Accessing Math and Science for Workforce Development

Constituents

Industry is calling for more students to be proficient in the areas of science, technology, engineering, and mathematics (STEM), while also possessing the abilities to problem solve, to use good communication skills, and to be able to work as a team for innovation and competitiveness. The Industry is focusing on partnerships with P-20 institutions, understanding the current education systems, and developing opportunities for teachers and students to be exposed to the myriad of jobs inside their industry. Workforce Development Councils and Centers are connecting with traditional education systems to align their programs, assessments, and content. Concurrently, universities and 4-year colleges are focusing on developing more resources for students in early math and science courses, finding ways to partner with industry to provide well-rounded and relevant experiential learning, and creating STEM related centers to elevate funding for STEM related projects. Technical and Community colleges are aligning themselves with industry sectors and providing specialized programs for students. And, P-12 is looking at how to articulate math and science across grade levels, understand what is important for workforce development, and reach out to higher education and industry for partnerships that can provide students with more experiences and thus more choices. Finally, Pre-Collegiate Service Providers such as GEAR UP and the TRiO programs are focusing on STEM priorities; and Community-Based Youth Service Non-Profit Organizations are ramping up educational content

All of these institutions are trying to raise the bar by understanding what is going to be required of students for the next workforce generation. None of these institutions can do it by themselves and none can be expected to. But, together they can ensure that every student has more than just a general awareness of STEM disciplines and that their knowledge base is relevant and meaningful to the current economic climate.

Students

We know that there are different types of students and that not all students will enter STEM fields or work in STEM related occupations. However, all students need to have knowledge about math, science, and

technology in order to serve as citizens who will have to make critical decisions for their community related to issues that are deeply rooted in this content (i.e. medical research, alternative fuels, global warming, and security). For those students who fall in love with math, science, engineering, or technology, we need to provide them the resources they need to stick with it, to not give up, and to be able to accomplish what they set out to accomplish. And finally, for those students who are proficient and/or enjoy math and science but have not thought about careers in these areas, we need to expose them to the possibilities.

STEM Related Workforce Opportunities

In Figure 1, we see that the workforce is made up of a variety of career clusters including: technical workforce, education workforce, professional technical workforce, research in both the private and public sectors, and business management or operations. The technical workforce includes operators and/or technicians that primarily come from community colleges/technical colleges and have been trained for specific industries or specialized jobs. The education workforce is comprised of teachers across the P-20 continuum that teach math and science related disciplines. The professional technical workforce included engineers, architects, mathematicians, scientists, and computer scientists that have degrees from 4-year colleges and universities. Researchers are typically those with doctoral degrees working for industry, university, or government laboratories. Business management includes those that typically move from math and science careers to become managers, sales associates, and others that run businesses while using their math and science knowledge to expand innovation in the marketplace.

The P-20 Education System

The system that provides educational services and opportunities to students is fragmented and diverse with few incentives for collaboration and little sources of feedback. The P-20 Education system includes both formal education providers that are publicly and privately funded (i.e. ECE, K-12 schools/districts, colleges and universities and Adult Learning programs), and informal education providers which include museums, laboratories, local businesses, and non-profit organizations. The structure and access to components of this system varies by region. Sources of fragmentation include separate funding streams, separate governance structures, and funding mechanisms that encourage competition for students. Collaboration between sectors is driven by local networks which

create systems that can meet the local needs, but conversely are inconsistent and unsystematic.

Access Points

In order for students to move along the education continuum to workforce opportunities or to become knowledgeable citizens, there are a number of conditions that need to be in place. As displayed in Figure 1, they are called "Access Points". They include: quality teachers, experience, challenging courses, informal and extracurricular activities, viable social environments that promote math and science education, technological resources and materials, and scholarships and funding. These access points might come from a variety of sources, but they need to be in place in order for students to excel and be prepared for tomorrow's workforce.

