Workforce Development and Training Issues

Testimony to the
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Issues

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“America’s human resources are the basis of our innovation capabilities and these underpin our economic strength and national security.” (Rep. Bart Gordon (D-TN), Roundtable on the Science and Technology Workforce, June 23, 2005)

Workforce training and education is truly an economic development activity, however, it is complicated by the rapid rate of change of science and technology. Coupling this rate of change with the increasingly complex nature of emerging science and technology calls for a new paradigm for educating and training the science and technology workforce. Today, technologies, like nanotechnology, are so ubiquitous, cutting across many markets with so many applications in a variety of disciplines from energy and medicine to global interoperability. These technologies allow humans the ability to manipulate matter on-demand, instantaneously changing products, services, markets, jobs and supply chains as we know them today. Because of the highly integrative and interrelated nature of these sciences and technologies, traditional education and training methodologies are no longer appropriate to prepare tomorrow’s workforce.

Two critical questions need to be resolved to address this dilemma: (1) What will it take for Virginia to maintain global leadership in discovery and innovation in a time of rising international competition in global science and technology enterprise? (2) How can education and training keep pace with the rapid change in science and technology? This paradigm shift will call for a greater collaboration and partnership between educational institutions, business and industry and government. The result will be a more responsive and flexible science and technology training and education infrastructure. Yes, we will still need to prepare traditional scientists, technologists, technicians, and engineers, but ones that have a greater understanding of how science and technology intersect and interact with each other in different environments. This new breed of science and technology workforce must also develop soft skills and an entrepreneurial spirit.

**National Trends**

Numerous studies have projected science and technology trends that impact the way that future workers need to be educated and trained (National Science and Technology Council, 2004, Electronic Industries Alliance, 2004, Spherion, 2003, National Science Board, 2003 & U.S. Department of Commerce, 2003). All reports call for a comprehensive cradle to grave approach to educating and training tomorrow’s science and technology workforce. The reports also acknowledge that the nature of emerging science and technology will demand a more creative and flexible approach to education and training.

For example, the National Science and Technology Council’s report, *The National Nanotechnology Initiative*, identified eight cross-cutting areas (aerospace, agriculture and food, national defense and homeland security, energy, environmental improvement, information technologies, medicine and health, and transportation and civil infrastructure) of nanotechnology which all have seven common program components. These seven common program components are necessary in order to properly train and
educate future nanotechnologists: (1) fundamental nanoscale phenomena and processes, (2) nanomaterials, (3) nanoscale devices and systems, (4) instrumentation research, metrology, and standards for nanotechnology, (5) nanomanufacturing, (6) major research facilities and instrumentation acquisition, and (7) societal dimensions. Whether one works in the nano-world of brain-machine interfaces, RFID, microphotronics, microfluidics, or robot design these core program components provide the foundation for the learning process. These cross-cutting or integrative relationships are also very evident in most emerging technologies and all require a good working knowledge of the societal dimensions of science and technology. While biologists, chemists, engineers and the like will always be necessary, others, who not only possess a technical know-how but also have the ability to create, analyze, and transform information and to interact effectively with others are needed to fully develop these emerging sciences and technologies. Therefore, new learning environments and curriculum experiences need to be created to best facilitate the learning process. These new learning environments are especially important to providing necessary credential and certification training created by the implementation of a new science or technology.

In order to better understand this impact and need for new training and education strategies and environments, it is important to understand the trends that are driving key areas of science and technology.

Top Ten Nanotech Trends for the 21st Century

1. Nanotech enterprises will provide the ultimate convergence of computers, networks, and biotech, and create products never before even imagined.
2. Nano-devices-invisible, intelligent, and powerful-will be used in every industry redefining the limits of what's possible.
3. Nanotech food compilers will create on-demand, low-cost, quality meals by assembling atoms into food.
4. Smaller than the head of a pin, surgical nanobots will operate from within the human body.
5. Nano-biology will prolong life, prevent illness, and increase people's health.
6. Nano-enhanced humans will have physical, intellectual, and sensing powers superior to other humans.
7. Nanotech will provide a cheap and available source of energy.
8. Nano-factories will build on-demand products in an inexpensive, flexible, and rapid process.
9. Nanotech will revolutionize the global economy, providing Power Tools that will produce high-tech products with low-cost and low-tech resources.
10. Nanotech will create new choices that will alter human evolution, raise dramatic ethical issues, and challenge social norms (Canton, 2005).

