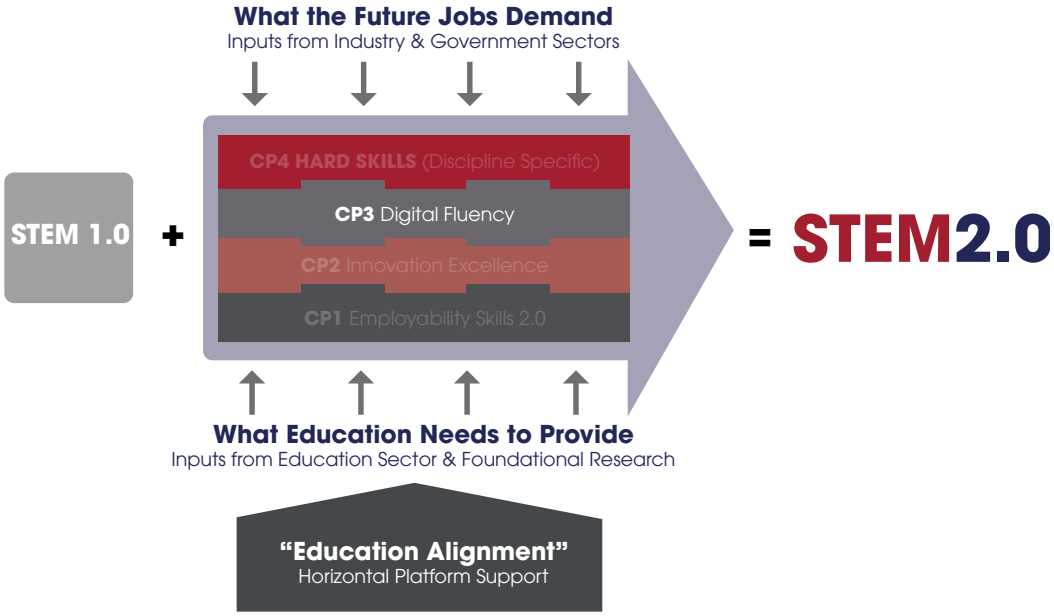
Balaji Ganapathy

Imminent Need for Digital Fluency

We live in a unique era in human history, where technology is blending the divide between machines and people. The globalization of markets across developed and emerging economies, presents us with a real-time connected and competitive world thanks to the advent of digital technologies. Demographic shifts and skilled talent availability in fast growing economies (such as China and India) have contributed to the global makeup of today's workforce.

Technology has undeniably transformed human behavior, influencing the way we live, work, play, eat, shop, and bank. While living in this digital era requires its own set of skills to interact with and use these technologies, developing solutions to real world problems in this digital era requires a new set of skills and a new way to use those skills—which we, STEMconnector's Innovation Task Force, have termed as *Digital Fluency*.

Figure 6. STEM 2.0 Framework Featuring Capability Platform 3: Digital Fluency

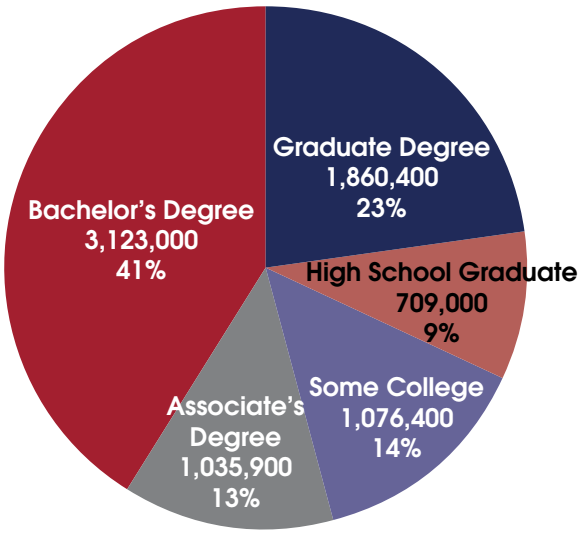


Rising Tide of Technology Jobs

80% of the Top 10 Global Internet properties were 'Made in USA' including Google, Microsoft, Facebook, Yahoo, Twitter, Instagram; with 81% of the users coming from outside America. Jobs that once required none or fewer technology skills now require working knowledge of programming and information technology. 88% of smart phones globally are running on operating systems 'Made in USA'. At TCS and within other businesses worldwide, the demand for a 'digitally fluent' workforce is increasing dramatically (Meeker and Wu).

As a human resources leader in the World's 2nd most valuable Information Technology services company with over 300,000 employees worldwide, I see the demand side of this equation up close and personal. Having a solid STEM education foundation can prepare our workforce for one of the 8 million jobs in the U.S. by 2018 (U.S Department of Commerce 1). 80% of the fastest growing occupations in U.S. require STEM skills, and 71% of those STEM jobs are in Computing (Executive Office of the President, *Preparing*; STEMconnector). The demand for skilled technology talent in the U.S. will continue to increase in the foreseeable future, and these jobs will include all sectors: banking, financial services, manufacturing, retail, insurance, energy, food, agriculture, high-tech, and more (STEMconnector). It is imperative that we prepare our future workforce with the critical capability of 'Digital Fluency' to be successful in tomorrow's STEM 2.0 jobs. This will determine our global competitiveness, our future prosperity, and our ability to meet some of society's greatest challenges in the current century and beyond.

Figure 7. Employment Projections of STEM jobs in 2018: 8 million



Source: Georgetwon University Center on Education and the Workforce forecast of occupational growth thourgh 2018.

Educating for a Digital World

Digital Fluency is defined as an *evolving aptitude that empowers the individual to effectively and ethically interpret information, discover meaning, design content, construct knowledge, and communicate ideas in a digitally connected world. We believe this aptitude thrives when inquiry, play, and exploration are valued and encouraged as meaningful learning experiences* (BSU's Mobile Learning Initiative).

Our educational ecosystem must inculcate the new critical capability platform of Digital Fluency in order to prepare our future thinkers, leaders, entrepreneurs and workers. Today's new millennial generation knows how to use digital technology and what to do with it; which helps them participate in a digital world as users and consumers of these technologies. As I watch my 18-month old nephew navigate through the iPad screens to play his favorite rhymes, it becomes apparent that even an infant can be a user of digital technologies. But for the STEM 2.0 jobs of the future, we need to develop a workforce that can draw upon their mastery of these technologies to solve real world challenges.

That requires a level of fluency where they are comfortable with when to use the digital tools, and why those specific tools would yield them the desired results.

An undeniable ingredient of Digital Fluency is knowledge and mastery of Computer Science. A huge opportunity awaits our workforce as more than 71% of the STEM jobs will require Computer Science credentials: in technologies such as Cloud Computing, Big Data, cyber security, and applications development. These are skills that are not being developed in our education system today (STEMconnector).

- 9 out of 10 schools don't even offer computer programming classes (Code.org);
- In 30 of 50 states in the U.S., Computer Science can't even count towards high school graduation math and science requirements (Code.org);
- Less than 2.4% of college students graduate with a degree in Computer Science (Code.org).

In September 2013, TCS & STEMconnector convened the Computer Science Executive Round Table on Education & Careers in the U.S., an event held at the National Press Club in Washington, D.C., that brought together more than 30 executives, government officials and thought leaders, who share a common cause – increasing students' interest and participation in Computer Science (CS), advocating for a stronger educational policy, and implementing programs that will effectively excite and prepare students for careers in CS.

Participants at the round table hit upon a variety of CS gap issues, including:

- Public policy landscape and advocacy strategies for CS education at a federal and state level;
- Initiatives of the Obama administration, industry groups, and formal education institutions to influence public policy and education reform;
- Nationwide data presentations on student interest in CS education and current and future trends in CS jobs;
- Implementation strategies, successful national programs (in-school and out of school) and CS mentoring;
- Corporate engagement, including funding strategies, advocacy, and employee volunteerism, as a tool to address the CS education issue.

As an outcome of the roundtable, we produced a white paper *Education & Careers in the U.S.: The Future of Computer Science* to serve as a playbook on effective strategies for supporting Computer Science education in the U.S. We launched this white paper and a microsite on.tcs.com/CSEd2C during CSEdWeek in December 2013. CSEdWeek is an annual program dedicated to inspiring K-12 students to take interest in Computer Science. In the true spirit of the topic of Digital Fluency, the unveiling was done over a Google+ Hangout session.

Next Steps

In order to move from a national roadmap to state and local level program implementation, TCS and STEMconnector organized a second Computer Science Round Table on May 16, 2014 at the New York Academy of Sciences. This event saw participation of experts from markets with successful CS program outcomes and impact; covering in-school, out-of-school, formal and informal, and industry-supported programs. Using the learnings from this round table, and the collective wisdom of the experts, we will then build a white paper and microsite to articulate the ingredients of a successful state, and local level program.

STEMconnector's Innovation Task Force will then distribute the CS program implementation playbook, and work with state and local bodies for adoption. Our collective vision is to start building learning networks, identify pilot projects to teach STEM 2.0 new capabilities platforms and broaden the STEM 2.0 ecosystem to prepare our future workforce to be successful in STEM 2.0 jobs. A bright future awaits our youth, our nation, and the world at large; let us equip them with the Digital Fluency to unlock the careers across industries, and sectors.

