



# Winning the Education Future

## *The Role of ARPA-ED*

*"[I]f we want to win the future – if we want innovation to produce jobs in America and not overseas – then we also have to win the race to educate our kids."*

- President Barack Obama, State of the Union Address, January 25, 2011

At the center of the President's strategy to "win the future" is the intersection of education, innovation and infrastructure. The growth industries of today and tomorrow require a workforce with unprecedented knowledge and skills and greatly improved adaptability. By aggressively pursuing new and better ways to educate and train our citizens, we can meet those requirements, leapfrog other nations, and reclaim global leadership in education. To achieve this, the United States must out-innovate the competition – competition that is already outperforming the United States and has clear national direction.

Closing the gap between the potential of learning science and technology to improve student performance and its current real-world impact can transform American education. The information technology (IT) revolution has catalyzed new capabilities and increased productivity in numerous sectors, yet it has not done the same for education. Technology, considered a "force multiplier" by the military, has also dramatically increased the impact and efficiency of doctors, pilots, engineers, and many others, and it should do the same for educators. Educational technology has the capacity to empower Americans, of all ages and backgrounds, living in rural America or urban America, to become true lifelong learners, enabling them to obtain, keep, and create the jobs of the future.

To address the under-investment in learning technology R&D, the President's FY2012 budget proposes to invest \$90 million to create an Advanced Research Projects Agency for Education (ARPA-ED). ARPA-ED will fund projects performed by industry, universities, or other innovative organizations, selected based on their potential to create a dramatic breakthrough in learning and teaching.

ARPA-ED will aggressively pursue technological breakthroughs that have the potential to transform teaching and learning the way the Internet, GPS, and robotics (all areas where the Defense Advanced Research Projects Agency, or DARPA, has had a profound impact) have transformed commerce, travel, warfare and the way we live our daily lives. ARPA-ED will

complement and build upon innovative work being done across the public and private sectors, and could catalyze development of:

- **Digital tutors as effective as personal tutors.** Researchers have long aspired to develop educational software that is as effective as a personal tutor, one of the “grand challenges” in the President’s innovation strategy. DARPA and the Navy have supported the development of a “digital tutor” to train new Navy recruits to become IT systems administrators. After using the digital tutor for only seven weeks, Navy recruits are dramatically outperforming their peers who are receiving traditional classroom-based instruction and have the level of expertise of an IT specialist with three years of experience. These early results from the DARPA project show the promise of additional investment in this area.
- **Courses that improve the more students use them.** Internet companies like Netflix and Amazon have devoted significant resources to develop tools that analyze consumer data to identify patterns, tailor results to users’ preferences, and provide a more individualized experience. Researchers are exploring whether similar techniques can be applied to education. For example, after developing software to teach fractions, researchers could study the learning patterns of how tens of thousands of students mastered different concepts. This “virtual learning laboratory” could draw on this data when presented with new users – taking what it knows about how students learn to tailor material based on how similar individuals successfully mastered those same concepts. The data collected by such software could also provide powerful new insights for practitioners about ways to guide traditional classroom instruction.
- **Educational software as compelling as the best videogame.** A well-designed game can keep players engaged for hours by becoming progressively more difficult without being impossible, and requiring complex collaborations in multi-player games. The insights from great game designers can and should be applied to develop rich and compelling learning environments for students.

The traditional under-investment in catalyzing developments in educational technology creates a huge opportunity for improving education in this country and underscores the President’s overall message to win the future through “out-innovating, out-building, and out-educating” the world.

Investment in this area also promises impact beyond the K-12 and university learning opportunities. A well-educated populace will be prepared to secure the quality jobs of the future. Education technologies that significantly accelerate the pace of learning will help address the challenge of retraining displaced workers as their companies and industries evolve.

American ingenuity, technology leadership, and entrepreneurship can help the United States lead a field that can be a growing export market.

The President intends to position ARPA-ED to succeed from the start. ARPA-ED has the opportunity to learn from the expertise of DARPA and the Advanced Research Projects Agency - Energy (ARPA-E) in order to make rapid progress. ARPA-ED builds on recent major reform efforts in education and the basic and applied research of other federal agencies such as the Institute of Education Sciences, the National Science Foundation, and DARPA. And a federal focus on learning technologies as an area of national priority, described in the President's *Strategy for American Innovation*, will help ensure that demand exists for innovators bold enough to pursue transformative improvement.