Quality Teachers

The No Child Left Behind Act of 2001 called for highly qualified teachers. In the State of Colorado, that meant 24 credit hours in a teacher content area or passing the PRAXIS test. However, being highly qualified does not necessarily mean being high quality. Teachers need both content and pedagogical content knowledge to be effective in the classroom. In addition, teachers also need to understand the workforce opportunities that exist for their students and how that in turn changes what they teach and how they teach it. Pre-service educators and staff developers need to keep this in mind as they make decisions about what teachers need to know. All teachers cannot know everything, but isolation from the workforce and dependence on standards and high-stakes test questions may not help prepare students for the future. If the best quality possible is expected, teachers need to have available resources to provide experiential learning, challenging/innovative courses, and technology resources for students. Finally, those that hire teachers need to incorporate feedback systems and tools to support excellence in teaching.

Experiential Learning

The classroom cannot be the only place that learning takes place. Young students need to visit and experience industry venues so that they can learn more about what people do and how they use math and science in their jobs. For instance, elementary students often have a day where they "go to work" with an adult; learning about what adults in the math and/or science fields actually use in their work should be a critical component. Older students need to participate in shadowing programs and

field trips with a similar purpose. High school students need internships that develop vast understanding of what people do and how they use their skills. And finally, teachers themselves need "externship" opportunities to stay current with industry developments and needs. These experiences need to be rich, varied, well-thought out, and made relevant to what students are learning in school.

Challenging Courses

Accelerated courses, such as Dual Credit, Advanced Placement, International Baccalaureate, Magnet Programs, and Early/Middle College, are all programs provided to the best and brightest to ensure that they are prepared to excel academically. While this is a good start, *all* students need to have access to challenging courses that are problem-based, involve real-world decision-making, are relevant to the student's life and community, and are rigorous enough to ensure deep understanding of the theories, concepts, and knowledge base.

Informal and Extracurricular Activities

Museums, zoos, government organizations, and other informal education organizations play a significant role in providing educational programs to students of all ages. They are designed to support public schools and can often provide materials and experiences the schools cannot. More and more summer camp opportunities are being developed that support math and science learning in new and different ways. After-school programs, day care, and summer camp programs need to find ways to enhance student learning in the areas of math and science. In Colorado, there are a number of summer camps, during-school programs, and after-school programs designed with this purpose in mind. They need constant support and recognition to enhance their activities and include more students.

Social Environments that Promote STEM

Possibly the most important of all access points, students need social environments that promote STEM education. All adults that interact with students need to ensure that students have access to knowledge and experiences that will allow them to view math and science as something that they can learn and ultimately use as a tool to attain jobs and pursue STEM careers. It is never too early for students and their parents to explore career interests and opportunities. Colorado continues to lack a comprehensive system to encourage and permit students to explore and pursue their career interests from middle school on into the workforce.