5 Key Takeaways from the Computer Science Executive Round Table:

- Leaders across sectors – government officials, corporate executives, educators, policymakers, and nonprofit leaders must join forces and align their efforts in supporting successful initiatives to advance CS education at national and regional levels;
- CS must be counted toward high school graduation requirements at the state level;
- Big and small businesses can, and should, join together to influence public policy and education reform;
- Nonprofit initiatives that provide education, coaching, and mentoring pathways to millions of students and youth, many of whom are minorities, girls, underrepresented groups, and at-risk youth, are critical to addressing the need for skilled programmers;
- Corporate America must ignite students' interest in CS by collaboratively spreading the world about the opportunities available through volunteer programs (Ganapathy et al. 29).

About the Author

Balaji Ganapathy *is the Head of Workforce Effectiveness where he oversees the functions of Talent Management, HR Business Consulting, Corporate Social Responsibility, Employee Retention, and Diversity & Inclusion for over 22,000 employees of Tata Consultancy Services in North America. Balaji is Vice-Chair of STEMconnector's Innovation Task Force where he leads the Digital Fluency capability platform of STEM 2.0.*

STEM 2.0 Discipline Specific Hard Skills: Reducing America's Innovation Deficit

Tim Welsh

A Call for Game Changing Innovations

The letter is clear, convincing and compelling.

At just one page, it explains why STEM talent is a national priority. Written in March 2014, and addressed to a prominent set of bipartisan leaders in Washington DC, its authors urge them to take steps immediately to *"tackle our mounting innovation deficit"* (Task Force on American Innovation).

They went on. America's global economic leadership will be lost, the authors noted, if the country fails to do two things quickly: first, to *"make science attractive to the best and brightest students in an increasingly diverse America."* And second, to equip the nation's workforce with resources and opportunities to "*enable (it) to make transformational discoveries and create game-changing innovations"* (Task Force on American Innovation).

Defining this call to action was the Task Force on American Innovation, about sixty professional societies, industry leaders and universities. The names are well known. Among them: Battelle, Microsoft, the Society for Industrial and Applied Mathematics, the National Association of Manufacturers, the Computing Technology Association, Proctor and Gamble and Texas Instruments.

Reducing America's Innovation Deficit with STEM Education Linked to Career Excellence

Exactly what to do about the nation's innovation deficit in STEM fields anchors innumerable national conversations held by industry centers of excellence, national thought-leadership organizations and prominent philanthropists. Enter STEMconnector's Innovation Task Force (SITF). The Task Force represents an interest by its members to *"…review and endorse relevant industry and government pathways for human capital development … by a national coalition of organizations operating as a unified STEM human capital supply chain accelerator"* (STEMconnector, STEM Innovation).

Established by STEMconnector, a national clearinghouse for STEM innovations in education and industry talent development, the work of SITF is presently organized around four "capability platforms." The set makes up what SITF calls "STEM 2.0" and collectively they form many of the elements needed for the "human capital supply chain." The work on each platform is done by leaders from industry, education and government. Together, these platforms embrace the characteristics of a STEM-capable workforce, requirements for its education and professional development and criteria for excellence in innovation to guide its performance. They also aim

to suggest actionable programmatic agendas for those interested and invested in helping to stand up and sustain a STEM-capable workforce.

The SITF team supporting the fourth in the series of SITF's platforms—Capability Platform 4 (CP4)—intends to show how foundational STEM expertise translates to enterprise-level innovations. The CP4 team's work products will also review which STEM "hard skills" are needed by industry and suggest opportunities for optimizing how these skills are evaluated in the workplace.

Subsequent steps by the SITF CP4 team will include delineating roles in the STEM human capital supply chain addressable by schools and colleges, professional certification groups and corporate universities.

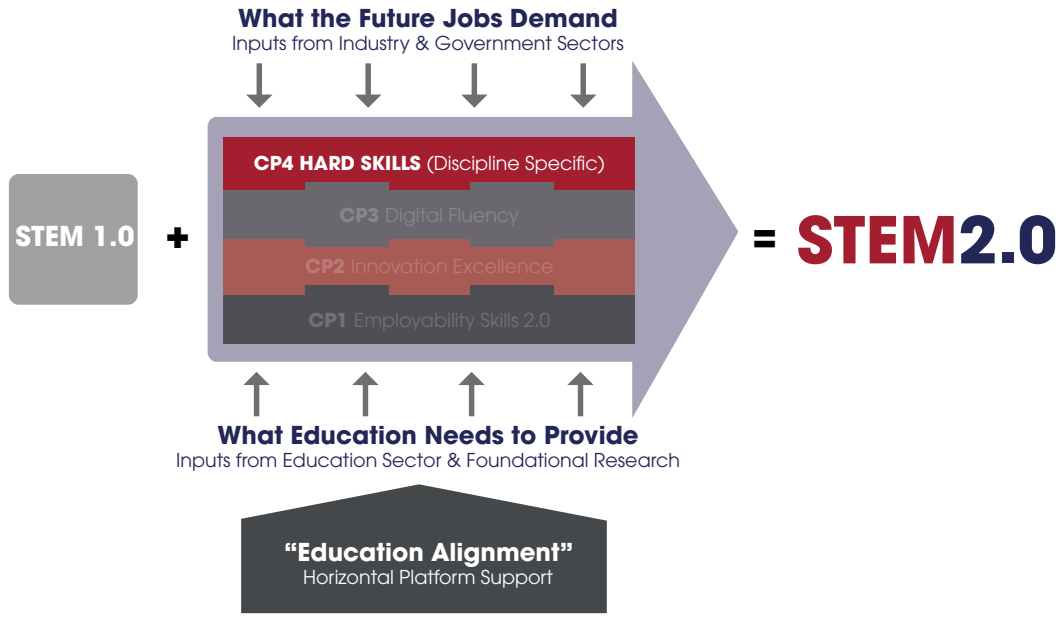
A STEM Innovation Skills Industry Index: Steps Ahead for the SITF Capability Platform 4

The first step—defining STEM "hard skills"—will entail sorting through what seems to be something of a "skills debate" emerging amidst efforts to solve a "skills shortage." For some time, STEM advocates have regularly distinguished between "hard skills" and "soft skills." And now a third category has been defined as "emerging STEM soft skills" (McAward and Raftery).

Examples of hard skills include fluency in mathematics, the ability to solve complex problems and computational expertise. "Soft skills" include "employability skills" such as the ability to work in teams, communicate clearly and lead. And "emerging soft skills" relate more to the application, distribution and communication of STEM expertise through social media and virtual collaboration tools.

From preliminary work done by SITF CP4, a notable absence across most if not all the skills categories are metrics illustrating how STEM skills could drive industry innovations and national competitive advantage: precisely the worry of the authors of the letter to national leaders - and it is here that the SITF Capability Platform 4 team sees an opportunity.

Figure 8. STEM 2.0 Framework Featuring Capability Platform 4: Hard Skills



Why not combine all "STEM skills" into one "STEM Innovation Skills Industry Index"? If successful, the "skills debate" underlying the "skills gap" could be ended, perhaps, with a single index of foundational STEM knowledge customized to priority workplace competencies across specific industries.

Resumes of STEM Workers in the Future: Defining "STEM Career Pathways 2.0"

For a single "STEM Innovation Skills" model to be actionable by employers, it must answer the question of "which STEM skills are used differently – and in which job roles – from one industry to the next?"

The answer appears to turn on a mix of emphasis, application of expertise by role and an ability to assess organizational culture. To illustrate, leaders in some large financial services firms assert that their companies are actually "technology companies." Alternatively, a "scientist" in the biopharmaceutical industry could be a medical scientist, a chemist, or a laboratory aide.

The SITF CP4 will consider whether or not a single "STEM Innovation Skills Index" keyed to current and emerging industry career priorities (as defined by innovations needed for competitive advantage) could see applications in talent management programs for STEM workers, curriculum by colleges and schools and as a means of continuous improvement for industry-endorsed certification programs.

It could also help improve the effectiveness of investments in STEM programs for students, affinity groups, community coalitions and other recipients of what is now a substantial flow of capital. The more clearly the answer to the question what counts for success in STEM careers and what is required by educators to support those STEM capable careers, the more effective will be the financial investment in STEM education nationally.

Future directions and conclusions from the work of the SITF's CP4 team will be made available in late 2014 and early 2015.

About the Author:

Tim Welsh, Ed.D. *is Senior Vice President of Industry Strategy at Apollo Education Group, a national authority on building education-industry partnerships to promote educational innovation and career pathways. Tim serves as Vice-Chair of STEMconnector's Innovation Task Force and is leading the Hard Skills capability platform of STEM 2.0.*

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SECTION 2

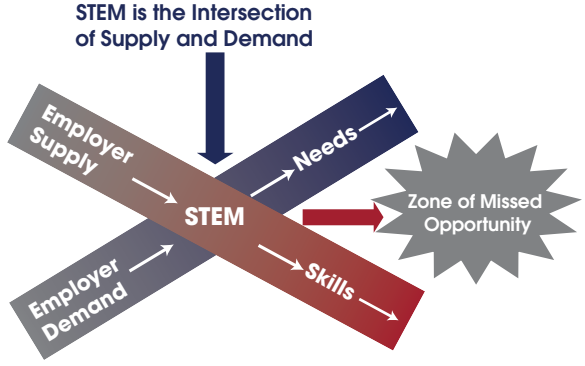
Viewpoints from the Education Community

Aligning STEM 2.0 with Higher Education

Rob Denson and Martha Kanter

For students earning degrees, certifications, and other post-secondary credentials in the STEM fields today, the future has never been brighter. STEM students are uniquely positioned at the intersection where *demand* for high skilled employees meets the *supply* of employees with STEM knowledge and skills. Students entering the workforce equipped with STEM competencies desired by the private and public sectors will have their pick of employers. We constantly hear from employers that there are thousands of open jobs and too few that meet the qualifications. This happens when there are more jobs than career-ready candidates, and a "zone of missed opportunity" is created (see graphic below). The unemployed remain jobless and employers miss opportunities to grow. In short, nobody wins.

