Focus On EMPLOYABILITY SKILLS For STEM Workers

Points To Experiential Learning

A Publication by STEMconnector's STEM Innovation Task Force

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ACKNOWLEDGEMENTS

Diversified Search, LLC

STEMconnector® would like to thank all of the contributing authors and their teams who have contributed to the publication for your continued support.

Published July 2015

Abstract

Employability Skills, part of the STEM 2.0 framework, are an essential skill set for 21st century employees. This focus on Employability Skills builds off the previous work of STEMconnector®'s Innovation Task Force – STEM 2.0 – An Imperative For Our Future Workforce – a publication that introduced the importance of STEM 2.0 skills in today's competitive, global workforce. This paper focuses on which Employability Skills are most important for STEM careers through an academic review, and the findings from expert interviews and roundtable discussions. The goal was also to identify key areas for improvement to lessen the gap between employer needs and student skills. Through research, two observations were made related to the current education system: 1) career-focused experiential learning is a vehicle to impart Employability Skills and 2) measurement & assessment of Employability Skills remains a gap. Career-focused experiential learning (CFEL), in particular, is a powerful mechanism to impart Employability Skills. Some exemplary CFEL programs exist today and should be looked at more closely as potential models. However, a void exists in published research to find what CFEL programs work best. There is similar void in assessment and measurement of CFEL programs. Further research is needed to validate the importance of CFEL as critical in the Employability Skills framework. The authors encourage educators and organizations that teach these skills to continue to prioritize Employability Skills and the use of CFEL.

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.

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Section 1
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Section 2
Introduction to the STEM 2.0 Framework

The world looks at the United States as the leader in innovation, but employers are seeing a growing shortage of qualified candidates for employment, with appropriate Science, Technology, Engineering and Math (STEM) skills, for their job openings. To make matters worse, the requirements to obtain these jobs continue to change as the needs of employers constantly evolve. New skills are being required as businesses and technology both change. What do employers believe are the vital skills? Who is responsible to impart these skills? What is the ecosystem that produces these employees doing to support their needs? What actions might stem this tide and help fuel future innovation?

No matter the field, innovation and technology are playing an increasing role in the future of all industries. The McKinsey Global Institute predicts a potential global shortage of 38 to 40 million high-skills workers in 2020. The STEMconnector® initiated STEM Innovation Task Force (SITF) has attempted to take a demand-driven, cross-industry view of the global need for STEM skills. Employers believe that a gap exists between the required skill set and the skills that employees entering the work force possess.

The STEM Innovation Task Force has taken a multi-phased approach to identify what skills lie in the gap, how those skills can be taught or imparted, and what actions employers, educators and policymakers can take to close the gap. The Task Force refers to the existing STEM education delivery as STEM 1.0, the current state of affairs. The team then proceeds to define multiple "capability platforms" that lie in the gap between what is being delivered and the current requirements. STEM 2.0 refers to the current state, referred to as STEM 1.0, plus the missing capability platforms. It is this STEM 2.0 skill set that employers must invest in today. The actions of the SITF will create focus on the development of STEM 2.0 capable employees. Tomorrow's STEM jobs will place increased demands on workers. To that end, the Task Force has identified four capability platforms (CPs) that the educational ecosystem must inculcate in students: Digital Fluency, Innovation Excellence, Employability Skills, and the fortification of discipline specific "Hard Skills."

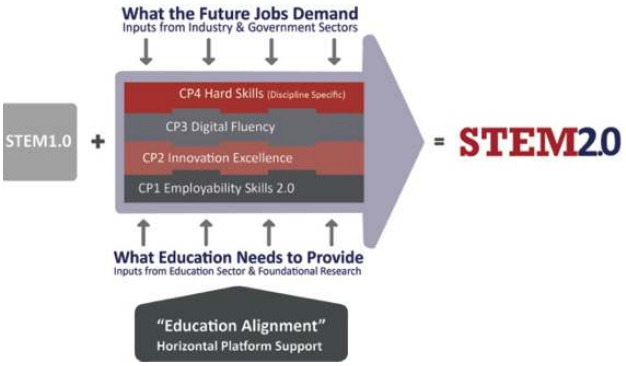


Figure 1: STEM 2.0 Framework
STEM 1.0 + Additional Capabilities = STEM 2.0

• **Digital Fluency** can be defined as the application of STEM learnings to specific "real world" problems. 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.

• **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. 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.

• **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.

• **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.

While most participants in the STEM discussion would agree the adoption of these four capabilities is common sense, that doesn't mean they are common practice. In addition to the 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).

The SITF is focused across the full spectrum of STEM 2.0. Within the SITF the authors of this paper lead a subgroup focused on so-called "Employability Skills". The research has included in-depth, one-on-one interviews with a wide range of experts in education, research, government, and industry. The team also hosted a day-long roundtable to convene these experts and others to discuss and debate the subject.

The SITF attempts to look at this problem holistically, from a cross-industry perspective, with regards to preparing employees for STEM jobs across the widest possible range of roles. The Task Force discusses the work of the STEM Innovation Task Force on "Employability Skills," including what they are, their importance in differentiating candidates, and how they are best imparted. There are many valuable resources, which outline these skills that are discussed later in Section 4. The SITF agenda is not to redefine or debate the list of Employability Skills. Rather the intent is to highlight their importance, the lack of explicit focus on these skills within the current educational system, methods for imparting these skills, exemplary existing programs, and gaps that have been identified in the research. Finally, the paper concludes with a call to action for educators, but also importantly for organizations that require these employees.