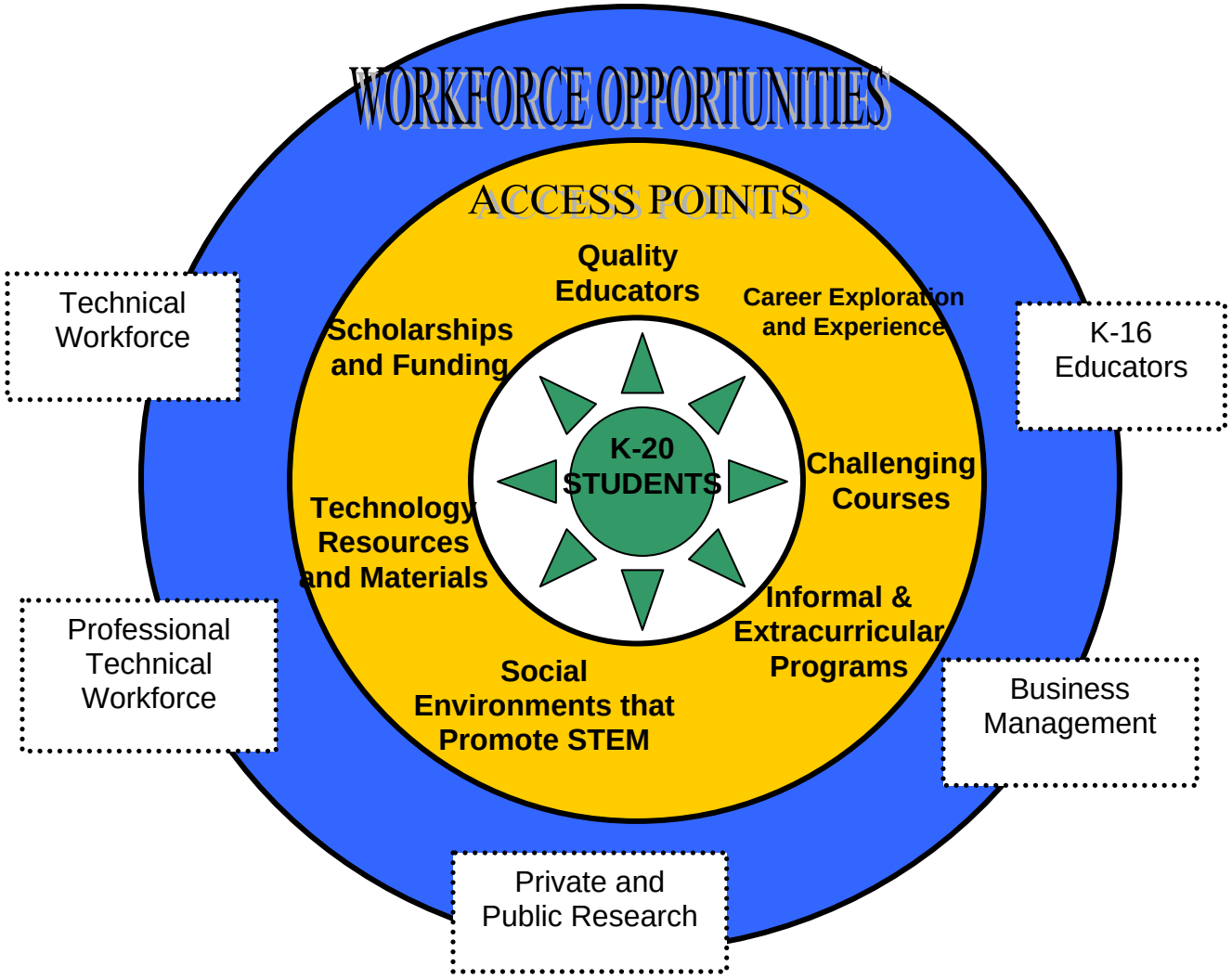
Technology Resources and Materials

Computers, microscopes, lab equipment, graphing calculators, and process technology are among the technology resources and materials that students need exposure to in order to be successful. Technology is changing quickly and schools need up-to-date technology so the students can be exposed to all the possibilities.

Scholarships and Funding

Funding—a common cry in education at all levels. All students need to be able to avail themselves of informal and extracurricular activities, the accessibility to the best teachers, and the availability of cutting edge educational innovation. Also, students must be able to understand how they will be able to pay for post-secondary education. State funding systems can incentivize competition rather than collaboration and provide little seed funding to develop new and innovative practices or programs. Both the public and private sectors need to understand what is needed and establish policy to meet those needs.

Figure 1: Access to Math and Science


WORKFORCE OPPORTUNITIES
ACCESS POINTS
Quality Educators
Career Exploration and Experience
Scholarships and Funding
K-20 STUDENTS
Challenging Courses
Technology Resources and Materials
Informal & Extracurricular Programs
Social Environments that Promote STEM
Technical Workforce
K-16 Educators
Professional Technical Workforce
Business Management
Private and Public Research