Figure 9. Current State of Supply vs. Demand at STEM 1.0



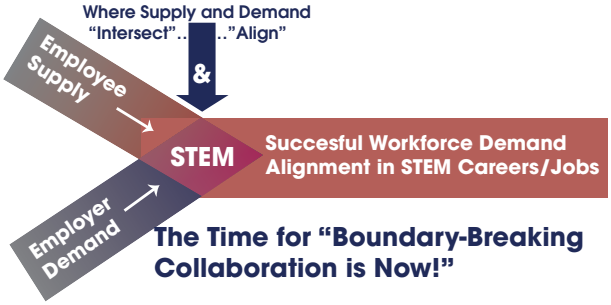
A recent Lumina Foundation study: *What America Needs to Know About Higher Education Redesign* summarized the following findings from business leaders:

- Only 13% said higher education collaborated with them a great deal;
- 88% wanted more collaboration;
- Only 10% of them strongly agreed that higher education is graduating students with the skills needed by business;
- 70% of the leaders said that they would consider hiring someone without a degree or credential over someone with one. Add this to the fact that: "Most Americans (77%) do not think higher education is affordable for everyone who needs it." These concerns and realities define the "zone of missed opportunity" (Gallup, Lumina Foundation).

Enter the STEM 2.0 initiative, a forward-thinking concept developed by STEMconnector's Innovation Task Force that seeks to identify and promote next-generation STEM skills that employers will demand from both the current and future workforce. The following graphic, utilizes a "boundary-breaking collaboration" engagement model that, by design, brings business and higher education together. The engagement model and the STEM 2.0 initiative allow business and education leaders the opportunity to work together towards mutual interests. Businesses desire skilled

workers, and skilled workers desire jobs. When the desires of each are aligned, STEM 2.0 will become the new reality.

Figure 10. Future State of Supply vs. Demand at STEM 2.0



Higher education plays a major role, arguably the primary role, in the move to STEM 2.0. The majority of future jobs, especially in the STEM fields, will require more than a high school degree to meet minimum industry standards (U.S. Department of Labor). Higher Education has the responsibility to help prepare students with the necessary skills, provided through the STEM 2.0 framework that will set the stage for success.

We in higher education are judged by the quality of our graduates. We are also accountable for educating students in K-12, through our teacher preparation programs. For STEM 2.0 to become our new reality, we must ensure that students at every level can succeed and, in doing so, we will expand the "zone of opportunity" for students and businesses. We must lead in tackling these challenges and contributing solutions for success!

One means of achieving the new STEM 2.0 reality is through STEMconnector's Higher Education Council. The Council is a high-energy, national "boundary-breaking STEM collaboration" of industry, government and education following this action-oriented agenda:

- Promotes high-impact strategies that improve outcomes in STEM education at all levels;
- Focuses on the unique role of Higher Education in connecting students to the workforce and STEM careers;
- Collaborates with business to calibrate supply with workforce demand;
- Emphasizes providing workplace-learning experiences to inform student preparation and career choices;
- Showcases model partnerships between higher education and industry that achieve measurable results and scale;
- Incorporates a diverse array of institutions including Community Colleges, Public and Land Grant Universities, Private Colleges and Universities and Minority Serving Institutions – and Businesses;

What will lead to STEM 2.0 outcomes?

1. How can a business increase its participation in the career exploration of youth and the recruitment of students into the skill-training programs the businesses rely on? This does not necessarily mean businesses need to put more money into the educational process.
2. Can logistics management be better employed? Business and education should each know the timing of a business needs for additional or the replacement of skilled employees and "future-load" the education system to have qualified graduates available as those openings occur. In this way, educational institutions are a key partner in the business "supply chain".
3. Can businesses use paid internships in a "earn and learn" model so that education and business needs can be addressed simultaneously?

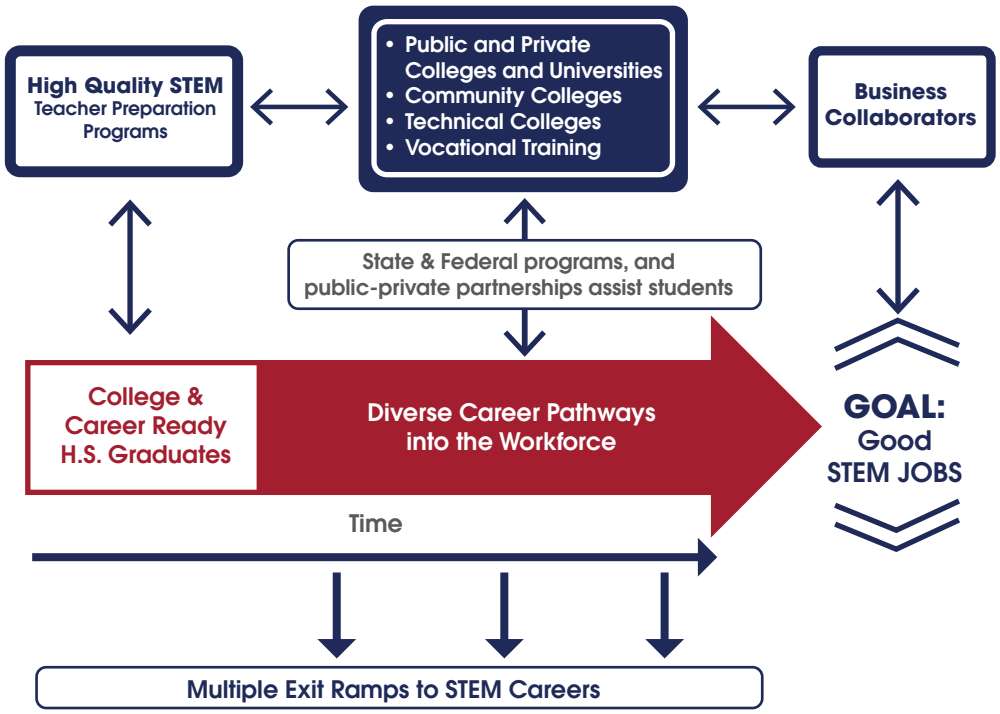
4. Should every academic program have an active business advisory committee to ensure that everything being taught ties to current or future competency needs?
5. Can every higher education institution form a high level "STEM Council" so that they know specifically where and how STEM 2.0 impacts their offerings? How can business be a key participant?

It can probably be said that many institutions, including higher education, "love progress but hate change." For too long we have "shared" best-practices but achieved minimal success. The Higher Education Council, linked inextricably to business, will connect the employee, through the education system, to the business customer and explore a form of the Kaizen "pull system." The active participation by the private sector in such activities as recruitment, selection, evaluation, curriculum development, teaching, internships and placement will be a stark contrast to past processes. Formerly, the education system was generally responsible for preparing students through to job placement, while employers could wait until a competent employee arrived at their door. Experience now shows that those days are gone!

What might this look like?

STEMconnector's Higher Education Council will address the transition from STEM 1.0 to STEM 2.0. The meetings will have "business at the table" to explore and identify real-world business–education solutions that are already working. Following the meetings, a publication will be released to summarize the challenges, recommendations, and solutions that were identified. STEMconnector's Higher Education Council is committed to a mutually-beneficial business collaboration and the firm belief that there is a workable solution

Figure 11. STEMconnector's Higher Education Council Framework



"What the world wants is a good job."—Jim Clifton, The Coming Jobs War

to close the STEM skills gap, once and for all.