## Background

*“Being average in reading and science – and below average in math – is not nearly good enough in a knowledge economy where scientific and technological literacy is so central to sustaining innovation and international competitiveness.”*

- Arne Duncan, Secretary of Education, on the results of the Program for International Student Assessment December 7, 2010

ARPA-ED will address critical national needs. It will help America regain its standing as the world leader in education by supporting the development of game changing educational technologies. It will fill a gap in the existing infrastructure for education research and development by establishing an organization focused on directed development. It will help drive economic growth by establishing American leadership in a new global growth sector.

### *We need to improve learning outcomes*

An educated workforce is necessary for our economic competitiveness, so we must ensure that our students develop the skills and knowledge they need to create the new ideas, new industries, and new jobs that will drive the country’s economy. America has many of the best schools in the world, but studies continue to show that the United States needs to make dramatic improvements in learning outcomes to ensure our future competitiveness:

- On the 2009 National Assessment of Educational Progress exams, only 30% of 8<sup>th</sup> graders and 21% of 12<sup>th</sup> graders scored proficient or higher in science.<sup>1</sup>
- In the 2009 Program for International Student Assessment, the U.S. ranked 14<sup>th</sup> in reading, 17<sup>th</sup> in science, and 25<sup>th</sup> in math.<sup>2</sup>
- Graduating roughly 75% of our students from high school, America ranks below the average of the Organisation for Economic Co-operation and Development (OECD) and behind 16 other OECD countries.<sup>3</sup>
- Despite having the best colleges in the world, America has relinquished its lead and fallen to ninth in the proportion of young people with a college degree.

**Performance improvement in education has lagged behind other sectors.** Between 1970 and 2000, productivity in education declined by nearly half.<sup>4</sup> Today, the United States spends

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<sup>1</sup> National Assessment of Educational Progress, “Summary of Major Findings,” *The Nation’s Report Card*, available at [http://nationsreportcard.gov/science\\_2009/summary.asp](http://nationsreportcard.gov/science_2009/summary.asp).

<sup>2</sup> Angel Gurría, Remarks at the Presentation of the PISA 2010 Results, Dec. 7, 2010, available at [http://www.oecd.org/document/7/0,3746,en\\_21571361\\_44315115\\_46635719\\_1\\_1\\_1\\_1,00.html](http://www.oecd.org/document/7/0,3746,en_21571361_44315115_46635719_1_1_1_1,00.html).

<sup>3</sup> “Science and Engineering Indicators: 2010,” The National Science Board (2010) at 1-36, available at <http://www.nsf.gov/statistics/seind10/pdf/c01.pdf>.

more than nearly all peer countries for the mediocre performance we achieve on international assessments such as the Program for International Student Assessment.<sup>5</sup>

The Administration recognizes, however, that performance on standardized tests is not and must not be the only way in which we measure the success of our education system. Developing soft skills and nurturing passion for learning is equally important in preparing every student for lifelong success and preparing the next generation of creators, builders, and entrepreneurs. Investments in educational technology can help eliminate the false choice between educating the most technically proficient citizens and inspiring interest and creativity.

*“The future is ours to win. But to get there, we can't just stand still. As Robert Kennedy told us, ‘The future is not a gift. It is an achievement.’ Sustaining the American Dream has never been about standing pat. It has required each generation to sacrifice, and struggle, and meet the demands of a new age.”*

- President Barack Obama, State of the Union Address, January 25, 2011

### *We need more education R&D*

If a scientist went to sleep in 1950 and woke up today, she would be dazzled by the new tools in her field. A doctor would be shocked by the novel devices in medicine. Yet, as former New York City Schools Chancellor Joel Klein has described, teachers still operate in a classroom full of children, often with only chalk and a chalkboard just as they did 60 years ago.<sup>6</sup> Despite the growing urgency to better position our students to succeed in a knowledge-based global economy, there is a lack of investment in research and development of the education tools that could help teachers provide extraordinary education to America's students *as the norm*.