Section 3
Why Are Employability Skills Important To STEM Careers?

According to the McKinsey Global Institute, 64 percent of companies currently have vacancies for STEM positions due to a lack of qualified applicants (Dobbs, et al., 2012). As discussed in Section 1, this current problem will lead to future consequences for the United States workforce and economy. The United States' economy will need 123 million highly skilled workers by 2020 but there will only be 50 million workers to fill these jobs unless action is taken (Gordon, 2009). This skills gap is due in part to the lack of priority given to Employability Skills being taught in the education system. There is a strong disconnect between how educators value many of these skills compared to the workforce.

THE IMPORTANCE OF EMPLOYABILITY SKILLS

Georgetown University's Center for Education and the Workforce explains the ever-expanding need for Employability Skills among workers. A recent study on STEM points out that technology decreases the frequency workers need to perform repetitive tasks and leaves more time for innovation and interdisciplinary collaboration among colleagues and occupations.

The increased demand for teamwork means that workers with different skill sets are working simultaneously on different components of the same project. This places a premium on the need to increase training in Employability Skills like communication and teamwork (Carnevale, Smith & Melton, 2011).

A 2009 Sodexo University Lifestyle Survey found that employers not only want discipline-specific competencies or technical skills but a broader range of skills including "team-work, communication, leadership, critical thinking, problem solving and managerial abilities" (10). In addition, the study emphasized the importance of work-based learning professional development. Internships give students the opportunity to apply their skills outside the classroom and increase the likelihood of finding employment after graduation. The study also notes that although initiatives are happening within higher education to address graduate employability, it varies by institution and there remains a disconnect between employers and those in managerial positions at institutions of higher education. Employers believe that curriculum changes should be made to degree programs that address the current and future economic climates and specific needs for talent.

Dr. Marilyn Rose (2013) from Canada's Brock University investigates the hardships Canadian graduate students face in finding meaningful employment after having been in the academic system and mindset for so long. She says that while these students are well-versed in academic skills, they are not well-versed in soft skills including "self-development, self-management, self presentation, communicating effectively to targeted audiences, and above all the ability to "translate" their achievements as graduate students—their knowledge, experience, and transferrable competencies—into language that can be understood and respected by potential employers outside the academic sector" (5).

A 2009 study in the Academy of Management & Learning Education finds that individuals working internationally or on international assignments are likely to engage in experiential learning and will subsequently develop global leadership skills that will allow these individuals to work cross-culturally with flexible leadership styles (Ng, Van Dyne & Ang).

THE IMPORTANCE OF INCORPORATING EMPLOYABILITY SKILLS INTO ACADEMIC CURRICULUM

As Nina Morel from the Delta Kappa Gamma International Society for Key Women Educators highlights in her work on collaboration as a twenty-first century skill, it is just as important for teachers to collaborate with colleagues, show problem-solving skills and keep up-to-date with new types of teaching because students will emulate these behaviors which will enhance their own relationship skills (2014). Her colleagues, Kathleen Ramsey and Barbara Baethe, argue that motivation alone for STEM learning will not lead students to a successful career path. Basic skills like writing, mathematics, critical thinking and class preparation are equally important (2013).

Mason, Williams and Cramer from the National Institute of Social Economic Research, London and the Institute of Education, University of London, discuss findings that employer involvement in curriculum development at the higher education level may have a positive effect on graduate employment. This finding suggests that creating this link before graduation gives students a better understanding of employer priorities and how companies operate and make decisions (2006).

Section 4
Elements of an Employability Skills Framework

ELEMENTS OF AN EMPLOYABILITY SKILLS FRAMEWORK

Although there is no one universal definition of Employability Skills, most generally accepted definitions would include the following qualities:

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

In the context of STEM 1.0, these include such skills as basic mathematics and reading. These Employability Skills frameworks or competency models also include personal qualities such as teamwork, communication and respect for co-workers and customers. Additionally, all frameworks also include some version of higher-order thinking skills such as critical thinking and problem solving. One of the greatest challenges in the implementation of workforce programs for these skills is that exact definitions of the expected levels of performance and methods for measuring the personal and higher-order thinking skills are difficult.

As is evident, the STEM 2.0 model coalesces the skills most needed by employers in the generalized high-tech workforce. While many models and organizations have explored the skills required by new employees, few have combined innovation and digital fluency together with Employability Skills into one cohesive model. The employers and other experts interviewed by the panels have found few examples that combine all of these essential elements in an actionable form, especially in the areas of innovation and digital fluency. However there have been many frameworks for basic Employability Skills that have been advanced, and would be useful in the context of the STEM 2.0 model.

The STEM 2.0 framework extends these basic Employability Skills to a higher level required for today's global, matrixed organizations. In this new work environment, employees are expected to be more self-directed in their jobs, and more capable of finding their own solutions to problems. This requires the Employability Skills mentioned above, but often to a higher degree or with a higher level of self-determination. For instance, instead of responding to a business need defined by a supervisor, the new STEM employee is expected to self-identify business needs or opportunities, network with resources to find assistance, determine

possible solutions, experiment with solutions often in spare time, and "sell" both the need and solution to the internal or external business partners.

