

Transforming American Education:

Learning

Powered by Technology

DRAFT

National Educational Technology Plan 2010
Executive Summary

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Executive Summary

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. It fosters the cross-border, cross-cultural collaboration required to solve the most challenging problems of our time.

Under the Obama administration, education has become an urgent priority driven by two clear goals. By 2020,

- We will raise the proportion of college graduates from where it now stands [39%] so that 60% of our population holds a 2-year or 4-year degree.
- We will close the achievement gap so that all students – regardless of race, income, or neighborhood – graduate from high school ready to succeed in college and careers.

These are aggressive goals and achieving them is a sizable challenge. Add to the challenge the projections of most states and the federal government of reduced revenues for the foreseeable future, and it is clear we need cost-effective and cost-saving strategies that improve learning outcomes and graduation rates for millions of Americans.

Specifically, we must embrace innovation, prompt implementation, regular evaluation, and continuous improvement. The programs and projects that work must be brought to scale so every school has the opportunity to take advantage of that success. Our regulations, policies, actions, and investments must be strategic and coherent.

Transforming American Education

To achieve these goals, the National Educational Technology Plan (NETP) calls for revolutionary transformation rather than evolutionary tinkering. It urges our education system at all levels to

- Be clear about the outcomes we seek.
- Collaborate to redesign structures and processes for effectiveness, efficiency, and flexibility.
- Continually monitor and measure our performance.
- Hold ourselves accountable for progress and results every step of the way.

Just as technology is at the core of virtually every aspect of our daily lives and work, we must leverage it to provide engaging and powerful learning experiences, content, and resources and assessments that measure student achievement in more complete, authentic, and meaningful ways. Technology-based learning and assessment systems will be pivotal in improving student learning and generating data that can be used to continuously improve the education system at all levels. Technology will help us execute collaborative teaching strategies combined with professional learning that better prepare and enhance educators' competencies and expertise over the course of their careers. To shorten our learning curve, we can learn from other kinds of enterprises that have used technology to improve outcomes while increasing productivity.

A 21st Century Model of Learning Powered by Technology

The NETP presents a model of 21st century learning powered by technology, with goals and recommendations in five essential areas: learning, assessment, teaching, infrastructure, and productivity. The plan also identifies far-reaching “grand challenge problems” that should be funded and coordinated at a national level.

The challenging and rapidly changing demands of our global economy tell us what people need to know and who needs to learn. Advances in learning sciences show us how people learn. Technology makes it possible for us to act on this knowledge and understanding.

Learning

The model of 21st century learning described in this plan calls for engaging and empowering learning experiences for all learners. The model asks that we focus what and how we teach to match what people need to know, how they learn, where and when they will learn, and who needs to learn. It brings state-of-the art technology into learning to enable, motivate, and inspire all students, regardless of background, languages, or disabilities, to achieve. It leverages the power of technology to provide personalized learning instead of a one-size-fits-all curriculum, pace of teaching, and instructional practices.

Many students’ lives today are filled with technology that gives them mobile access to information and resources 24/7, enables them to create multimedia content and share it with the world, and allows them to participate in online social networks where people from all over the world share ideas, collaborate, and learn new things. Outside school, students are free to pursue their passions in their own way and at their own pace. The opportunities are limitless, borderless, and instantaneous.

The challenge for our education system is to leverage the learning sciences and modern technology to create engaging, relevant, and personalized learning experiences for all learners that mirror students’ daily lives and the reality of their futures. In contrast to traditional classroom instruction, this requires that we put students at the center and empower them to take control of their own learning by providing flexibility on several dimensions. A core set of standards-based concepts and competencies should form the basis of what all students should learn, but beyond that students and educators should have options for engaging in learning: large groups, small groups, and work tailored to individual goals, needs, interests, and prior experience of each learner. By supporting student learning in areas that are of real concern or particular interest to them, personalized learning adds to its relevance, inspiring higher levels of motivation and achievement.

In addition, technology provides access to more learning resources than are available in classrooms and connections to a wider set of “educators,” including teachers, parents, experts, and mentors outside the classroom. On-demand learning is now within reach, supporting learning that is life-long and life-wide (Bransford et al., 2006).

What and How People Need to Learn

Whether the domain is English language arts, mathematics, sciences, social studies, history, art, or music, 21st century competencies and expertise such as critical thinking, complex problem solving, collaboration, and multimedia communication should be woven into all content areas. These competencies are necessary to become expert learners, which we all must be if we are to adapt to our rapidly changing world over the course of our lives, and that involves developing deep understanding within specific content areas and making the connections between them.