**Because of limited R&D investment, the benefits of the IT revolution have largely passed education by.** Facebook and Twitter have shown us new ways of connecting, advances in biotechnology have enabled the National Institutes of Health to fund the sequencing of 1,800 complete genomes, and Amazon and E-bay have changed business models and created thousands of new businesses along the way. But there is simply not enough spending on research and development to produce similar breakthroughs in education. R&D accounts for

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<sup>4</sup> Caroline M. Hoxby, *Productivity in Education: The Quintessential Upstream Industry*, Southern Economic Journal, 71(2), 2004, pages 209-231 (measuring productivity as national percentile rank points of average scores on the National Assessment of Education Progress divided by average per pupil spending).

<sup>5</sup> Secretary Arne Duncan, Remarks at OECD's Release of the Program for International Student Assessment 2009 Results, ED.gov, Dec. 7, 2010, available at <http://www.ed.gov/news/speeches/secretary-arne-duncans-remarks-oecd-release-program-international-student-assessment->

<sup>6</sup> Joel Klein, former Chancellor of the New York City Department of Education, The Aspen Institute's Education Innovation Forum. <http://www.aspeninstitute.org/video/2011-education-innovation-forum-innovation-education-inspiration-implementation-transformation>.

only 0.2 percent of total national K-12 expenditures. Knowledge-intensive sectors of the economy invest 10-20 percent of sales in R&D, and even mature industries devote 2 percent of sales to R&D. Too little innovation has deprived teachers of the tools and strategies they need to provide all students the skills they must acquire. Innovations in other fields, however, promise to make a surge of innovation in education easier, as education entrepreneurs leverage the IT revolution already underway in other sectors.

*We need a mechanism for directed development in education*

There are three broad pathways to innovation in education: (1) Basic & Applied Research, (2) Field Scan/Field Innovation, and (3) Directed Development.

The federal government’s research and development process traditionally focuses on awarding grants to researchers through a competitive process, based on established priorities, to develop portfolios of **basic and applied research**. For

example, the Institute of Education Sciences has research and training programs that range from Early Childhood to Policy, Finance, and Systems. The projects that emerge from this pathway are well-suited for applied research and for contributing to knowledge that can influence policy and practice. Such basic and

applied research is also a critical foundation for innovation; basic research and development supported by the National Science Foundation, the Office of Naval Research, and the private sector, among others, led to the development and testing of such important innovations in learning technologies as Logo, Smalltalk, Squeak, and Scratch, as well as the theoretical cognitive modeling foundations of today’s cognitive tutors.

In a sector as large as education and learning, there are also myriad different efforts and approaches to improve student learning being tried at any given time. Inevitably, some will demonstrate significant promise while others will fail to meet existing needs. **Field scans** of efforts by practitioners and others throughout education can help identify and support the most successful, ideally resulting in the spread of effective ideas.

**Education Sector Lacks a Structure to Support “Directed Development” of Transformational Improvements**

| <u>Route to Innovation</u> | <u>Explanation</u>  | <u>Existing Structures</u>   |
|----------------------------|---|--|
| Field Scan                 | Identification of and support for promising projects that have been attempted in the field            | <ul style="list-style-type: none"> <li>Investing in Innovation</li> <li>Demonstration grants</li> <li>Communities of Practice</li> </ul> |
| Basic & Applied Research   | Broad portfolio of projects in range of focus areas to build knowledge and inform policy and practice | <ul style="list-style-type: none"> <li>IES research programs</li> <li>NSF</li> <li>NIH/NICHD</li> <li>Institutes of higher ed</li> </ul> |
| Directed Development       | Focused efforts to produce working solutions to <i>specific</i> problems and needs                    | ?  |

The Investing in Innovation Fund (i3) and other more narrowly-targeted demonstration grants, as well as structures such as communities of practice, embody this approach. i3 is especially noteworthy because of its explicit focus on evidence as a primary criterion for assessing what should be expanded, an emphasis previously absent in many education grant programs to the extent of i3, and in federal grant programs with the level of resources of i3.

Even the best existing practice in the sector, however, will not always keep pace with the significant advances in technology, cognitive research, and other fields. Advances in basic research may suggest game-changing approaches that could revolutionize both the effectiveness and productivity of approaches to learning. Further, some projects may demonstrate such promise that they merit support in a more aggressive and direct manner than either of the two approaches above allows, so a third approach is needed.

**Directed development** provides the ability to pursue a small number of high-impact projects, from concept through demonstration or prototyping. Directed development projects begin with a *specific end goal*, rather than the aim to increase broad areas of knowledge, and generally include a defined time period and path forward. Directed development focuses on advancing *beyond the state-of-the-art* such that the activities of the field are unlikely to produce the desired outcome in the prescribed time frame.