The ideal Employability Skills framework would be actionable, practical and effective. To achieve these goals, the framework would have the following elements:

- **Skills Definitions** - detailed descriptions of each skill objective and levels of individual attainment, which would allow for the development of training and measurement systems
- **Curriculum and Training** - integrated, aligned or associated curriculum and training programs that provide opportunities for students and trainees to gain the needed skills
- **Assessments -** Practical and affordable means for measuring the skills possessed by individuals
- **Career and Job Alignments -** Practical and affordable means for determining the skills and skill levels required by careers or individual jobs using the same definitions and scales as the training and assessment systems
- **Validation -** Documented means for measuring the effectiveness of the system in predicting the workplace performance of individuals who have been assessed and determined to possess the required Employability Skills
- **Fairness and EEOC Compliance -** Evidence that assessment and selection procedures are directly related to requirements of the job and do not have any disparate impact on minority groups

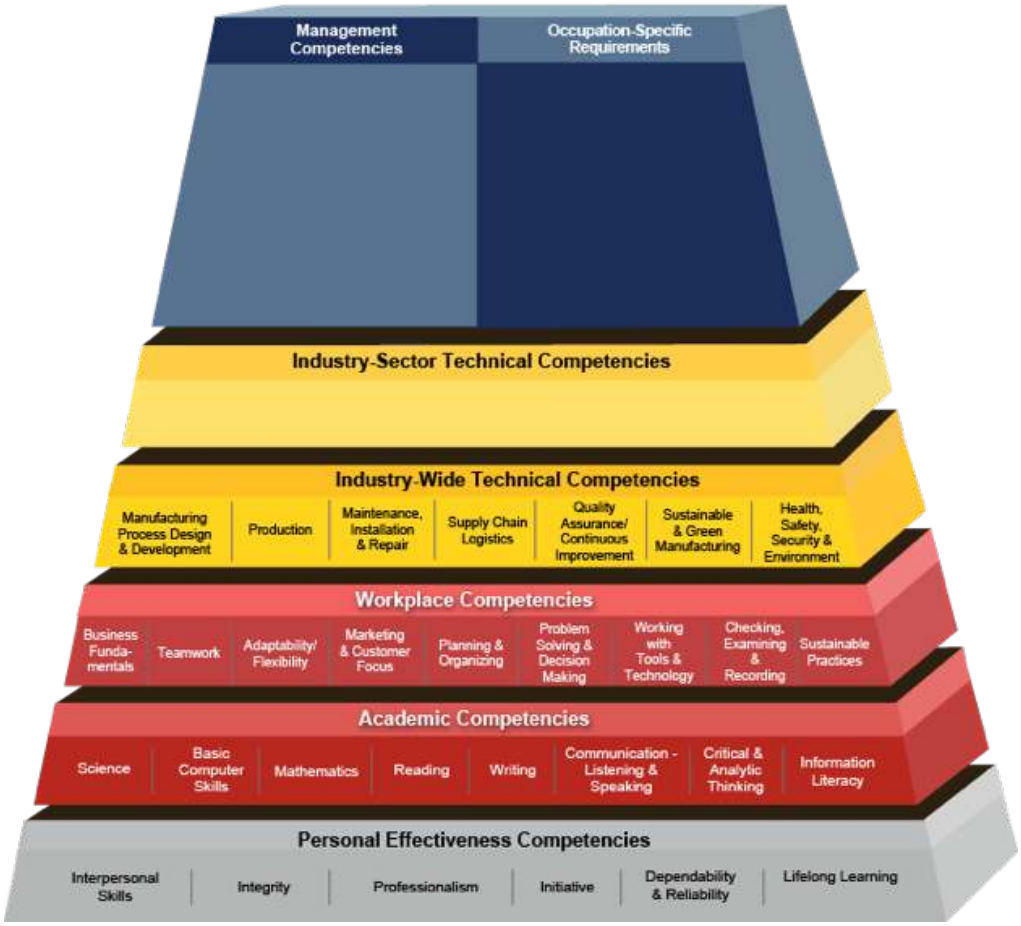
Section 5
Useful Employability Models and Initiatives

This section reviews some models and initiatives that can be used as the basis of education, training, measurement and hiring. The objective is not to replace the detailed skills models or definitions advanced by others with something new; rather it is to point out how these can be used to construct a comprehensive framework that encapsulates the skills needed by all modern STEM workers including those defined by the STEM 2.0 concept. Several models are available that include a general description of the Employability Skills. However fewer of these models break the general skills definitions down into specific and detailed definitions that can form the basis of education and training standards. Still fewer provide measurement and hiring systems that can be used to identify individuals with the desired traits in an efficient manner.

Much of the current work on Employability Skills can be traced to the **SCANS commission report of 1991** (The Secretary's Commission On Achieving Necessary Skills). The SCANS report was one of the most complete listings of Employability Skills to that date. It included five competencies of resources, interpersonal skills, information, systems and technology; and three foundations of basic skills, thinking skills and personal qualities. The SCANS then has become the basis or inspiration of a generation of Employability Skills frameworks in the years since.

