



# FEDERATION OF AMERICAN SCIENTISTS

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## Testimony

**Presented by  
Dr. Henry Kelly  
President**

**Federation of American Scientists**

**United States Senate  
Subcommittee on Technology, Innovation and Competitiveness  
Hearing On  
Fostering Innovation in Math and Science Education  
April 26, 2006**

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## **Statement for the Record**

Henry Kelly, President, Federation of American Scientists

The Federation of American Scientists is proud to have been among the organizations listed as endorsing the National Innovation Act (S. 2109) when it was introduced on December 15<sup>th</sup> last year. We strongly support the goals of the legislation and the actions proposed to support them. As the legislation is discussed and refined during the next few months we strongly urge you to consider adding provisions that would stimulate innovation in the institutions that provide education and training services. Specifically, we urge you to consider the provisions of the Digital Opportunity Investment Trust Act (S. 1023) as essential elements of national innovation.

The National Innovation Act finds that “In the 21st century, a well-educated and trained workforce, investment in research and development, and a regulatory and physical infrastructure that supports innovators are essential to ensuring that the United States continues to lead the global economy on innovation.” We argue that the strategy of investing in research and development to improve education and providing a regulatory environment and infrastructure that encourage use of new technology and new learning science should also be applied to education and training.

## **The Challenge**

Innovation in education and training services is essential for a number of reasons. The most important has already been stated: America’s ability to stay ahead of increasingly sophisticated international competitors depends on a workforce that has high levels of skill and can constantly learn and adapt to rapid change. This observation is at the core of assessments of the U.S. economy conducted by a large and diverse group of organizations over the past few years.<sup>i</sup>

An economy based on innovation places increasing value on education; studies continue to show that returns to investments in education continue to increase.<sup>ii</sup> Among other things, this means that the benefits of innovation can only be shared widely in our economy if all Americans are able to receive a high quality education. Pay is increasingly linked to an ability to perform challenging tasks – at virtually all levels of the organization. In his statement introducing S. 2109 Senator Lieberman pointed out that “The number of jobs that require technical training is increasing at five times the rate of other occupations.”

Sales workers may operate with sophisticated information systems to tailor products to the needs of individual customers, truck drivers wrestle with new communication and location systems, car repair technicians operate computer diagnostic equipment. A recent Department of Commerce study<sup>iii</sup> found, however, that companies are most interested in skills such as the following:

- Interpersonal skills
- Adaptation to rapid change
- Team building
- Decision-making
- Learning on the fly
- Strategic thinking
- Rapid information acquisition
- Information synthesis
- Analytical thinking
- Problem definition
- Solution development

- Plan development/execution
- Multiple-task prioritization
- Creativity
- Negotiating and influencing
- Focus on customer
- Ability to assess time, cost, and resources required

These sophisticated skills are often not provided by existing education and training programs. The challenge is even more daunting given the enormous diversity of the U.S. population. This is a large challenge for school systems that must meet the needs of students entering the system with a wide range of backgrounds – including large numbers of immigrants. But the need to continuously upgrade the skills of the diverse group people now in the workforce presents an even greater challenge.

While the importance of improving the performance of education and training is clear, serious doubts have been raised about the ability of the US system to meet the demand. In fact, the productivity of educational institutions is actually declining.<sup>iv</sup> One result is that post-secondary tuition has risen much faster than the general inflation rate for decades. This lack of improvement increases concern that our system of education and training may not be able to meet growing demands for high quality education and training services. But it would also be a concern simply because the institutions providing education and training services are a large part of the U.S. economy -- we spend about \$1 billion a year on education and training at all levels.

### **The Response**

It seems highly unlikely that the enormous education and training challenges faced by the United States can be overcome by relying exclusively on traditional approaches – if only because the cost would be enormous. There is, however, growing evidence that, using methods that have led to large gains in the productivity of other U.S. service industries, education and training institutions can make major gains in the rate at which people learn. The core of this strategy, of course, lies in innovation.

The National Innovation Initiative, led by the Council on Competitiveness which called attention to the problems addressed in S. 2109, points out that each generation must develop its own response to the challenge of innovation: “To thrive in this new world, it will not be enough – indeed, it will be counterproductive – simply to intensify current stimuli, policies, management strategies and to make incremental improvements to organizational structures and curricula.”<sup>v</sup>

There is no reason why the institutions providing education and training services should be exempt from this logic. Advances in learning science achieved over the past few decades point to much more productive ways of developing complex expertise in highly diverse groups of learners. Advances in information technology have made it possible to implement these suggestions in a way that is affordable. Our focus should be development of new learning systems that can make the process of learning much more compelling through use of simulations and other information technologies that directly connect the power of new ideas to the power to achieve goals that are meaningful to the students. These learning systems can tailor instruction to the background of each student and the rate at which they demonstrate expertise. Just as a well designed computer game continuously measures the player’s ability in order to determine whether they are ready to advance, a modern instructional system can continuously monitor a student’s progress in ways that make complete sense to the student, the instructor, parents, and future employers.

We know that progress is possible because of the way similar tools have been used in other service sector industries: powerful simulations and visualization tools are used in computer games and movies, sophisticated help systems provide accurate answers to questions using a combination of artificial intelligence and live operators, websites undertake continuous evaluations of the people who use them – often tailoring offerings to interests and preferences revealed by the user: “viewers who liked this movie also liked.” The Department of Defense is making major investments in new learning technologies and proving success in a wide range of areas: flight simulators and other equipment simulators, leadership training, language instruction, team training, and many others.

Most education and training institutions outside the Defense Department have been slow to adopt innovations, in spite of increased pressure for performance improvement. The way instruction is organized and provided today has remained fundamentally unchanged for the past one hundred years—a low-productivity, high-cost mass production model that would not be competitive in any other industry today. As with other industries, investments in research and innovation are needed to take advantage of highly promising opportunities to improve productivity and the quality of services delivered to customers. Unfortunately, the U.S. education sector is simply not managed in a way that allows the kind of long-term investment in research and innovation that has transformed other service institutions. A variety of barriers discourage education and training service organizations from making the necessary R&D investments. These failures define a need for a major program of federal research, development, and demonstration as proposed in the DO IT legislation.

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<sup>i</sup> *Innovate America*, The Council on Competitiveness, 2005; *Rising Above the Gathering Storm*, the National Academy of Science, 2005; *TechNet Innovation Initiative*, TechNet; *Losing Competitive Advantage*, American Electronics Association; *Technology Industry at an Innovation Crossroads*, Electronics Industry Alliance; *Tapping America's Potential*, Business Roundtable; *Computational Science: Ensuring America's Competitiveness*, President's Information Technology Advisory Committee; *Sustaining the Nation's Innovation Ecosystems*, President's Council of Advisors on Science and Technology; *Choose to Compete*, Computer Systems Policy Project.

<sup>ii</sup> See for example “Investment in Education: Private and Public Returns”, Joint Economic Committee, 2000.

<sup>iii</sup> U.S. Department of Commerce, June 2003.

<sup>iv</sup> Productivity in Education and the Growing Gap with Service Industries, Barry Bosworth, The Internet and the University: Forum 2004.

<sup>v</sup> National Innovation Initiative Summit, Council on Competitiveness, 2006