The education sector currently suffers from the lack of directed development. Directed development is a means to fund transformational or game-changing technology that the private sector alone cannot or will not support because of high risk, uncertain returns, or extended time horizons for completion. Federal support for public-private partnerships that are high-risk and high-return can play an important role in education, as it has in other areas:

- The Defense Advanced Research Project Agency (DARPA) was created in 1958, and has played a critical role in the development of a broad range of technologies, including the Internet, GPS, stealth aircraft, and night vision.
- The Advanced Research Project Agency - Energy (ARPA-E) has shown that the DARPA model can work outside of the defense industry, and has awarded nearly \$400 million since April 2009 to over 100 projects seeking fundamental breakthroughs in energy technology. ARPA-E also demonstrated the demand for such a funding mechanism in another field with limited R&D funding, receiving approximately 3,700 concept papers in response to its first solicitation.<sup>7</sup>

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<sup>7</sup> [ARPA-E, "ARPA-E Projects \(Current\)," http://arpa-e.energy.gov/About/FAQs/ARPAEProjectsCurrent.aspx](http://arpa-e.energy.gov/About/FAQs/ARPAEProjectsCurrent.aspx) (click on "How were these projects selected?").

## Transforming Teaching and Learning

*“Education is the key to America’s economic growth and prosperity and to our ability to compete in the global economy. It is the path to good jobs and higher earning power for Americans. It is necessary for our democracy to work.”*

- National Education Technology Plan 2010

The National Education Technology Plan 2010 called for “revolutionary” change through technology and noted the power of a DARPA-style approach to research.<sup>8</sup> In September of 2010, the President’s Council of Advisors on Science and Technology explicitly called for the creation of an ARPA-ED to help technology “play a transformative role in education.”<sup>9</sup> Others have recognized the power of technology in education, including Jeb Bush and Bob Wise, who in December 2010 wrote that educational technology could provide education that “maximizes every child’s potential for learning, prepares every child with the knowledge and skills to succeed in college and careers, and launches every child into the world with the ability to pursue his or her dreams.”<sup>10</sup>

Technology has the potential to support improved learning outcomes, empower and engage students through new approaches to education, and give teachers the tools they need to ensure each student receives a world-class education. The possibilities include:

- ✓ **Providing Highly Personalized Instruction.** Affordable, large-scale personalized instruction has long been an aspiration of the education system. Benjamin Bloom articulated the “two sigma problem” in 1984, showing that the average student taught

### Case Study:

In a recent study, DARPA compared students who trained to be Navy Information System Technicians, and found that those who had been trained by a new digital tutor outperformed traditionally-trained students by two standard deviations. In other words, the average student trained by the new digital tutor outperforms around 98 percent of students trained using traditional instruction.

Source: J. D. Fletcher (2011). DARPA Education Dominance Program: April 2010 and November 2010 Digital Tutor Assessments (NS D-4260). Alexandria, VA: Institute for Defense Analyses.

<sup>8</sup> U.S. Department of Education, *National Education Technology Plan 2010* at ix, 76, available at <http://www.ed.gov/sites/default/files/netp2010.pdf>.

<sup>9</sup> President’s Council of Advisors on Science & Technology, *Prepare and Inspire: K-12 Education in Science, Technology, Engineering, and Math (STEM) for America’s Future* at ix (2010), available at <http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-stemed-report.pdf>

<sup>10</sup> Jeb Bush and Bob Wise, *Digital Learning Now!*, Foundation for Excellence in Education at 2 (2010), available at <http://excelined.org/Docs/Digital%20Learning%20Now%20Report%20FINAL.pdf>.

through one-on-one tutoring outperformed 98 percent of students taught in a traditional classroom. Computer-based tutors and other methods of personalization that employ a range of practices and that adapt to student needs demonstrate promise in cost-effectively providing this highly personalized instruction. Indeed, ARPA-ED can build on the work by DARPA highlighted in the case study to understand whether such outcomes are possible in core academic subjects.