Others have recognized that these Employability Skills are only the basis of a complete set of workplace skills that are built over a lifetime and tailored for the specific career or jobs that an individual has in a lifetime. One of the most common visual models for this is the pyramid format advanced by the U.S. Department of Labor's Competency Models (United States Department of Labor). In this model, Employability Skills form the three base tiers, generally consisting of the personal skills and the basic academic skills.

Figure 2: U.S. Department of Labor's Competency Model



***Note that there are numerous examples for specific industries, and that the industry-wide and industry-sector technical competencies are often linked to specific implementation examples.**

The U.S. Department of Education's Employability Skills Framework (Department of Education) combines a more broad set of personal and higher-order thinking skills than the SCANS framework. It also inventories the inclusion of these skills in a large number of other Employability Skills frameworks. The website seeks to be a resource for selecting assessments that would allow practical implementation of training and hiring systems based on these skills, but it stops short of recommending specific assessment systems. The Department of Education is currently exploring a new phase of this initiative to expand this resource in order to identify assessments for

Several organizations have worked to expand or create actionable systems built on the foundation of the SCANS skills. One notable example is the "21st Century Skills" from the **Partnership for 21st Century Learning** (Partnership for 21st Century Skills). The 21st Century skills are organized as Content Knowledge and 21st Century Themes, Learning and Innovation Skills, Information, Media and Technology Skills, and Life and Career Skills. The framework is mainly intended to guide instruction and education, and is less easily actionable for employers and workforce agencies.

The National Occupational Competency Testing Institute (NOCTI) created a battery of tests that assess a student's competence in a number of Employability Skills and various vocational and technical pathways. The assessments are best utilized in educational settings, although services are available that can adapt the system for employer use.

The **WorkKeys® employment system** (ACT) is an example of a complete system that is designed as an employer hiring tool, combining skills definitions and levels with curriculum, assessments, job analysis and validity. The system consists of 12 tests covering foundational skills and soft skills. The job analysis component provides a standardized framework for documenting the job alignment, validity and EEOC compliance for a specific position. The National Career Readiness Certificate employs the three most popular assessments to create a simple credential for the most essential applied academic Employability Skills. This system has been widely implemented in education and workforce system in numerous states. The system is best used for basic academic skills and higher-order thinking skills. Extensions of the system to personal skills lacked some of the robustness in job analysis and validity that was developed for the academic skills components, and have met with more modest levels of adoption.

The National Association of Manufacturers' Manufacturing Institute has worked to gather together existing industry certifications to create an ecosystem for awarding skills certifications signifying employability and industry sector skills (National Association of Manufacturing).

This model utilizes the Dept. of Labor's competency model to aggregate multiple layers of skills from the basic Employability Skills up to higher level industry hard skills. The system is designed to allow individuals to move up a career ladder and/or to make lateral movements while recognizing skills attained in education or throughout his or her career. Instead of creating a single database of specific skills, the system uses resources from various affiliates to assemble the total certification system. The use of industry-recognized certification partners provides a high level of portability to the endorsed credentials.

More recently, some new initiatives have sought to integrate a more modern view of Employability Skills that include more emphasis on the innovation and problem solving needed for the new STEM industries. A notable example is the **Common Employability Skills Framework published by the National Network of Business and Industry Associations.** The Network recognized that employers in every industry sector emphasize the need for employees with certain foundational skills, but they do not always talk about or label them the same way. This makes it difficult for prospective employees and educators to know exactly what it takes to be ready to succeed in any career path in any industry. To solve this, the Network identified the core set of fundamental skills that potential employees need in the workplace – and a common vocabulary to explain them.

The Network recognized that Employability Skills can be acquired in a variety of ways, including military service, work experiences and community service, as well as traditional education. Network officials continue their commitment to identifying common skills across economic sectors. A team is now focused on identifying and defining the core technology skills required across the majority of jobs in all economic sectors, and an evaluation has commenced around "clusters of core technical skills" that align with clusters in the productive and service industries.

Additionally, there is recognition that any set of skills definitions that is written by one group at one point in time will be limited in the viewpoints presented and its ability to adapt over time. **The Hope Street Group** has gathered together a broad coalition of employers, educators, policy makers, etc. to create a consensus on the skills required for the workforce, and seeks to create a method where this listing of skills can easily be codified and updated as jobs change over time.

The Hope Street Group seeks to create a skill marketplace that is able to:

- Evolve as the needs of employers and individuals change
- Operate in a global and portable capacity
- Support discovery and motivation opportunities for individuals
- Integrate and be inclusive of training and experience
- Support career trajectories as well as jobs

The Hope Street Group is working to develop a solution with necessary input and diverse perspectives, experience and learnings across core stakeholder groups. They are working to elevate the best practices and solutions with the ultimate objective of leading market transformation by creating a sustainable foundation and blueprint for all actors to work seamlessly across the learning-to-work continuum.

The large number of these efforts conducted over many years testifies to the difficulty of defining and measuring STEM 2.0 Employability Skills in a practical and scalable manner. While many can list general areas of skills needed, few can teach or assess these skills in a way that fills industry's need for qualified employees in technical careers.