How we need to learn includes using the technology that professionals in various disciplines use. Professionals routinely use the web and tools such as wikis, blogs, and digital content for the research, collaboration, and communication demanded in their jobs. They gather data and analyze it using inquiry and visualization tools. They use graphical and 3D modeling tools for design. For students, using these real-world tools creates learning opportunities that allow them to grapple with real-world problems – opportunities that prepare them to be more productive members of a globally competitive workforce.

Assessment

The model of 21st century learning requires new and better ways to measure what matters, diagnose strengths and weaknesses in the course of learning when there is still time to improve student performance, and involve multiple stakeholders in the process of designing, conducting, and using assessment. In all these activities, technology-based assessments can provide data to drive decisions on the basis of what is best for each and every student and that in aggregate will lead to continuous improvement across our entire education system.

President Obama has called on our nation's governors and state education chiefs to develop standards and assessments that measure 21st century competencies and expertise – critical thinking, complex problem solving, collaboration, and multimedia communication – in all content areas. Technology-based assessments that combine cognitive research and theory about how students think with multimedia, interactivity, and connectivity make it possible to directly assess these types of skills. And we can do so within the context of relevant societal issues and problems that people care about in everyday life.

When combined with learning systems, technology-based assessments can be used formatively to diagnose and modify the conditions of learning and instructional practices while at the same time determining what students have learned for grading and accountability purposes. Both uses are important, but the former can improve student learning in the moment (Black & William, 1998; Black et al., 2004). Furthermore, systems can be designed to capture students' inputs and collect evidence of their knowledge and problem solving abilities as they work. Over time, the system "learns" more about students' abilities and can provide increasingly appropriate support.

Using Data to Drive Continuous Improvement

With assessments in place that assess the full range of expertise and competencies reflected in standards, student learning data can be collected and used to continually improve learning outcomes and productivity. For example, such data could be used to create a system of interconnected feedback for students, educators, parents, school leaders, and district administrators.

For this to work, relevant data must be made available to the right people at the right time and in the right form. Educators and leaders at all levels of our education system also must be provided with support – tools and training – that can help them manage the assessment process, analyze data, and take appropriate action.

Teaching

Just as leveraging technology can help us improve learning and assessment, the model of 21st century learning calls for using technology to help build the capacity of educators by enabling a shift to a model of connected teaching. In such a teaching model, teams of connected educators replace solo practitioners and classrooms are fully connected to provide educators with 24/7 access to data and analytic tools as well as to resources that help them act on the insights the data provide.

The expectation of effective teaching and accountability for professional educators is a critical component of transforming our education system, but equally important is recognizing that we need to strengthen and elevate the teaching profession. This is necessary if we are to attract and retain the most effective educators and achieve the learning outcomes we seek. Just as leveraging technology can help us improve learning and assessment, technology can help us build the capacity of educators by enabling a shift to a model of connected teaching.

In a connected teaching model, connection replaces isolation. Classroom educators are fully connected to learning data and tools for using the data; to content, resources, and systems that empower them to create, manage, and assess engaging and relevant learning experiences; and directly to their students in support of learning both inside and outside school. The same connections give them access to resources and expertise that improve their own instructional practices and guide them in becoming facilitators and collaborators in their students' increasingly self-directed learning.

In connected teaching, teaching is a team activity. Individual educators build online learning communities consisting of their students and their students' peers; fellow educators in their schools, libraries, and afterschool programs; professional experts in various disciplines around the world; members of community organizations that serve students in the hours they are not in school; and parents who desire greater participation in their children's education.

Episodic and ineffective professional development is replaced by professional learning that is collaborative, coherent, and continuous and that blends more effective in-person courses and workshops with the expanded opportunities, immediacy, and convenience enabled by online environments full of resources and opportunities for collaboration. For their part, the colleges of education and other institutions that prepare teachers play an ongoing role in the professional growth of their graduates throughout the entire course of their careers.

Connected teaching enables our education system to provide access to effective teaching and learning resources where they are not otherwise available and provide more options for all learners at all levels. This is accomplished by augmenting the expertise and competencies of specialized and exceptional educators with online learning systems and through on-demand courses and other self-directed learning opportunities. Clearly, more teachers will need to be expert at providing online instruction.

21st Century Resources for Professional Educators

The technology that enables connected teaching is available now, but not all the conditions necessary to leverage it are. Many of our existing educators do not have the same understanding of and ease with using technology that is part of the daily lives of professionals in other sectors. The same can be said of many of the education leaders and policymakers in schools, districts, and states and of the higher education institutions that prepare new educators for the field.