- ✓ **Rethinking Curricula.** Curricula and pedagogy tend to be developed and refined based on the beliefs of experts, and not always on an empirical basis of what works best for learners. Rigorous research that leverages data generated by learning technologies can be used effectively in tandem with powerful new methods for interpreting that data. These efforts can shed new light on which methods of instruction are most effective and what adjustments can most benefit different types of students.
- ✓ **Providing Teachers Powerful Tools.** Many teachers struggle to personalize instruction to a classroom of 20-30 students. A handheld device that provides teachers continuous access to analysis of student performance, engagement and interest information; makes real-time recommendations about topics that need re-teaching; and connects with resources from the vast universe of available online resources would enable teachers to focus their attention on student interactions.
- ✓ **Leveraging Collaboration.** Collaborative information technologies have the power to reshape education. Online communities have already demonstrated the ability to sustain exponential performance improvement,<sup>11</sup> but related efforts are nascent in education. Players of the online game World of Warcraft have built communities, tools, and relationships that allow them to learn from each other and constantly improve their in-game performance. Working together, teams of strangers separated physically can accomplish highly complex virtual tasks that no individual could achieve alone – technology can bring that capability to education.
- ✓ **Targeting Job Training.** At a time when America needs workers with skills for the jobs of the future, affordable and effective job training is crucial. Educational technologies may allow us to provide unemployed workers with targeted training in their particular areas of need, rapidly accelerating the pace of training and substantially decreasing the cost as students focus their time, money, and effort on the knowledge and skills they need most.

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<sup>11</sup> Douglas Thomas and Jagan Nemani (2009). “The collaboration curve: Exponential performance improvement in World of Warcraft.” Deloitte Center for the Edge. *Available at* [http://www.deloitte.com/assets/Dcom-UnitedStates/Local%20Assets/Documents/us\\_tmt\\_WoW\\_082009.pdf](http://www.deloitte.com/assets/Dcom-UnitedStates/Local%20Assets/Documents/us_tmt_WoW_082009.pdf).

Educational technology has extraordinary potential that has yet to be unleashed. While work such as Sugata Mitra's Hole in the Wall project - installing computer stations in public areas in disadvantaged communities - demonstrates that young children can learn complex topics with little support beyond technology, the tools are likely to be much more powerful in the hands of effective and excited teachers.

With accelerating progress and key trends - including nearly ubiquitous mobile devices, investment in national broadband, more useful data, and deepening understanding of cognitive science - the time is ripe for targeted investments to improve our use of technology in education.

## Helping America's Workers and Creating a New Export Sector

*"At a time when the unemployment rate for Americans who've never gone to college is almost double what it is for those who have gone to college; when most of the new jobs that are being created require some higher education; when other countries are out-educating us today to out-compete us tomorrow; making sure that we offer all our kids, regardless of race, a world-class education is more than a moral obligation. It is an economic imperative if we want to succeed in the 21st century."*

- President Barack Obama, at the signing of the Executive Order for the White House Initiative on Educational Excellence for Hispanic Americans, October 19, 2010

Studies have shown that every \$1 spent on R & D adds about \$2 of benefit to our economy and society. Indeed, the history of American economic competitiveness has been one of innovation. New processes and new technologies such as the explosion of the Internet marked a century of American innovation. Entire industries have invented and re-invented themselves: from renting movies in a local video store, to renting movies by mail, to streaming movies instantly, on demand.

Technology can help America's workers develop new skills and can provide new opportunities for adult learners who are struggling to balance the competing demands of work and family. We cannot know all the skills and competencies that the jobs of the future will require, but we can develop tools that will rapidly and effectively re-train workers to compete in whatever future emerges.

The United States can also seize the open opportunity for global leadership in educational technology. Digital devices are becoming increasingly higher-performing while simultaneously lower-cost. The President's commitment to spread 4G wireless to 98% of the country will make high-speed broadband virtually ubiquitous even in rural and low income communities. Cloud computing will put the power of multi-billion dollar computer networks in the hands of anyone with a hundred-dollar smart device while lowering upkeep costs. Furthermore, unprecedented data analytical capability will let us make sense of the massive flow of data to exponentially increase the pace of "learning about learning."

Education technology can have a major impact in three areas:

- ✓ **An American workforce ready to fill – and create – the jobs of tomorrow.** Educational technology can help our students flourish, including in the increasingly-essential fields of mathematics and science. Students ready for the jobs of the future will also come up with the ideas of tomorrow, adapt to a changing world, start businesses, and provide more workers with quality jobs. Just as critically, educational technology can help re-train and re-teach the American workforce in

response to new and constantly evolving industries that will require new knowledge and skills that we cannot currently predict.