About the Authors:

Rob Denson *was appointed President of Des Moines Area Community College in 2003, becoming the first native Iowan to lead the college. Rob is a vocal supporter of STEM education and collaboration between business and education. Rob is Chair of STEMconnector's Higher Education Council, while serving on STEMconnector's Innovation Task and STEMconnector's Food & Ag Council.*

Martha Kanter, Ed.D. *is Distinguished Visiting Professor of Higher Education at New York University's Steinhardt School of Culture, Education, and Human Development. Prior to her position at NYU, Martha served as Under Secretary at the U.S. Department of Education where she oversaw policies, programs, and activities related to postsecondary education, adult and career-technical education, and federal student aid. Martha serves as a Senior Adviser to STEMconnector's Higher Education Council.*

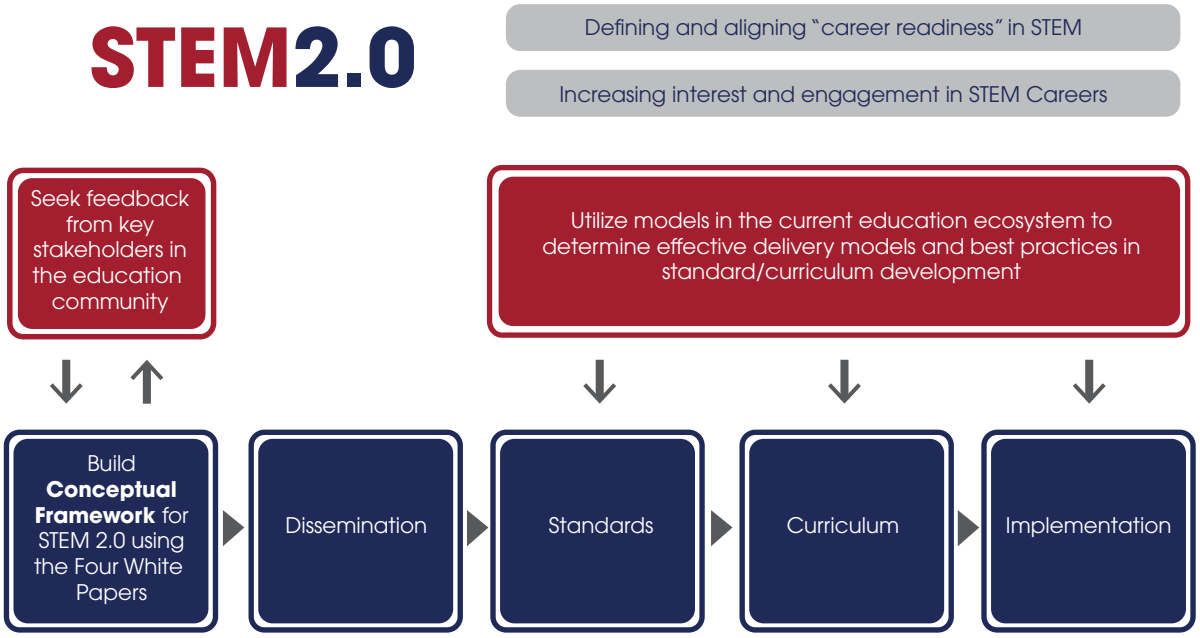
STEM 2.0 From the Teaching Perspective

Melissa Moritz

STEM fields hold some of the fastest growing jobs globally. For students who know at a young age that they wish to pursue them, a strong STEM education is a must. And for students who are uncertain about their futures, a solid foundation in math and science will ensure that their options are kept open, and that they're competitive candidates in the global job market. STEM 2.0 will provide educators with the framework and guidance to help all their students become career-ready.

Today's education system is leaving too many students without excellent STEM opportunities. This inequity falls primarily along racial and socioeconomic lines. According to a 2008 NACME study, just 4% of underrepresented minorities that graduate from high school or are considered "engineering eligible," or having the proper credentials to study engineering at the university level (NACME 2). As a result of this and other factors, according to the National Science Foundation, only 3% of the U.S.'s engineering workforce is black and Hispanic (NSF 13).

Figure 12. Integration of STEM 2.0 Into Current Education Ecosystem



This is an unacceptable reality – we cannot leave entire pockets of the population out of prosperous careers. STEM 2.0 will provide clarity, resources, and engagement to support students in STEM.

STEM 2.0 not only helps teachers set clear expectations for students, but also helps students set clear expectations for themselves as they navigate what the workforce will require of them. The guidelines call for connecting real-world careers to the STEM content being taught in the classroom, helping students realize the applicability of their curriculum and investing them in their own development. STEM 2.0 will also aid educators in determining what skills and content are used in what careers. This is particularly helpful in a field as diverse and rapidly changing as STEM. Given the fast pace of innovation in these careers, it would be nearly impossible for any educator to keep up with the requisite skills.

Perhaps the biggest implication for educators is that STEM 2.0 will provide a concrete explanation and set of associated resources to support and reinforce their instruction. STEM 2.0 is not meant to make more work for educators or the education system as a whole, but rather to compliment the current approach and provide clarity to what it means to be career-ready in STEM. Many different companies from across STEM sectors are coming together to align on the most pressing needs for the workforce. They've determined that digital fluency, innovation excellence, and employability are common to all STEM sectors.

The bottom line is that STEM 2.0 will support the work of educators by providing clarity and coherence to the question of what it means for a student to be STEM career-ready. I am excited to work with educators and the education community, as STEM 2.0 is developed to ensure we are seeking perspectives of the community and feedback on our approach.

About the Author:

Melissa Moritz *is Vice President of Education Initiatives & STEM at Teach For America where she oversees the team that leads the organization's initiatives in Early Childhood, STEM, Special Education, and Native Alliances. Melissa is a member of STEMconnector's Innovation Task Force.*

Connecting STEM 2.0 to State Education Standards

Dane and Sheila Boyington

The STEM 2.0 framework seeks to define employer expectations of the STEM workforce over the next decade with an emphasis on new capabilities that have not been part of the traditional educational experience in the U.S. This includes increased capabilities in such topics as innovation, digital literacy, and virtual collaboration. These skills are essential to a workforce that must adapt to new challenges and find solutions to problems in a faster, more diverse, and virtually connected world.

Our educational institutions have also been responding to some very similar demands by introducing new educational standards. The best examples of these are the Common Core State Standards (CCSS) and the Next Generation Science Standards (NGSS). While all of these efforts have undeniably noble goals, they have met varying levels of controversy. In particular the Common Core has been alternately criticized as too difficult for young students or too easy for the STEM workforce. Here we will examine if these standards such as the Common Core are helpful or hurtful to STEM education and STEM 2.0.

Forty-four states have now adopted the Common Core as a basis for academic standards in K-12. The Common Core is not an actual curriculum, nor is it the only topics taught in schools. However it does set out expectations of topics that should be taught in each grade level, particularly in mathematics. It aims to give students a deeper understanding of the most essential concepts in math, and to show how these concepts are related to solving problems in multiple disciplines. For instance there is an increased focus on showing that graphs are not only a way to visualize mathematical relationships, but that they can be used to solve practical, real-world problems. English standards also emphasize real-world applications by increasing the amount of non-fiction sample texts in addition to traditional fiction works.

This emphasis on real-world problems parallels the STEM 2.0 framework. A STEM education does not just mean studying more math and science; it encourages a way of thinking that incorporates problem-solving using scientific methods. The capability platforms in the framework emphasize innovation and problem-solving using modern digital and collaboration tools. While the Common Core does not provide all of the skills that a modern STEM worker needs, it does provide the thought processes that pervade all STEM disciplines.

While the majority of schools nationwide are already finding the new mathematics standards difficult for current students to meet, criticism of the standards in relation to college-level STEM courses is based on the belief that the standards set expectations too low.

These are commonly based on the analysis of Stanford Professor James Milgram, who points out that the Common Core leaves out "major topics in trigonometry and precalculus" (Milgram and Stotsky 8). Although there are significant algebra elements in the 8th grade standards, the belief is that a lack of a total algebra focus in that grade would make it difficult to master all of the math courses expected by the most-selective colleges. But only a small minority of previous state standards had included the precalculus course for all students. In fact Milgram himself points out that the Common Core math standards are better than "85 or 90%" of the previous state math standards.

While it is true that some STEM students will need more math than specified by the CCSS, the Common Core is beneficial to the future STEM workforce. The Common Core is designed to be *common* to all students – they are minimum expectations, not maximums. Lifting up all students will create the workforce that our nation needs, which includes increasing numbers of technically trained middle-skill jobs. These include jobs like technicians, machinists and craftsmen that typically required two-year degrees or certifications. While some decry the loss of "middle-class" jobs, these analyses usually focus on the gap between high-school and four-year degree graduates. Studies by the Georgetown University Center on Education and the Workforce show that two-year degree STEM workers actually earn more than most four-year degree holders in other subjects (Carnevale, Smith, and Melton 33). There will always be the need for some students to achieve more than what the common standards require, but the standards benefit students and industry by lifting all students to a level that can earn them real living wages.

Similarly, the Next Generation Science Standards also have an increased focus on the scientific method, problem solving, and interrelationships between data and the real world. Memorization of individual facts is subjugated to creating models that show how systems work. These models are the key to solving new and unexpected problems. Consistent with common practice in STEM education, there is a heightened emphasis on project-based learning and hands-on experimentation. Unlike the CCSS, adoption of NGSS is just beginning. Some resistance will occur in part because schools will find the teaching methods unfamiliar. We will need to support teachers with appropriate professional development to help them to adapt to the experimental methods that are required and shared with STEM 2.0.

Figure 12. A Conceptual Hierarchy of Standards

Based on Scientific Principles

Teaching both the CCSS and NGSS also put an increased emphasis on technology. The NGSS requires both an intellectual understanding of technology and the use of technology as a tool for experimentation. While the CCSS has less of an explicit technical requirement, many of the new curricula and testing for the standards will require the use of technology. This will be a challenge for many schools, as current devices and band-

width often cannot support the demands of standardized testing. But solving these problems is something that we must do. Both modern postgraduate education and the new workforce require that students be able to use distance learning. Beginning this in K-12 schools only advances this part of the STEM 2.0 framework.