Similarly, the health care industry provides credence for the need to provide a more integrative education and training process. Like the nanotechnology trends, health care trends will demand a more cross-disciplinary knowledge.
Top Ten Health-Care Trends for the 21st Century

1. Most hospitals, clinics, trauma centers, physicians, and patients will be connected to one large network enabling access to critical medical information.

2. Consumer health information, accessible over a variety of Net channels, will become the most in-demand content worldwide.

3. The medical industry will face an ethical and social dilemma over the disclosure of patient information.

4. Health-care professionals, available via remote Internet connections, will provide services to millions of people who were previously under-served.

5. Medicalbots, nonhuman intelligence agents, will dispense medical care to patients and doctors worldwide to save money and share expertise.

6. Advanced nano-biology and genetic technology will eliminate many diseases, accelerate healing, and increase longevity.

7. Bio-engineered food will help promote health and longevity.

8. A new generation of smart drugs, implants, and medical devices will enhance our health and performance.

9. Virtual-reality medical simulations will become the dominant mode of medical training.

10. Cyber-health care that is customized for us—designed to monitor, diagnose, educate, and intervene regardless of location or time—will be common (Canton, 2005).

Tomorrow’s Workforce

The composition of tomorrow’s workforce is drastically changing and will create new challenges for science and technology workforce training and education. Unless action is taken immediately the pool of qualified science and technology workers will continue to shrink due to off-shoring or lack of people studying or entering science and technology fields. The 77 million boomers eligible for retirement greatly out number younger workers available to replace them. Workers from 25 to 40 years old will decline by 1.7 million by 2008 (Hudson Institute). During the same period of time the replacement pool of 35 to 44 year olds will decline by 15 percent during the same period (U.S. Bureau of Labor Statistics). Unlike workers of the industrial age, tomorrow’s workers will switch jobs, careers and companies frequently. Thirty-nine percent of the workforce now has worked for six or more employers, up from 27 percent in 1999 (Spherion's 2003 Emerging Workforce Study). Forty-five percent of workers want to change jobs at least every three to five years, up from 26 percent in 1999 (Spherion's 2003 Emerging Workforce Study). Fifty-one percent of U.S. workers are extremely likely or very likely to look for a new job or work situation (Spherion's 2003 Emerging Workforce Study). Further compounding future workforce education and training will be the large number of military personnel returning to the civilian workforce.

Therefore, science and technology education and training must be made attractive to the K-12, university, and military generation that grew up with computer games. At the same time it must be adaptive and flexible enough to train and educate low skilled adults.
Education and training must be provided where people work and learn. New compressed formats for learning need to be created that reduce the amount of time the learner spends in instruction, but provide the learner the same content only in a more robust environment. This format could be in traditional laboratories and classrooms, in business and industry through internships, in the home, or virtually anywhere through wireless environments. One such learning environment is that provides an ideal solution for educating and training tomorrow’s workforce is practice-oriented educational environments.

**Practice-Oriented Educational Environments**

The goal of practice-oriented educational environments is to produce educated knowledge workers, people who are equipped not simply with technical know-how but also with the ability to create, analyze, and transform information and to interact effectively with others (Greenspan, 2000). Practice-oriented educational environments align well with integrative curricula, curricula that must remain fluid so that it can be reconfigured as science and technology and the learner’s needs change. It is this approach to training and education that can address national critical needs faster and in a more comprehensive way. College is designed as an alternative to the traditional university curriculum for students needing or desiring an affordable third-way academic program. Its emphasis on practice-oriented learning offers students a contemporary education in select scientific and technical fields, along with development of the personal and professional skills necessary for succeeding in business and industry, and it does so without sacrificing an understanding of the liberal arts and sciences. The key to practice-oriented educational environments is that it is learner-centric, custom designed for the individual learner. It also works best in compressed time frames, usually allowing for learners to complete a four-year degree in two and one-half years. Four key successfully tested educational methods drive this approach: (1) an integrative and applied curriculum, (2) web-enhanced and other electronic or e-learning technologies, (3) competency-based assessment, and (4) instruction in collaborative and individual professional and personal skills.