Additionally, much of the progress in these areas has been focused on entry-level or technical skills. This is largely because these skills are more easily teachable and measurable than the interpersonal skills required for creating innovative solutions to complex problems at the level of middle-tier knowledge economy workers. This has led employers to seek other methods to develop and observe these skills in individuals. Employers have indicated that the higher-order skills desired for the new STEM workers are best learned in real-life workplace experiential learning. These include experience such as internships, co-ops and apprenticeships. While this still leaves future opportunities for developing better measurement and assessment systems, it is clear that the educational process to gain these skills must now include elements of experiential learning.

Many institutions of higher learning are already giving priority to Employability Skills with a focus on experiential learning. The following are examples from community, private and public colleges and universities:

- **Guilford Technical Community College:** Guilford offers job preparedness training with a focus on Employability Skills. They teach students how to find successful employment through self-assessments and learning important soft skills. In addition, experiential learning is a critical part of the Guilford experience. These experiences have to be real-word and promote positive change.

- **Olin College of Engineering:** Olin College is known for being a leader in their educational approaches and learning environments. Students learn outside of the classroom by participating on real engineering teams that allow the students to collaborate and be innovative when thinking of solutions to some of today's biggest design challenges.

- **Kent State University:** At Kent State, students have a variety of opportunities for hands-on experience including internships, service learning, research projects and study abroad. The Office of Experiential Education and Civic Engagement assists students in finding what experience is best for them.

Section 6
Findings From The Employability Skills Interview & Roundtable

FINDINGS FROM THE EMPLOYABILITY SKILLS INTERVIEWS & ROUNDTABLE

After releasing the initial publication, STEM 2.0: An Imperative For Our Future Workforce in June 2014, the STEM Innovation Task Force (SITF) began to explore and validate specific capability platforms outlined within the STEM 2.0 competency model. The first, and arguably the most fundamental of these capabilities is Employability Skills 2.0. As defined in the STEM 2.0 publication:

"Employability Skills are a discipline-independent set of competencies and behaviors that all employers expect from their employees. At the most basic level Employability Skills include: teamwork; communication; reliability; and flexibility, the ability to understand and adapt to new ideas."

In order to confirm the hypothesis that Employability Skills are a critical and desirable component of the ideal next-generation STEM employee, the SITF sought out over thirty leaders from the private sector, academia, government, and non-profit sectors and they were interviewed to gather a broad range of perspectives. A target shortlist of candidates, beyond the SITF members, representing the different fields was compiled and subsequently contacted to schedule phone interviews.

The group developed a focused questionnaire to help guide the interviews, which was distributed to individual interviewees prior to the phone interview. The following is a sample of questions included in the questionnaire:

- How critical are Employability Skills to success in STEM careers?
- What constitutes an ideal set of next-generation Employability Skills for STEM careers?
- Can Employability Skills be taught or learned, or are they inherent?
- Can you assess Employability Skills, if so what are some successful assessment tools?
- What are some model programs that inculcate students or the workforce with next-generation Employability Skills?
- What else needs to be done in this space? What are your recommendations?

These questions helped spark discussions that highlighted the talent needs of employers, with a focus on the importance of Employability Skills, in addition to gaps in the education system and the delivery mechanisms of imparting these skills in students. After completing the interviews, the information was synthesized and compiled into several themes that were consistent across each discussion. The following themes were distilled during the interview process.

CRITICAL EMPLOYABILITY SKILLS 2.0 Areas

Through research and extensive, in-depth interviews the Task Force has attempted to further validate that a skills shortfall exists and specifically that Employability Skills are part of that shortfall. Furthermore, the team has explored that idea that like all skill sets, these skills evolve over time. Some notable quotes were selected here to help emphasize some of the key points that have emerged through the conversations.

"It's almost impossible, in all roles in our organization, to accomplish your job without thoroughly teaming and collaborating with others. I run a very large engineering team and it's global, so one of the first priorities is working in a diverse team."
-Mark Papermaster, Chief Technology Officer, Advanced Micro Devices

"When you look at the types of problems that are out there today, these require people from different disciplines to come together to be able to solve them. It is also necessary to possess a degree of cultural awareness within the context of the problem you are trying to solve."-Susan Puglia, VP, Global Technical Development Programs, IBM

"Educators are preoccupied with content acquisition. There is no competitive advantage in knowing more content. What the world cares about is what you can do with what you know? This is a very different educational problem. We haven't even begun to address this challenge."
-Tony Wagner, Expert in Residence, Harvard University

OBSERVATIONS RELATED TO THE EDUCATION SYSTEM

Another consistent theme that emerged from the interviews is the need for change in the education system. Learning is less today about storing and repeating back information. Learning is more today about knowing how to access information, how to assemble the meaningful related information, and then how to construct scenarios and test one's assumptions. Educators must teach that failure is acceptable and more often than not lies along the path to success.

Additionally, to gain the skills needed for the workplace learning must include teamwork and collaboration. Little happens in the real world through individual effort. Most significant accomplishments are not solo efforts. Context is essential and gives learners a more complete understanding of the situation at hand. The Task Force has decided to utilize the term Career-Focused Experiential Learning (or CFEL) to define what many employers and educators have deemed as essential to imparting these skills. In the Task Force's definition, CFEL includes problem-based learning, internships, team competitions and all forms of work experience.