These standards frameworks are interrelated in that they all promote the use of scientific thinking processes. Although they overlap each other in the education timeline, they build upon each other in creating higher-order skills. Adopting new educational standards such as the Common Core and NGSS will not be easy on our educational system. They present significant challenges for budgets, teachers, and school infrastructure. However, these standards elevate all students and provide an increased focus on a STEM-based thinking process of problem solving. These are the skills that are the basis of the STEM 2.0 framework, and are required for the good-paying jobs of the future. The STEM community should welcome the adoption of these standards and provide the support necessary for successful implementation.

About the Authors:

Dane Boyington, Ph.D. *and* ***Ms. Sheila Boyington*** *are Co-Founders of Thinking Media, a company focusing on e-learning development designed to improve workplace literacy for Fortune 500 industrial companies and government. Thinking Media recently deployed Learning Blade, an online education platform designed to sharpen skills and grow interest in STEM. Sheila and Dane serve as Senior Advisers to STEMconnector.*

Human and Technology Networks Help Students Become Workforce Ready

Alex Belous

In an increasingly connected world, we still (largely) accept or even demand that a school experience delivers a product appropriate for 1965. As Mary Moss and Alisa Berger write in their new book, *How To Innovate: The Essential Guide for Fearless School Leaders,* "Our current school model, one based on seat time and regurgitation of broad swatches of factual data, is not serving the needs of our children".

What is needed to survive and thrive in this century relies on a focus on STEM. Studies show that skills in these areas will be required in the workforce of the future. For example, a study from the Brookings Metropolitan Policy Program showed that 20% of all U.S. jobs —that's 26 million jobs—require a high level of knowledge in one STEM field. STEM jobs are not confined to Silicon Valley—the same study showed that half of all STEM jobs are in manufacturing, healthcare, or construction industries (Rothwell).

It is clear that knowledge in STEM fields represent great opportunity for our future workforce, and is necessary for economic growth. But hard or specialized skills are only one factor essential for success in tomorrow's workforce. According to STEMconnector's Innovation Task Force, workers must also possess these skills, talents and training to succeed in the 21st century:

- Innovation Excellence
- Digital Fluency
- Employability Skills 2.0

We are not prepared for a transition of this magnitude, yet if we don't launch it now we will be rapidly marginalized. Further, we need to be aware that the STEM experiences will take place in a new environment with new expectations.

One of the most interesting new "environments" for math learning I've seen as the Education Portfolio Manager with the Cisco Foundation is the Spatial Temporal Math (ST Math) program developed by MIND Research Institute. ST Math uses language-independent animation to help students learn key concepts and improve their problem-solving and critical-thinking skills. ST Math helps students develop Digital Fluency because they are applying math to specific "real world" problems, like launching a balloon or crossing a chasm.

The software games are web-based, self-paced, and have a built-in performance-tracking system that is closely aligned to state and Common Core standards. Students can make as many 10 attempts before the program or a teacher intervenes. This trial-and-error approach is proven to improve understanding and to help students become

more persistent and self-confident in their ability to solve problems.

Teachers have noted that the program elevates the lowest performers while also challenging high performers. We've seen double and triple growth in math scores year after year in schools using ST Math in Arizona, California, and Virginia, compared to non-ST Math schools. We invest in ST Math because it's proven to work (Cisco, MIND Research Institute).

Another program that helps students develop digital fluency is the Cisco Networking Academy® program—the largest online project in the world over the past 17 years. Its focused, polished curriculum has been updated constantly, as has its teaching methodologies.

But developing Employability Skills is also central to the Networking Academy curriculum. These are the skills that, according to SITF, enable employees to "sell their ideas to others, to function in teams, to develop business acumen, to develop leadership skills, to navigate across complex, matrixes global organizations" (Cisco, Networking Academy).

Figure 13. Students in Istanbul, Turkey also gain Employability Skills through Cisco Networking Academy

Networking Academy is intentionally designed to help students develop the problem-solving, critical-thinking, communication and collaboration skills that will give them a competitive edge in the global workforce. Our online learning environment, Cisco NetSpace, contains collaboration and communication tools that provide an informal and social learning environment that students are comfortable navigating. The curriculum also includes case studies and simulation activities in entrepreneurship and other topics to help students develop critical business and financial skills.

Networking Academy helps students develop Innovation Excellence by instilling in them "the discipline, rigor, and a determination to attack a problem or opportunity methodically, from all angles" (Cisco, Networking Academy). Cisco Packet Tracer, a powerful visualization and simulation program, allows students to design, build, and troubleshoot networks in a virtual environment. Students can experiment and explore "what if" questions so they learn by doing. National and international competitions allow students to test their skills under pressure, developing the creative thinking and decision-making skills employers in all industries seek.

Networking Academy helps students get and succeed in jobs. For example, Atrion Networking Corporation in Rhode Island recruits Networking Academy students from the Community College of Rhode Island because, "they can think on their feet, put the customer at ease, and solve their problems for them," according to talent recruiter Patrick Halpin (Cisco, Apprenticeship Program).

Figure 14. Angel Gavidia, a Cisco Networking Academy student at Community College of Rhode Island

Programs that instill the tenets of STEM 2.0 are out there, and we hope more will be developed. Our next challenge is inspiring and encouraging students to use them. More than 80% of students think they need a four-year degree to get a STEM job. But according to the Brookings study, half of all STEM jobs are available to workers without a four-year college degree, and these jobs pay $53,000 on average (Rothwell).

One program with great potential to connect the dots is the U.S. STEM Pipeline developed by Futures, Inc. with Cisco support. This online talent exchange targets the 40 million U.S. middle and high school students, helping them make valid, meaningful career decisions based on rich, relevant job data.

The STEM Pipeline matches students' skills and interests to every STEM career, then shows them what nearby two- and four-year colleges offer training programs for it, and what jobs are available in the local area. As a result, students can see what is possible, often in their own backyard, and that attaining those jobs are feasible.

We are already seeing the positive results from a pilot of the U.S. STEM Pipeline. A study by Duke University's Center for Child and Family Policy of 17,000 students from 16 schools in 2 states who used the tool found the following:

- 85% have a better understanding of STEM careers;
- 72% have a better idea where to find supporting programs;
- 76% feel more confident about getting a STEM career they would enjoy;
- 70% said they are "more determined to do well in high school."

The tools to move education in our country toward STEM 2.0—21st century learning and preparation for 21st century jobs—are out there. Our next step is to collaborate and capitalize on the human innovation and networked connections that can multiply their impact on our students and our workforce.

About the Author:

Alex Belous *is Education Portfolio Manager of Cisco Public Benefit Investments & Cisco Foundation where he is responsible for grants with Cisco NGO partners that have helped millions of students and teachers. Alex serves as Vice-Chair of STEMconnector's Innovation Task Force.*

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SECTION 3

Industry Perspectives on STEM 2.0

Manufacturing 2.0 Drives Innovation

The Dow Chemical Company

Why Does Manufacturing Matter?

Manufacturing matters because it produces more value across the economy per dollar spent than any other economic sector, creates more jobs, and drives innovation that produces new goods that fundamentally change the world.

Today, in countries throughout the world, manufacturing has entered a new era. By need or demand, manufacturing is evolving to reflect struggling economies, emerging markets, modern technology and a new generation of workers. This is creating a new definition of manufacturing—one that is fuelling competition between countries, not just companies. To succeed in this new environment, an innovation-centric model of advanced manufacturing is critical.

Manufacturing is deeply intertwined with another vital economic phenomenon: innovation. No other sector performs more R&D that leads to the ideas and capabilities that support the next generation of products and processes. In fact, manufacturing is responsible for 70% of all private-sector research and development funding, and accounts for more than 90% of all U.S. patents (Executive Office of the President, *A Framework* 7). Advanced manufacturing will create the semiconductors and microprocessors for our electronics; the wind turbines and solar cells for our energy needs; and the advanced batteries and state-of the-art medical devices that will remake our future.

Around the world, the growth and expansion of the manufacturing sector has created employment, raised wages, elevated living standards, and increased purchasing power. That's why manufacturing matters. Due to its economic importance, we have to collectively take the next step to protect and promote it. Through sound policymaking and commitment from both the public and private sectors, the world's leading manufacturing regions can begin a sustainable path to a more prosperous future—enabled by advanced manufacturing.

Advanced Manufacturing At A Crossroads

Manufacturing has historically been the lifeblood of U.S. economic growth, job creation and prosperity. While production was responsible for 28% of GDP in the 1950s, it now makes up less than 15%—and that number is shrinking. In 1975, we were exporting $12.4 billion more in goods than we were importing (Dow Chemical Company 2). Since then, the U.S. has continued to run a trade deficit in the tens of billions of dollars.

The U.S. has experienced a manufacturing crisis over the past several decades. In fact, the

U.S. lost 5.8 million manufacturing jobs from 2000 to 2010 (McKinsey Global Institute 2). Perhaps this trend is due in part to the imagery manufacturing evokes—smokestacks, repetitive manual tasks and basic industries—but that is the manufacturing of yesterday. Today, advanced manufacturing depends on innovation and offers high-paying jobs in high-tech, state-of-the-art industries.

Manufacturing jobs declined in the U.S. as more and more companies "off-shored" manufacturing to emerging economies where labor at the time was cheaper. Labor costs in emerging countries are catching up with developed countries and more and more countries no longer present an advantage. With advanced manufacturing technologies creating new jobs and better paying jobs than those of the past, we need to once more adapt to 'home-growing' our manufacturing capabilities and developing our workforce accordingly.