This gap in technology understanding influences program and curriculum development, funding and purchasing decisions about educational and information technology in schools, and pre-service and in-service professional learning. This gap prevents technology from being used in ways that would improve instructional practices and learning outcomes.

Still, we must introduce connected teaching into our education system rapidly, and therefore we need innovation in the organizations that support educators in their profession – schools and districts, colleges of education, professional learning providers, and professional organizations.

Infrastructure

An essential component of the 21st century learning model is a comprehensive infrastructure for learning that provides every student, educator, and level of our education system with the resources they need when and where they are needed. The underlying principle is that infrastructure includes people, processes, learning resources, policies, and sustainable models for continuous improvement in addition to broadband connectivity, servers, software, management systems, and administration tools. Building this infrastructure is a far-reaching project that will demand concerted and coordinated effort.

Although we have adopted technology in many aspects of education today, a comprehensive infrastructure for learning is necessary to move us beyond the traditional model of educators and students in classrooms to a learning model that brings together teaching teams and students in classrooms, labs, libraries, museums, workplaces, and homes – anywhere in the world where people have access devices and an adequate Internet connection.

Over the past 40 years, we have seen unprecedented advances in computing and communications that have led to powerful technology resources and tools for learning. Today, low-cost Internet access devices, easy-to-use digital authoring tools, and the web facilitate access to information and multimedia learning content, communication, and collaboration. They provide the ability to participate in online learning communities that cross disciplines, organizations, international boundaries, and cultures.

Many of these technology resources and tools already are being used within our public education system. We are now, however, at an inflection point for a much bolder transformation of education powered by technology. This revolutionary opportunity for change is driven by the continuing push of emerging technology and the pull of the critical national need to radically improve our education system.

Always-on Learning Resources

Our model of an infrastructure for learning is always on, available to students, educators, and administrators regardless of their location or the time of day. It supports not just access to information, but access to people and participation in online learning communities. It offers a platform on which developers can build and tailor applications.

An infrastructure for learning unleashes new ways of capturing and sharing knowledge based on multimedia that integrate text, still and moving images, audio, and applications that run on a variety of devices. It enables seamless integration of in- and out-of-school learning. It frees learning from a rigid information transfer model (from book or educator to students) and enables a much more motivating intertwine of learning about, learning to do, and learning to be.

On a more operational level, an infrastructure for learning brings together and enables access to data from multiple sources while ensuring appropriate levels of security and privacy. It integrates computer hardware, data and networks, information resources, interoperable software, middleware services and tools, and devices and connects and supports interdisciplinary teams of professionals responsible for its development, maintenance, and management and its use in transformative approaches to teaching and learning.

Productivity

To achieve our goal of transforming American education, we must rethink basic assumptions and redesign our education system. We must apply technology to implement personalized learning and ensure that students are making appropriate progress through our K-16 system so they graduate. These and other initiatives require investment, but tight economic times and basic fiscal responsibility demand that we get more out of each dollar we spend. We must leverage technology to plan, manage, monitor, and report spending to provide decision-makers with a reliable, accurate, and complete view of the financial performance of our education system at all levels. Such visibility is essential to meeting our goals for educational attainment within the budgets we can afford.

Improving productivity is a daily focus of most American organizations in all sectors – both for-profit and nonprofit – and especially so in tight economic times. Education has not, however, incorporated many of the practices other sectors regularly use to improve productivity and manage costs, nor has it leveraged technology to enable or enhance them. We can learn much from the experience in other sectors.

What education can learn from the experience of business is that we need to make the fundamental structural changes that technology enables if we are to see dramatic improvements in productivity. As we do so, we should recognize that although the fundamental purpose of our public education system is the same, the roles and processes of schools, educators, and the system itself should change to reflect the times we live in and our goals as a world leader. Such rethinking applies to learning, assessment, and teaching processes, and to the infrastructure and operational and financial sides of running schools and school systems.

Rethinking Basic Assumptions

One of the most basic assumptions in our education system is time-based or “seat-time” measures of educational attainment. These measures were created in the late 1800s and early 1900s to smooth transitions from K-12 into higher education by translating high school work to college admissions offices (Shedd, 2003) and made their way into higher education when institutions began moving away from standardized curricula.

Another basic assumption is the way we organize students into age-determined groups, structure separate academic disciplines, organize learning into classes of roughly equal size with all the students in a particular class receiving the same content at the same pace, and keep these groups in place all year.

The last decade has seen the emergence of some radically redesigned schools, demonstrating the range of possibilities for structuring education. These include schools that organize around competence rather than seat time and others that enable more flexible

scheduling that fits students' individual needs rather than traditional academic periods and lockstep curriculum pacing. In addition, schools are beginning to incorporate online learning, which gives us the opportunity to extend the learning day, week, or year.