Finally, a research gap has been identified related to assessing and measuring the effectiveness of various learning approaches. While the Task Force is convinced that CFEL is powerful and effective, the team encourages educators to publish their approaches and their results to help all improve the delivery of CFEL programs at all learning levels. The following are quotes from leaders in academia as well as the private and non-profit sectors describing the importance of CFEL and assessment in measuring learning success.

"It sticks better because you're doing it for a purpose."-John Abele, Co-Founder, Boston Scientific

"In the past education was all about content. Education is now more about doing. Future learning environments will look more like a kindergarten classroom than a lecture hall. The art, drama and music departments all know about experiential learning." -Rick Miller, President, Olin College of Engineering

"Behavioral traits or dispositions have a bearing on performance. These are skills that are required and can be learned. While some people's personalities may lend themselves to better or worse performance, we know from our work that we can enhance these skills with proper training."
-Martin Scaglione, President & CEO, Hope Street Group

Following the interviews, the SITF hosted an expert roundtable in Boston, MA on November 6, 2014 to continue building the discussion on Employability Skills with a cross-section of similar stakeholders involved in the interviews, in addition to several other organizations. The roundtable focused discussions on each of the following questions:

- What are the changing factors affecting Employability Skills?
- What is the appropriate role of different stakeholders?
- How can Employability Skills be assessed effectively?
- What are the missing pieces in the Employability Skills ecosystem?

During the roundtable, a subject-matter expert presented a specific perspective on the question, which was then followed by moderated group discussion. The larger group was then divided into four subgroups to discuss the questions further. The following are recommendations from the subgroups:

- There is a need to identify and define several new emerging factors (technology developments, demographics, globalization, interdisciplinary nature of work, etc.) that influence the way Employability Skills are taught, learned, and used in the work place.
- Utilize the various STEMconnector® networks to disseminate Employability Skills messages with a focus on the importance of experiential learning.
- Encourage educational institutions and employers to adopt experiential learning at every level and "mainstream" this thinking into the national-level discussions about education and workforce development.
- Develop a standardized set of competencies for Employability Skills.
- Build an assessment framework based on the above with a focus on "middle-tier" workers.
- Develop a national database for STEM internships and experiential learning opportunities.

The SITF is currently working towards including these recommendations, in addition to others as it plans its future priorities and actions. One primary area of focus has been researching the application of career-focused experiential learning to impart STEM 2.0 capabilities, as this was a common theme throughout the responses from the roundtable and interviews.

Section 7
Moving Towards Career Focused Experential Learning

One of the keys to increasing student skills sets in order to adequately prepare students, for not only getting a job, but being successful over a career, is the concept of career-focused experiential learning. This observation emerged as a major outcome from the primary research and will be discussed in this section.

First, it is important to frame a common definition of experiential learning utilizing the theories of several experts and universities. EL contains four discreet elements:

1. Intention and Investment – the experience is deliberately designed for a specific learning outcome that will benefit the learner and he must commit to fully engage in the experience and see the process through to completion.
2. Learner-centric Action – the learner must complete the action-oriented task by himself and be an active participant in lieu of an observer of an experience.
3. Observation and Analysis – the learner should be aware of the learning objectives so that while actively experiencing, he is taking note of cause and effect and application of theory in context. Trial and error are acceptable and encouraged.
4. Feedback and Reflection – once the experience is complete, the learner needs to receive objective feedback on his performance and he must internalize and determine reaction to both the self-assessment as well as the third-party feedback moving forward.

For the purposes of this paper, the Task Force has accepted this common definition and elements of experiential learning.

THE EXPERIENTIAL LEARNING CONTINUUM

Tremendous personal anecdotal evidence exists that a learning experience is internalized much more deeply if a person experiences it. Each of us has a personal example from the past; does a person read a textbook on how to ride a bike, or do they get on the bike, learn balance, and figure out how to react to the mechanics of the bike through trial and error? Is someone a better driver now than ten years ago because they have experienced driving in rain, snow, ice and traffic countless times and are keenly aware of how their automobile will and won't react?

From kindergarten through senior career levels, an experiential learning continuum exists. K-12 education includes role play, field trips, gaming, Boy/Girl Scouts, 4-H, and academic/extracurricular clubs. Post-secondary education builds upon those foundational experiences with case studies, problem-based learning, clinical work, live cases, simulations, labs and field work. Lifelong learning occurs in a workplace that offers internships, apprenticeships, job rotation, workshops, stretch assignments and affinity groups.

During the literature review, it became abundantly clear that an active learning experience was not only more enjoyable, but was able to impact business. When Sun Microsystems immersed its CEO and executive leadership in a business simulation called Leadership Connections, the directors reported a 99 percent rate of understanding the corporate strategy as high, compared to 30 percent prior to the exercise (Bersin, 2010). When HP employed a job rotation program for its leadership, participants cited a much more comprehensive understanding of the business and felt much better networked, enterprise-wide (Bersin, 2010). Cisco Systems launched its Executive Action Learning Forum (E-ALF) in an effort to foster innovation and teamwork. Many new businesses have been launched as a result and Cisco estimates the project to be worth $20 billion over the next 5 years (Bersin, 2010).