Manufacturing has a key role in job creation and long-term prosperity. It employs millions of Americans, performs nearly two-thirds of private sector research and development, drives innovation, creates new products, and pushes the frontiers of science and technology. No other sector has the power to create more jobs. For every job created in the manufacturing sector, three to five jobs are created across the economy. We need to develop and implement a national strategy focused on creating an environment that will enable this manufacturing renaissance to take hold.

Since 2010, manufacturing has been a bright spot as the economy continues to recover from the financial crisis. In fact, around 662,500 manufacturing jobs have been created between January 2010 and April 2014 (Bureau of Labor Statistics). Abundant natural resources are spurring a renaissance in American manufacturing, but we cannot rest. We must seize this opportunity.

The history books are full of stories of once-great countries that declined and dissolved into obscurity because they did not evolve. If the U.S. wants to retain its economic leadership position, we have to understand that change is constant and that we must either lead the change or fall victim to it. We must change course and initiate a manufacturing policy revolution to build a strong economy and reap its many benefits.

U.S. manufacturing needs a broad policy framework that allows the industrial base to grow in an economically sustainable way. We need a regulatory framework that helps American industry compete around the world. These policies should be designed to restore the resiliency and fortitude of our economic system while promoting global competitiveness, fairness and a renewed sense of vigor and entrepreneurship. To succeed, we must unleash companies to innovate, partner with policymakers to enable, motivate consumers to demand, and inspire collaboration among everyone to transform sustainable change into sustainable prosperity.

Innovation Matters

Innovation, the development of new ideas and technologies, is both an essential principle and a pillar of the global economy. It is a concept that is especially fundamental to the chemical industry, which still has vast potential for technological advancement, as it works to identify and solve problems facing the world. In order to foster innovation, we must cultivate the next generation of innovators to fill the manufacturing jobs of the future. The Innovation Excellence capability platform within the STEM 2.0 initiative hopes to accomplish exactly that.

Manufacturing and innovation are inextricably linked. Manufacturing spurs innovation. In the U.S. alone, manufacturing is responsible for nearly two-thirds of private sector R&D, and it also depends on innovation to make products more sustainable, efficient and effective. Furthermore, because R&D is linked to production, innovation follows manufacturing—where manufacturing goes, the ideas follow.

Innovation in manufacturing creates jobs, new products and industries, and raises wages and living standards around the world. As globalization continues to present new opportunities and challenges, innovation in manufacturing will be crucial to achieving market competitiveness and economic development. Whether countries compete on the basis of cost or higher value-ad, innovation is central to competitiveness.

STEM Education & Workforce Development are Critical

The future of the United States depends on its ability to prepare the next generation to be innovators in STEM. Yet far too few students are prepared for the challenges ahead. Empowering students with the skills defined in the Innovation Excellence capability platform is a step in the right direction.

Technological developments in the manufacturing sector are beginning to outpace workforce skills around the world. Demographic shifts, a gradual erosion of skills in some developed nations and a need for basic education in many emerging geographies combine to create a future skills shortage. In order to attract manufacturing investment necessary to develop a sustainable, diversified economy, the talent must be there to fill the pipeline, and that must be across a specific focus in STEM fields.

The responsibility for creating this environment does not fall on any one single sector. Government, academia and industry need to intensify cooperation in programs to encourage the highest quality STEM education at all levels to fill the talent pipeline, and develop ways in which to improve retention of students interested in STEM careers. Students also need STEM skills that cut across industries, some of which are explored within the STEM 2.0 initiative, such as Digital Fluency and Employability Skills 2.0 that will make them viable candidates in the future marketplace.

Recommendations

- Create an engaging, hands-on learning model to build, support and grow the STEM skills in the workforce of the future.
- Improve teachers' skills through mentoring and formal training to ensure students have access to high-performing teachers, and hands-on STEM-based curricula.
- Develop partnerships among government, academia and industry focused on creating the workforce of the future with an emphasis on workforce training and retraining.
- Encourage state policymakers to implement higher science standards such as the Next Generation Science Standards which are internationally benchmarked and developed with future workforce needs in mind.
- Build a positive image and perception of manufacturing as a dynamic, creative and rewarding profession.
- Continue to enhance U.S. visa policy for international students and scholars with STEM.
- Encourage state programs and funding that improve affordability of higher education and support a culture of completion.

- Create state policies that link dropouts and graduates to college and career-readiness.
- Improve the perception and promote the value of career and technical education.

About:

This article was adapted for this publication from The Dow Chemical Company's Advanced Manufacturing Plan for the United States.

Applying STEM 2.0 To The Agriculture Sector

Sherri Brown

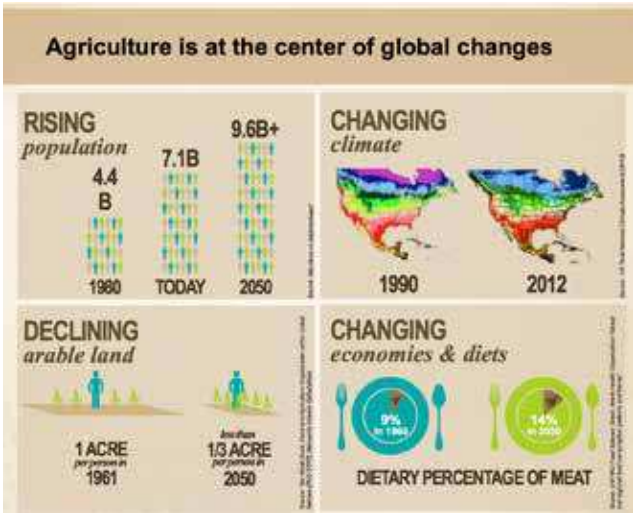
A Major Challenge for the 21st Century

One of the greatest challenges our world faces is how to produce enough food, feed, fiber, and fuel for the more than 9 billion people by the year 2050, while using less land, water, and energy. The challenge is complex and compelling and will require the talents of today and tomorrow's agricultural workforce to create the new technologies and innovative solutions needed to overcome these challenges.

Food security is critical to overcoming poverty and advancing peace and stability around the world. But the challenge is more complex than just feeding an additional 2.5 billion people. As per capita incomes grow in developing countries, the standard of living and quality of diets also improve. The addition of animal protein to diets has already resulted in a significantly increased demand for beef, pork, and poultry and an increased need for crops for animal feed. This trend is expected to continue.

Given that much of the arable land is already in agricultural production, ensuring sufficient food, feed, and fiber for the 9 billion-plus population in 2050 will require a doubling of crop yields on existing farmland. This increase in productivity must come from sustainable agricultural systems with efficient use of land, water, and energy to minimize impact on the environment. Climate change has the potential to bring additional challenges to crop and animal agriculture. Changes in temperature, frequency and intensity of extreme weather, and shifts in weed and pest pressure, could have significant impacts on crop yields adding to the needs for crops that thrive under evolving agronomic and environmental conditions.

Figure 16. Monsanto info graphic detailing global challenges affecting agriculture



Innovation and a Talented Workforce are Needed to Address the Challenge

At Monsanto, we have considered ways to approach these challenges. We believe that, through a combination of innovations

in breeding, biotechnology, and agricultural practices, it is possible to double yields while reducing the use of key resources and have pledged to partner with farmers and others in the agriculture industry to enable these improvements. But this will not be possible without the human capital to create these innovations.

So the solution to meeting the needs of the grand challenges of agriculture will require the creativity of a motivated and talented workforce. What capabilities will be needed in that workforce?

People with training across the various areas of agriculture: agronomy, soil science, entomology, pathology, weed science, and breeding will continue to be in high demand. Other scientific backgrounds will also be needed. For example, breeding and biotechnology research utilize capabilities in genomics, molecular biology, cell biology and tissue culture, biochemistry, robotics, and automation. New areas such as genomics, bioinformatics, and computational biology of plants, animals and their pathogens bring together computer science and biology and require researchers with capabilities in both areas.

Advances in agronomic practices have continued to evolve and improve productivity. For example, the use of global information systems, global positioning, and remote sensing technologies are forming the basis of precision agriculture that promises to increase crop productivity by optimizing growing conditions within a field. Some form of precision agriculture is already in use on many farms in the U.S. and workers with expertise in this area are already in high demand. Continued innovations in this area will require capabilities in engineering, information technologies, as well as knowledge in traditional agricultural disciplines.

I believe the most innovative solutions will continue to come from the intersections of multiple disciplines. Strong capabilities in interdisciplinary collaboration and innovative problem solving, teamwork, working across international and cultural borders—the major capability platforms of STEM 2.0—will be absolutely critical to address the agricultural challenges of the future.

How to fill the workforce pipeline?

How do we fill the talent pipeline that will creatively solve the agricultural challenges of the future?

Each year, there are approximately 50,000 job openings in the food and agriculture sector, with 75% of these in business and science (U.S. Department of Agriculture). A comparison of the number of students with agriculture or life science degrees shows that there are only half as many graduates in these areas (U.S. Department of Agriculture). The workforce gap will worsen as the need for qualified STEM workers in these areas is growing and the students in relevant disciplines decrease.