- ✓ **Cost-effective solutions for training needs.** Fiscal constraints will likely continue to impact education budgets in the years ahead, as funding levels for education may grow slowly even as the economy improves. Education technology can help the country work within those fiscal constraints without sacrificing our children's education or job-readiness. Studies have shown that technology-based instruction can reduce the time students take to reach an objective by 30-80%.<sup>12</sup> This acceleration can help educational technology train new workers in government and the private sector more cheaply, more thoroughly, and more quickly.
  
- ✓ **Export opportunities in a global industry.** Globally, education is nearly a \$4 trillion industry,<sup>13</sup> and that number will grow rapidly as emerging economies in Asia, Africa, and South America increasingly look to provide high quality education to all their citizens. Education technology likely will play a critical role in the expansion of education in these countries – in much the same way that some developing countries skipped building a landline phone system and built cell networks. Targeted investment by ARPA-ED can establish American leadership in the field so that we are a net exporter rather than a net importer.

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<sup>12</sup> Cohn, J., & Fletcher, J.D. (2010). What is a Pound of Training Worth? Frameworks and Practical Examples for Assessing Return on Investment in Training. Proceedings of the InterService/Industry Training, Simulation and Education Annual Conference. Arlington, VA: National Training and Simulation Association.

<sup>13</sup> Nextup, *Next Knowledge Factbook* (2010), available at [http://www.nextupresearch.com/Site/neXtup\\_files/Next%20Knowledge%20Factbook%20v4.pdf](http://www.nextupresearch.com/Site/neXtup_files/Next%20Knowledge%20Factbook%20v4.pdf).

## The President's Plan for ARPA-ED

*"Cutting the deficit by gutting our investments in innovation and education is like lightening an overloaded airplane by removing its engine. It may make you feel like you're flying high at first, but it won't take long before you feel the impact."*

- President Barack Obama, State of the Union Address, January 25, 2011

In his FY2012 Budget, the President proposed the creation of an Advanced Research Projects Agency – Education (ARPA-ED) at the Department of Education, with funding of \$90 million in its first year.

ARPA-ED will be structured similarly to DARPA. ARPA-ED program managers will be experts in their fields, recruited into government. They will run competitions to which a broad set of entities including industry, universities, and other innovative organizations can apply. Winners will be selected based on their potential to create dramatic breakthroughs to empower learning and teaching.

### *Structured to Thrive*

DARPA (and similar organizations including ARPA-E) are small, flexible organizations that focus on 3-5 year projects to deliver solutions with the potential for a transformative impact. ARPA-ED will be positioned for success, with a close relationship with DARPA and ARPA-E to ensure the new agency utilizes best practices for existing and successful government programs.

The Administration has identified key policies and practices, based on the experiences of DARPA and ARPA-E, to help ARPA-ED succeed in funding transformative innovation:

- **A focus on outcomes.** ARPA-ED should focus on specific deliverables with measurable impact.
- **Unmatched expertise.** ARPA-ED should have the flexibility to attract and hire a respected, world-class director and program officers that are leaders in their field. A former Director of DARPA testified that the "Director's most important task is to recruit and hire very creative people with big ideas, and empower them."<sup>14</sup>
- **A flat and non-hierarchical structure.** There should be few levels of management, so the director has a relationship with program managers.

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<sup>14</sup> Dr. Tony Tether, Statement to the Subcommittee on Terrorism, Unconventional Threats and Capabilities of the House Armed Services Committee in the United States House of Representatives, March 13, 2008, available at <http://www.dod.gov/dodgc/olc/docs/testTether080313.pdf>.

- **Empowered and invested employees.** Program managers should “own” their projects and be responsible for debating internally for funding, and fostering external support for partnerships. ARPA-ED also should bring in new program managers every 4-6 years, ensuring fresh thinking and a sense of urgency.
- **Flexibility to execute.** ARPA-ED should have specific authorities, in areas such as procurement, so that the agency can quickly fund the best ideas from a broad set of sources – be it efforts in industry, universities, or other innovative organizations.
- **A lean organization with a broad network.** ARPA-ED should have not have a large bureaucracy but connect to vast external networks of teachers, academics, researchers, corporations, and others.<sup>15</sup>

The Administration proposes initially funding ARPA-ED with \$90 million in the FY 2012 budget to allow it to support a first round of 10-15 projects.