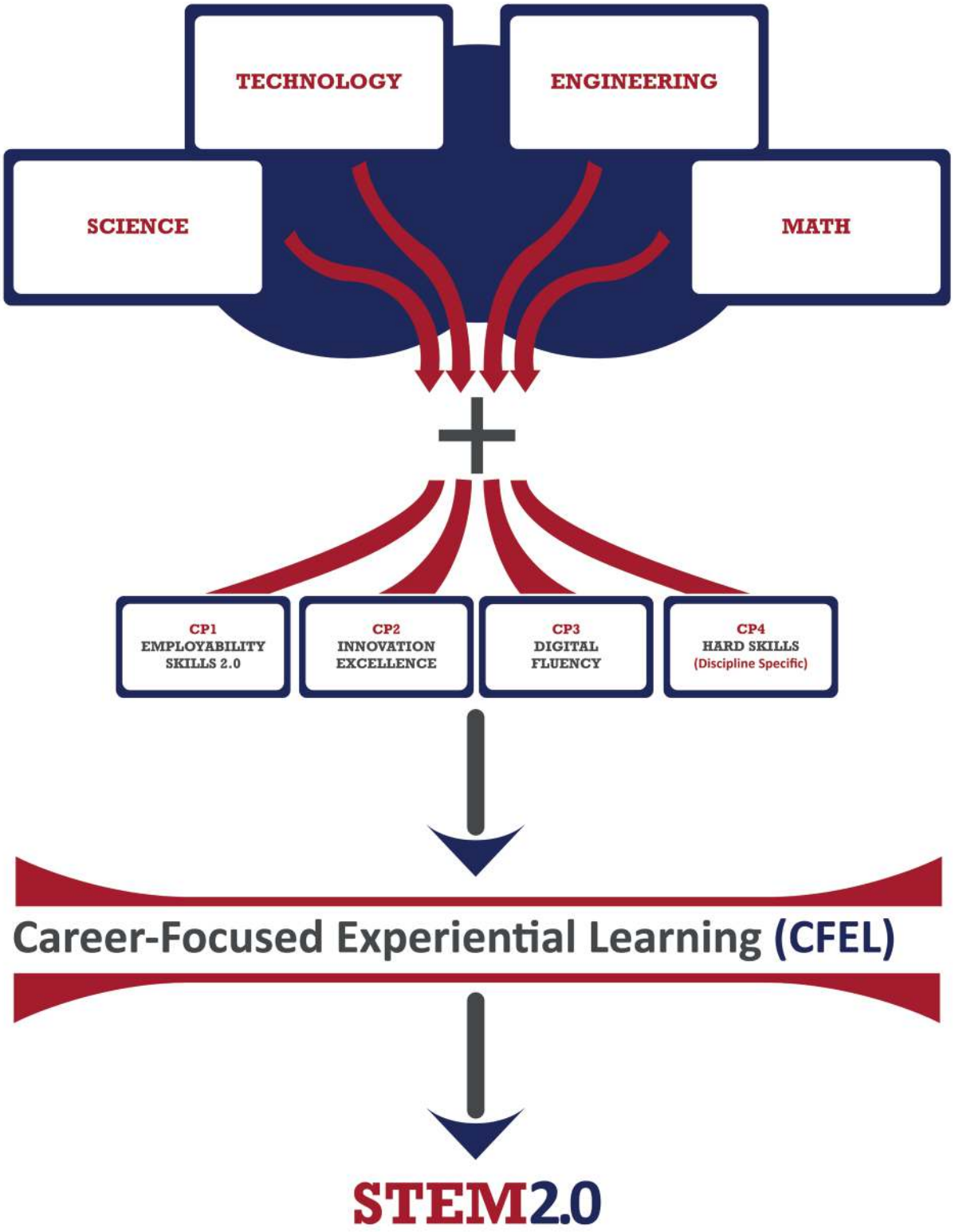
The Blended Learning Book by Josh Bersin shows that individuals retain only five percent of what they hear, 10 percent of what they read, 20 percent to 30 percent of what they see and almost 50 percent of what they learn through discussion and interaction. When direct experience is added to that mix (i.e., on-the-job experience with the real risks and dangers of making mistakes), the retention and application levels of new skills and information go up to 75 percent or more.

One similar model to career-focused experiential learning focuses on work-based learning. Work-based learning is a type of instructional strategy that does not have to be a hands-on experience. The goals of this model are to expose students to future career options and provide opportunities for the development of skills and the mastery of those skills in the long-term. Although the focus is school-based instruction, all of these learning experiences center around the involvement of industry professionals. These experiences also do not have to take place at a workplace or during a workday. They are designed to be an extension of classroom work and help students achieve learning outcomes that they could not achieve with standard classroom time or project-based learning alone (Linked Learning, 2012).

FROM EMPLOYABILITY SKILLS TO CAREER-FOCUSED EXPERIENTIAL LEARNING

The Task Force accepts the fact that experiential learning is highly effective in teaching complex ideas and processes and found plenty of evidence to that end. The team identified a residual outcome of experiential learning:
In order to be effective in the experience, per the definition, learners needed to utilize good communication skills and practice teamwork, analytical thinking, planning, organizing, reflection, and flexibility. A successful experiential learner needs to adapt to his environment, collaborate with his mentor and peers, utilize the various tools and technology available, synthesize information and be open to constructive criticism and possess self-awareness.