A survey of the agricultural science workforce needs by the Coalition for a Sustainable Agricultural Workforce, an organization of eighteen companies in the food and agriculture industry, predicts significant growth in the global agriculture-related workforce and found that the pipeline of scientists with appropriate education and experience is insufficient to meet the demand (Coalition for a Sustainable Agricultural Workforce).

In order to obtain the talent needed, it will be important to attract students to the pipeline. A first step is to increase the communications with students. We need to attract the best and brightest by showing the critical importance of solving the challenges of

agriculture. We need to show students that interesting jobs and careers are available and that agriculture is a dynamic and growing industry where new technologies and talented individuals in all areas of STEM are critically needed.

It will be important to grow the future workforce by attracting talented people from the broadest pool of potential talent including groups currently underrepresented in the agricultural and scientific workforce: those with non-rural backgrounds, women, and minority students.

How to get the future agriculture workforce engaged

"It will take boundary-breaking collaboration" between industry, higher education, schools, and youth organizations and the students that will fill the pipeline, says Rob Denson, President of DMACC and Co-Chair of the Workforce Committee of the STEM Food and Agriculture Council. Consistent with the premise of STEM 2.0, we must lead with an understanding of the demand. Companies in the agricultural industry must define the capabilities needed for jobs in the future and then partner with education and youth organizations to build awareness and skills to meet the innovation needs for the future. In addition, we must reach out to students to help them see and experience the excitement of careers in STEM roles in food and agriculture through hands on learning and internships. The STEM roles in agriculture are exciting—from genomics to robotics to big data, a career in agriculture is much more than old-fashioned farming. Today's youth and young adults want to play a role in solving the big challenges such as poverty, food security, and climate change. The challenge of sustainably feeding a growing planet will require innovations created by a talented agricultural STEM workforce. We must all work together to attract the best and brightest to the food and agricultural sector.

About the Author:

Sherri Brown, Ph.D. *is Senior Director of External Science Relations for Monsanto where she brings together Monsanto's many interactions to help grow the pool of talented scientists and advance sustainable agriculture for a healthy and abundant food supply around the world. Sherri helps lead the Workforce Committee of STEMconnector's Food & Ag Council.*

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SECTION 4

Regional Outlooks on STEM 2.0

Iowa & STEM 2.0 – Achieving Global Competitiveness

Lieutenant Governor Kim Reynolds

As a high school student growing up in St. Charles, Iowa, it never occurred to me to that I could become a food scientist, civil engineer, or aerospace engineer. Primarily because I didn't have an opportunity to learn within an innovative STEM classroom, join a robotics team, or experience computer coding. Those experiences did not exist in my school district. That's why I'm so passionate about driving STEM education because of the opportunities that it offers Iowa students.

Every year, I travel to all 99 counties in our great state. During these visits, I observe firsthand how STEM captures the imagination and passion of our students through high-quality STEM programs.

In eastern Iowa, I watched Clinton High School sophomores be actively engaged as they solved difficult science problems by using a collaborative learning environment in their STEM Tile Classroom, a project that increases opportunities for student success by transforming teaching practices, lively interaction, enhanced learning, and increased faculty-student engagement.

In central Iowa, I saw a confident Stillwell seventh grader use HyperStream, which brings technology education and innovation to students, to combine technology and music to create a robotic guitar. That same student also learned online how she could recode a simple robot to become a robotic dog that could walk on a leash. Students who are versed in coding and other 21st century skills are digitally fluent, a capability platform within the STEM 2.0 framework, which helps students prepare for the STEM careers of tomorrow.

Figure 16. **Elementary students using microscope in classroom**

In western Iowa, I can't begin to describe how amazing it was to visit with second graders in Harlan Elementary School who were building model homes using renewable energy components as part of their project. In the Harlan School District, the community has embraced STEM by implementing 66 STEM scale-up programs. They also raised more than $500,000 through their local foundation to ensure sustainable STEM programs. The Harlan School District is a perfect example

of how schools, businesses and communities can come together to create a sustainable STEM culture that promotes great STEM opportunities for their students.

Figure 17. Iowa high-school students in science laboratory

Establishing a STEM culture is critical for increasing awareness among parents, teachers and students on the importance of STEM and achieving educational excellence. That's why we are working hard to prepare all Iowa students for the jobs of tomorrow. We know they will be competing in a knowledge-based, global economy that demands a highly skilled workforce and a strong educational foundation.

However, we only have to look at a few statistics to gauge how far we have to go. Currently, only 16% of high school seniors are considered proficient in math and interested in a STEM career (U.S. Department of Education). Yet STEM careers are projected to outpace non-STEM jobs 17.1% compared to 9.8%. Also, an international student assessment revealed that 15-year-olds in the United States ranked 26th out of 34 countries in math (U.S. Department of Commerce).

As the greatest nation in the world, I am convinced that we can and must do better. Collectively, we want the next generation to excel and to achieve the American Dream. Individually, we want the very best for our children and grandchildren. Economically, we want the businesses that employ our friends and neighbors to grow and thrive. And, from a societal perspective, we want to nurture innovation to solve the challenges facing our citizens.

In order to address the STEM issue, Governor Terry Branstad established the Iowa Governor's STEM Advisory Council nearly three years ago. The Council is a public-private partnership comprised of 45 visionary leaders representing business, education, nonprofits, students, legislators, and many others.

I am honored to serve as the initiative's co-chair with Vermeer Corporation CEO Mary Andringa. The Council's mission is ambitious: raising student interest and achievement in STEM subjects, and enhancing STEM economic development.

We're already seeing great results in Iowa. This is partly due to the bipartisan approach taken by our Legislature and the annual $5.2 million allocation that they have provided since 2013. The state's investment has been leveraged to draw in more than $2 million in additional funding from federal, foundation, business, and partner cost-share.

STEM is working in Iowa! In the first year, Iowa's STEM initiative reached nearly 40,000 students with innovative, high-quality STEM programs. This school year, we expect to serve more than 100,000 students. STEM awareness has significantly improved among Iowans from 26% to 43% in the last couple years. But that's not all! Iowa students who participated in the first round of high-quality STEM education programs scored higher on state assessments in math and science. That rein-

forces the need to continue offering such programs, especially in underserved areas.

Our next step is redefining STEM education so it stretches beyond the classroom by putting more emphasis on education-business partnerships. Currently, the Council is studying a variety of initiatives underway like an exciting new locally-based program in Waukee, Iowa. Waukee is bringing the Center for Advanced Professional Studies (CAPS) programming to Iowa, based on an innovative program in Kansas.

Starting next school year, Waukee High School students will gain real-life experiences at area businesses for two and a half hours a day in the fields of insurance and actuarial science; and advanced manufacturing to name just a few.

Another aspect of STEM that sometimes goes unnoticed is the need to build a pipeline for students to enter careers in food and agriculture, something that is critical to the economy of Iowa. That's why I'm co-chairing STEMconnector's Food & Ag Council together with DuPont Pioneer President Paul Schickler. Our vision is to fully prepare the next generation for meeting the human capital needs in the Food and Ag industries as well as solving the challenges related to feeding 9 billion people in 2050.

We want to mobilize America's youth to inspire, nurture and engage individuals to passionately pursue food and agriculture careers by unlocking their full potential as leaders and professionals. STEMconnector's Food & Ag Council has three committees exploring the best ways to build a skilled workforce pipeline, engage young people, and increase STEM awareness. One of their charges is to identify and find solutions that equip students with the skills necessary for the food and agriculture careers of tomorrow.

Identifying the specific skills needed for tomorrow's STEM workforce is exactly what STEM 2.0 is working to accomplish. The STEM 2.0 initiative will be the common thread running across STEMconnector's Food & Ag Council, Innovation Task Force, and Higher Education Council. STEM 2.0 is a sound solution for building a successful pipeline of skilled workers who can compete in a knowledge-based, global economy. It also can serve as a springboard for future generations by providing effective education and countless career opportunities.

Iowans believe that to be true and so do I.

About the Author:

Lieutenant Governor Kim Reynolds *of Iowa was elected to office along with Governor Terry Branstad in November 2010. Kim works tirelessly to provide access to quality STEM programs for students, especially the underrepresented and underserved. Kim currently serves as Co-Chair of the Iowa STEM Governor's Advisory Council and STEMconnector's Food & Ag Council.*

Next Generation Global STEM Workforce

Ana C. Rold

Mind-boggling changes and advances in technology and online communications, the fluidity, easiness and speed that characterize it, encourage best practices to evolve and platforms to improve at an impressive rate. And while some warn that these advances will create unemployment, the opposite is actually true. Displaced workers will find new jobs that do not exist yet—human history proves this undeniable theory. Yet, skeptics see technological advances as disruptive forces.

In January, *Diplomatic Courier* and STEMconnector convened leaders in STEM as well as leaders from the policy and diplomatic communities in our nation's capital for "The World in 2050," a global summit addressing the future of jobs in these fields. As we considered our global STEM future we concluded that there are two key factors that are mutually critical in the success of companies and entire countries alike: talent and innovation. We are now confronted with a difficult reality: to survive the constant disruptions every industry is experiencing globally we must foster a culture of talent and innovation. "Talentism," Professor Klaus Schwab of the World Economic Forum says is the new capitalism. Just like financial capital replaced manual labor during the industrialization period, capital is now being replaced by human talent with the latter being the decisive competitive factor between companies and entire nations.