### *Positioned for Success*

#### *Building on Momentum*

ARPA-ED will build on the success of, and complement, the Administration’s other programs designed to spark innovation in education. Race to the Top is the most meaningful reform of our public schools in a generation, and for less than 1% of what the country spends on education each year, it led over 40 states to raise their standards for teaching and learning. In 2010, the Investing in Innovation (i3) Fund gave awards to 49 proposals from around the country to start or expand research-based innovative programs that help close the achievement gap and improve outcomes for high-need students. ARPA-ED also will tap into the portfolio of existing projects and research that has been developed by a number of government programs over the years but frequently not applied in education.

Further, the state-led work of the Common Core State Standards Initiative has put over 40 states on track to share common standards in mathematics and English language arts, as well as aligned assessments. The efforts of the National Governors Association and the Council of Chief State School Officers to establish nationwide yardsticks support education research and development generally and will particularly assist ARPA-ED by enabling the organization to develop solutions relevant for large numbers of students.

#### *Working with Communities of Support*

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<sup>15</sup> See, e.g., William B. Bonvillian, “Power Play: The DARPA Model and U.S. Energy Policy,” *The American Interest* 11 (November/December 2006).

ARPA-ED will benefit from overall high-level federal focus on education technologies as a critical component in the President's innovation strategy. Guided by the efforts of the National Economic Council, the Domestic Policy Council, and the Office of Science and Technology Policy, the National Science and Technology Council's Committee of Technology recently chartered a Subcommittee on Education Technology. This cross-cutting federal focus will have three key elements:

- **Articulating a vision.** The Subcommittee will articulate a vision for the learning environment of the future and the role that technology can play in improving learning outcomes. This effort builds on foundational documents such as the National Education Technology Plan, which envisions a future of 24/7 learning enabled and powered by the advanced technologies that have already transformed much of daily personal and professional life.
- **Improving coordination.** The Subcommittee will develop near term and long term strategies in areas such as educational technology R&D and facilitating coordinated efforts across federal agencies. Currently, agencies as diverse as the Department of Education, the Department of Defense, the National Institutes of Health, and the National Science Foundation support research related to learning and technology.
- **Nurturing demand.** The Subcommittee will use a combination of policy advocacy and "pull" mechanisms such as Advance Market Commitments and working with the Department of Defense Education Activity (DoDEA) schools to serve as platforms for innovation and as early "customers" for advanced effective education technology. For example, in the recently finalized Presidential Study Directive on Military Families, DOD committed to making DODEA a "leader in the use of advanced learning technologies"<sup>16</sup>

Among the greatest challenges to a vibrant education technology sector is limited informed demand for effective products, which makes the sector unattractive for private investment

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<sup>16</sup> **PSD-9, Strengthening our Military Families.** "DOD commits to making DOD Education Activity (DODEA) schools a leader in the use of advanced learning technologies that have the potential to significantly improve student performance. DOD will invest in research, development and demonstration projects that involve DODEA schools, building on relevant research by agencies such as the Defense Advanced Research Projects Agency and the Office of Naval Research. Examples of advanced learning technologies include software that is as effective as a personal tutor, engaging and compelling "games for learning," student-authored and sharable simulations, and online courses that improve the more students use them."

[http://www.defense.gov/home/features/2011/0111\\_initiative/strengthening\\_our\\_military\\_january\\_2011.pdf](http://www.defense.gov/home/features/2011/0111_initiative/strengthening_our_military_january_2011.pdf)

because there is limited reward to being better. ARPA-ED also will benefit from the research that has begun to investigate the best way of implementing educational technology in the classroom, such as the recent study by the National Academies, funded in part by the National Science Foundation, and the work of teachers and school districts around the country, that are experimenting and using educational technology in their classrooms on a daily basis.

## Conclusion

Leading the world in educational technology provides varied, important, and expanding benefits. It can help position the United States to compete in a 21<sup>st</sup> century economy, with students who graduate ready to fill – and create – the jobs of the future. Those same students, graduating ready for the workforce, will be better positioned to become innovators, bringing higher quality products to the marketplace which will, in turn, better educate the next generation of students. Additionally, educational technology can offer an expanding market for American exports, as countries around the world seek ways to educate their population in affordable ways. ARPA-ED is thus a key component of the country's opportunity to out-innovate and out-educate the world, so that America can win the future.