Education and training are custom designed for the individual learner using the following guidelines.

1. Electronic education via the Net enables interconnected learning experiences, choices, and opportunities regardless of location.
2. Educational content will be delivered by new computer, interactive TV, satellite, and Internet technologies using interactive online multimedia and multidimensional content.
3. On-demand virtual learning will be self-paced, self-directed, and individualized.
4. Virtual Reality scenarios that depict real-world and fantasy experiences will increase the learning impact for all types of education.
5. Real-time Net chats with other global learners will make virtual education a satisfying social experience beyond the limits of time and distance.
6. Teachbots-smart agents-will transform education, providing personalized guidance when and where people need it (Canton, 2005).
Harrisonburg Downtown Technology Zone/Harrisonburg Innovation Center

The Harrisonburg Innovation Center (HIC) is the first technology innovation center in the City of Harrisonburg’s newly created Harrisonburg Downtown Technology Zone (HDTZ). Located two hours from Washington, D.C. and ideal for federal contractor relocation and technology development, the HIC is a “self-networking” environment that integrates intellectual capital with technology to develop health and security solutions for corporate and national well-being. The HIC provides client-members unprecedented support through their highly developed philosophy and model that networks client-members, provides contracting and research vehicles, helps grow client-members through business assistance seminars and workshops and provides a “world class” and secure technology infrastructure.

This collaboration between the City of Harrisonburg and James Madison University (JMU) germinated in the university through student research and was embraced by the City as a means to grow jobs and provide a new economy, one based on technology. The HIC employs a highly sophisticated network model that includes a three-tier incentive package; access to university faculty, student interns, and resources; business assistance and mentoring; funding vehicles; and an advanced technology infrastructure with multiple backups. Key for client-members is their access to over 4000 university graduates a year.

Because of this partnership between the City of Harrisonburg and JMU, HIC client-members and their employees have access to customized education and training, designed specifically for their needs. University students have the opportunity to work as interns for client-members and serve as part of collaborative research teams. Class projects are also integrated with the work product of the client-members.

In addition to these educational and training opportunities, the City of Harrisonburg and HIC are working with JMU students and faculty to create a biodiesel and alternative fuels research and production facility. This facility, like the HIC, will provide students with real-world educational experiences that will supplement their traditional university experience.

Recently, the City of Harrisonburg, through the HIC, helped facilitate a collaborative between JMU, Visual Link of Winchester and Harrisonburg City Public Schools to establish a program, No Child Left Offline, to provide elementary school children who are on the free or reduced lunch program with computers. This initiative was started as a means to open young minds, which traditionally would never have home access to a computer or the Internet, to the world of the Internet and computing. This program is a way to educate young students beyond the doors of their school, and hopefully get them interested in science and technology at an earlier age.

Synergistic Strategies for Success
In order for training and education to be successful, key synergistic strategies must be in place. These synergistic strategies are:

1. Integrating institutional structures and services - Establish links among programs and create pathways that students can navigate to gain necessary skills, credentials and certifications.
2. Accelerating learning - Help students learn more, learn faster, and complete programs more quickly.
3. Provide labor market payoffs - Help students gain credentials valued by employers, get a first or better job, and advance up career ladders as they gain skills and credentials.
4. Providing comprehensive supports - Provide compelling motivators and support systems to help students persist through difficult transition points.

Conclusions

Education and training is a cradle to grave process. With the rapid changes and complex nature of emerging science and technology, new paradigms must to be created at all levels of education and training that better meet the needs of the individual learner. Innovative uses of educational technologies and delivery formats need to be utilized in order to provide real world, integrative learning experiences. Compressed timeframes should also be used that incorporate practice-oriented educational environments. Special emphasis should be placed on how to continually provide training and education in national critical needs, especially when special credentials or certifications are necessary. After all, a well trained workforce is the essential ingredient to maintain a competitive advantage in a global economy and provide for a strong national security.
References