Not all nations are equally preparing their youth with the skills they'll need to compete in the 21st century. This poses a risk to our future—some economies will flourish while others flounder. Young Americans will be competing for fulfilling, stable jobs in STEM fields against a cadre of youth in China and India who may be better prepared to fill them. Globally, we must reconsider how we prepare future generations for these careers.

How can we adapt and prepare our youth in such a disruptive world? The answer is innovation. In the future, the distinction between high- and low-income countries, or between emerging and established markets, will no longer matter. The question will be whether or not an economy can innovate. STEM is at the heart of the innovation discussion.

Today, we are dealing with a paradox: 200 million people unemployed worldwide—40 million in the advanced economies and 75 million of which are youth—and global companies still have millions of unfilled positions (International Labor Office). There is a critical need to unleash growth, to leverage emerging trends in technology, market needs, and society to expand enterprise and economic opportunity. Success in breaking through to a new wave of growth and prosperity will

depend increasingly on human capital. In turn, a new, global burst of innovation and entrepreneurship will require a deep pool of highly skilled, creative, inclusive, risk taking individuals and communities.

Given the essential role of human capital in the coming expansion, a global war for talent is beginning and will intensify. At the heart of this competition are three issues:

Skill Gaps. The inability to fill jobs despite massive unemployment is not only due to geographic imbalances in supply and demand, but also due to large skill gaps between the needs of the industry and the output of the education systems.

Technology Development. Advances in technology, especially Information Technology, will continue to disrupt societies in the coming years. Cloud, mobile technology, social networks, collaboration technologies, and big data provide almost infinite computing, storage, and bandwidth at a very low cost. This has increased the amount of innovation in every sector and aspect of our lives. These developments are redefining jobs of the future and with it, the talent needed for the future.

Change in Demographics. Emerging economies like India and China are increasingly becoming magnets for talent while advanced economies like Japan, the EU and the U.S. are facing the challenges of an aging workforce. The most direct impact of the widespread aging around the globe is that regional and national economies that depend on a largely static local workforce will be challenged, as the local population ages out of the working economy.

Today's young people—aptly coined First Globals and Digital Natives—are a generation that intuitively knows how to use tablet computers, smart phones and multiple applications at once. We can harness those skills. Technology offers us the chance to capture the attention of young students interested in entering STEM fields, but we aren't doing it efficiently enough: 70% of elementary school students report interest in STEM subjects, but by college, just 4% of them end up studying computer science (Villanueva Beard and Rold).

So how do we cultivate our strongest asset—human capital—in the new economy of the future? Education is but one critical pathway that should align parallel to the following four capability platforms designed by the STEM 2.0 initiative to respond to the demand side of jobs: Digital Fluency, Innovation Excellence, Employability Skills, and Hard Skills. Driven by leaders in the demand industry, these platforms are meant to develop tomorrow's workforce in a clear, step-by-step process.

It is not enough to talk about these issues—though raising awareness is critical. Solutions will not come by the academic and think tank sector alone or from one or two nations alone. The issues we face are global and the response and solutions must be global. And the industry—those who create jobs and hire the workforce—now more than ever need to be part of the solutions. And there is no one more global than the private sector. We have much to learn from them.

About the Author:

Ana C. Rold *is the founder and editor-in-chief of Diplomatic Courier, a globally focused publication that connects the next generation of leaders to current policy professionals.*

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SECTION 5

Moving Forward With the STEM 2.0 Agenda

Empowering the Next Generation of STEM Leaders

Michael Norris

As an executive managing over $1.4 billion of business at over 1,800 locations across the country, I am passionately committed to developing the next generation of STEM leaders, and for that matter, helping to prepare all young leaders entering our workforce to be successful. With the global marketplace expanding at unprecedented rates, shifting demographics and emerging global trends play an ever-increasing role in the American economy. It has become increasingly apparent that we as business leaders, industry experts and academics can offer a more comprehensive approach to preparing our future leaders to successfully enter the workforce.

The numbers speak for themselves. My company alone plans to add nearly 100,000 jobs over the next 10 years. When you are considering those kinds of growth targets, you have to be focused on identifying, attracting and retaining the best talent. How then, do business leaders employ a strategy that ensures the next generation of STEM educated leaders are prepared for the jobs of tomorrow?

STEM Innovation Task Force & The STEM 2.0 Initiative

I would argue that such a strategy begins with reaching future employees long before they are ready to enter the workforce. One group that I've had the pleasure of working with over the last year is aiming to accomplish exactly that. STEMconnector's Innovation Task Force, a thirty-plus member consortium of leaders from industry, government, education, and the non-profit sectors are working towards identifying new pathways to STEM careers.

The Task Force has made STEM 2.0 its primary focus for 2014-2015. The STEM 2.0 initiative seeks to identify a number of critical new capability platforms that our future talents need in order to be successful in the future. The first three capability platforms (CPs), Employability Skills, Innovation Excellence, and Digital Fluency are applicable to all STEM fields and are the foundation of the initiative. The fourth "Hard Skills" platform will identify skills that are applicable to certain industries, including but not limited to: information technology, food and agriculture, and advanced manufacturing.

STEMconnector's Innovation Task Force is actively seeking partnerships to scale-up the STEM 2.0 initiative in the United States and globally. We are embracing the education community, aligning to state-level standards, involving teachers, and connecting to youth development organizations with strong STEM programming. We know that in order to make STEM 2.0 a reality, we must leverage our greatest strength, collaboration.

The Applicability of STEM 2.0

My expertise and perspective have been gained over an extensive 30-year career. And from that, I have gleaned five essential ways business leaders can better support students considering a career in the STEM fields. I hope my recommendations open up a dialogue among stakeholders who are committed to creating a stronger and more sustainable economy.

1. **Apply Theory to Practice:** STEM students need exposure to practical applications of their subject matter. This is particularly relevant to the STEM fields. For example, Sodexo's National Research Director, Dr. Rachel Permuth, has a degree in Mathematics and another in Biostatistics. While Rachel loved math as a student, she didn't completely grasp the idea that it could inform business decisions until she entered the workforce. I am convinced that no age is "too early" to expose children to how education aligns with jobs. One way of introducing this to students is STEM Career Accelerator Day, a nationwide event that brings students into major STEM facilities to experience firsthand the excitement and rewarding potential of a STEM career.

2. **Moving Beyond People Skills: Instructing Students on the "Art" of Social Influence and Persuasion:** Young students may be natural negotiators, but there are finer points to being influential in the workplace that can be taught and cultivated. In terms of STEM 2.0 priorities, I firmly believe that the ability to be persuasive, as well as using social influence appropriately and ethically, are some of the key skill-sets that students need to be successful. The art of social influence and persuasion will be explored within the Employability Skills CP, and I would argue for the following to also be included:
   - » Goal Setting
   - » Making evidence-based decisions
   - » Data Visualization
   - » Story Telling (as an art of persuasion)

3. **Stay Relevant:** In order to cultivate student interest in STEM fields, we need to provide relevant and exciting examples of STEM job opportunities. Recently, I spoke to the head of the National Facilities Management Association, who said if we provide a "big picture" simulation of the roles and responsibilities of engineers and facilities managers, this would glean a lot more interest in the field rather than describing the tactical aspects of the day to day job.

   Case in point, a student learning about how to manage and help design huge complexes where people will learn and work in the future, and how to make them comfortable and productive – with all of the technological advances coming to fruition – is an example of how we should be explaining the field of facilities management (as opposed to understanding how boilers work, adjusting building temperature, etc.).

4. **Actively Seek Educational Partnerships**: Educational institutions within our communities typically welcome the opportunity to engage with local businesses. It takes time to develop relationships with different types of organizations (such as education and nonprofits) and even longer to develop a level of trust. The first step for any business leader is to learn about their mission, goals and strategies. Then, visit high schools, vocational schools, and community colleges and listen to the administrators, teachers, and the students talk about their frustrations and aspirations. Look for ways to establish mutually beneficial partnerships. Perhaps you could offer to speak to students or establish an internship. The opportunities to collaborate are endless; you just have to seek them out.

5. **Be a Mentor!** Research on mentor-student relationships has shown that a mentoring relationship can have a dramatic impact on a mentee's (or an apprentice's) performance. Perhaps more importantly, is the way we set up relationships with the students. We have to ask ourselves whether we are challenging the students (at the appropriate level) with what we are teaching them. Are we treating them with respect and soliciting their ideas? Do we provide constructive feedback to the students and follow-up with them to ensure they are learning appropriately and correcting any deficits that they have? Conversely, do we give accolades for great performance and innovation?

I am so enthusiastic about our future leaders and I am confident that our success will be in large part due to our investment in today's students. There is a whole new world emerging that we can open them up to, but we must first lay the foundation! My hope is to capture the attention and the creative minds of the best and the brightest and lead them to the STEM disciplines. By doing this, we can create more engaged employees, better communities and a stronger global presence.

About the Author:

Michael Norris *was appointed Chief Operating Officer of Sodexo North America, an $8 billion solutions provider, and Market President of the Corporate Services Market in June 2005. Michael is Senior Adviser to STEMconnector and serves on STEMconnector's Innovation Task Force.*

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STEM Innovation Task Force Members
(As of May 2014)