Experiential learning is a practical way for individuals to internalize Employability Skills within the context of a career.



SUCCESSFUL EXPERIENTIAL LEARNING MODELS

The most effective programs partner industry with educational institutions. Many examples exist of educational institutions and company-sponsored competitions to engage students in the STEM fields. The following is a sample of these programs:

- **SAE International:** Baja SAE® consists of competitions that simulate real-world engineering design projects and their related challenges. Engineering students are tasked to design and build an off-road vehicle that will survive the severe punishment of rough terrain.
- **Bayer Young Environmental Envoy Program:** Each year, around 50 Young Environmental Envoys from around the world have the opportunity to participate in a field trip to Germany to learn about trends and perspectives in the field of environmental protection and sustainability.
- **Boston University Design Challenge:** Using items like LEGOs, plexiglass and wads of duct tape, students design 12-inch-square vehicles that are required to descend an eight-foot ramp, drop a bean bag through a hole at the bottom, climb back up the ramp, knock over a flag at the top and hold position against an opposing vehicle while being closest to the center line at the top of the ramp.
- **Cornell Cup:** Teams of 3-5 students will create detailed design plans, a working prototype, and a final presentation that effectively demonstrates the capabilities and robustness of their ideas.
- **FIRST Robotics Competition:** Teams of high school-aged youth design and build robots that compete with other teams to complete a set of prescribed tasks. All of the FIRST programs reach over 400,000 students per year.
- **Lemelson-MIT InvenTeams:** InvenTeams are teams of high school students, teachers, and mentors that receive grants up to $10,000 each to invent technological solutions to real-world problems.
- **National FFA Organization:** Twenty-four career development events and one activity cover job skills in everything from communications to mechanics. Some events allow students to compete as individuals, while others allow them to compete in teams.
- **SAE International:** Baja SAE® consists of competitions that simulate real-world engineering design projects and their related challenges. Engineering students are tasked to design and build an off-road vehicle that will survive the severe punishment of rough terrain.

Career-focused experiential learning may also come in the form of summer work, internships or fellowships for students. This allows the students to learn about company culture and not only observe what skills are needed to be a permanent employee but take the first step in learning these skills firsthand. By taking part in experiential learning, students improve technical skills and other skills like leadership, communication and confidence. Partnerships between companies and educational institutions should take place at all levels of education. Many of the existing partnerships focus on high school or college students but it is just as imperative to reach younger students to start engagement into STEM career fields through experiential learning early.

Section 8
What's Ahead for Employability Skills & Career-Focused Experiential Learning?

In this paper the Task Force has attempted to establish what are some important points, including that:

- Employability Skills, part of the STEM 2.0 framework, are an essential skill set for 21st century employees.
- Traditional educational systems have not focused sufficiently on these key skills.
- Career-focused experiential learning (CFEL) is a powerful mechanism to impart Employability Skills.
- Some exemplary CFEL programs exist today and should be looked at as potential models.
- A void exists in published research to find what CFEL programs work best.
- There is similar void in assessment and measurement of CFEL programs.

Many of the most effective CFEL programs are partnerships between industry and academia. A recently published book, **Advancing a Jobs-Driven Economy,** discusses a number of innovative approaches, but these are just a few of what should be a much more widespread implementation of CFEL programs. The SITF agenda will include imploring both educators and companies to work more closely in the deployment of many more CFEL opportunities for students at all levels.

The SITF has taken a logical approach to define and refine the STEM 2.0 model. The approach has started with baseline assumptions in which interviews, roundtables and independent research were used to adjust and validate. The SITF then explored where the findings led us and have seen both exemplary work in some areas and gaps in others. It is the hope of the SITF, that this publication will help accelerate the good work taking place, compel additional organizations to make investments aligned with these findings, and finally to encourage researchers to explore the gaps identified and to publish their results. The accomplishments to date demonstrate that the resulting outcomes will be significant.

Looking at the STEM job gap from a wider lens, the education system needs to focus on teaching students' knowledge and skills that will be relevant for today's job market. The hope is that this paper will provide insight to educators about what students need to learn in order to not only land their first job, but also have a successful career. Finally, the authors recommend that more partnerships are needed between employers and educators, as these appear to lead to the most impactful CFEL programs.

Recommendations

- Employability Skills are an essential skill set for success in STEM careers and should get explicit focus from cultivators of STEM talent.
- An actionable employability skills framework includes skills, definitions, curriculum, assessments, career alignments, validation and EEOC compliance.
- Career-focused Experiential Learning is a method to impart these skills and should be included in student's educational experience at all learning levels starting in elementary schools.
- Educators and researchers are encouraged to publish more empirical data on what works and what doesn't regarding CFEL methods.
- Work must be done on research related to the measurement and assessment of CFEL effectiveness. This research will help to shape future programs.
- Educators and organizations that teach these skills are encouraged to continue to focus and prioritize Employability Skills in curriculum, degrees and programs

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Notes

STEM Innovation Task Force Members
(As of July 2015)