The United States has a long way to go if we are to see every student complete at least a year of higher education or postsecondary career training. There is no way to achieve this target unless we can dramatically reduce the number of students who leave high school without getting a diploma and/or who are unprepared for postsecondary education.

A complex set of personal and academic factors underlie students' decision to leave school or to disengage from learning, but support should start as early as possible, before children enter school, and should become intensified for those students who need it as they move through school. Practices supported with technology can help address the problem, including learning dashboards that keep students on track with their course requirements and earning credits for courses taken online.

Redesigning education in America for improved productivity is a complex challenge that will require all 50 states, the thousands of districts and schools across the country, the federal government, and other education stakeholders in the public and private sector coming together to design and implement innovative solutions. It is a challenge for educators – leaders, teachers, and policymakers committed to learning – as well as technologists, and ideally they will come together to lead the effort.

A Rigorous and Inclusive Process

The NETP, led by the Department of Education's Office of Educational Technology, was developed using a rigorous and inclusive process built on the report of a technical working group of leading education researchers and practitioners.

In keeping with the White House's Open Government Directive, the Department invited extensive public participation in the development of the NETP. Broad outreach efforts and state-of-the-art communications and collaboration technology enabled tens of thousands of individuals to learn about and contribute to the development of the NETP over its 9-month development period.

The Time To Act Is Now

The NETP accepts that we do not have the luxury of time – we must act now and commit to fine-tuning and midcourse corrections as we go. Success will require leadership, collaboration, and investment at all levels of our education system – states, districts, schools, and the federal government – as well as partnerships with higher education institutions, private enterprises, and not-for-profit entities.

In the United States, education is primarily a state and local responsibility. State and local public education institutions must ensure equitable access to learning experiences for all students and especially students in underserved populations – low-income and minority students, students with disabilities, English language learners, preschool-aged children, and others. States and districts need to build capacity for transformation. The Department of Education has a role in identifying effective strategies and implementation practices; encouraging, promoting, and actively supporting innovation in states and districts; and nurturing collaborations that help states and districts leverage resources so the best ideas can be scaled up.

Postsecondary education institutions – community colleges and 4-year colleges and universities – will need to partner more closely with K-12 schools to remove barriers to postsecondary education and put plans of their own in place to decrease dropout rates. Clearly, postsecondary institutions would be key players in the national R&D efforts recommended in this plan.

Education has long relied on the contributions of organizations in both the private and not-for-profit sectors, and this will not change.

As we enter the second decade of the 21st century, there has never been a more pressing need to transform American education and there will never be a better time to act. The NETP is a 5-year action plan that responds to an urgent national priority and a growing understanding of what the United States needs to do to remain competitive in a global economy.

Goals and Recommendations

The NETP presents five goals with recommendations for states, districts, the federal government, and other stakeholders in our education system that address learning, assessment, teaching, infrastructure, and productivity. The plan also identifies far-reaching grand challenge problems that should be funded and coordinated at a national level.

1.0 Learning

All learners will have engaging and empowering learning experiences both in and outside of school that prepare them to be active, creative, knowledgeable, and ethical participants in our globally networked society.

To meet this goal, we recommend the following actions:

1.1 Revise, create, and adopt standards and learning objectives for all content areas that reflect 21st century expertise and the power of technology to improve learning.

1.2 Develop and adopt learning resources that use technology to embody design principles from the learning sciences.

1.3 Develop and adopt learning resources that exploit the flexibility and power of technology to reach all learners anytime and anywhere.

1.4 Use advances in the learning sciences and technology to enhance STEM (science, technology, engineering, and mathematics) learning and develop, adopt, and evaluate new methodologies with the potential to enable all learners to excel in STEM.

2.0 Assessment

Our education system at all levels will leverage the power of technology to measure what matters and use assessment data for continuous improvement.

To meet this goal, we recommend the following actions:

2.1 Design, develop, and adopt assessments that give students, educators, and other stakeholders timely and actionable feedback about student learning to improve achievement and instructional practices.

2.2 Build the capacity of educators and educational institutions to use technology to improve assessment materials and processes for both formative and summative uses.

2.3 Conduct research and development that explore how gaming technology, simulations, collaboration environments, and virtual worlds can be used in assessments to engage and motivate learners and to assess complex skills and performances embedded in standards.

2.4 Revise practices, policies, and regulations to ensure privacy and information protection while enabling a model of assessment that includes ongoing student learning data gathering and sharing for continuous improvement.

3.0 Teaching

Professional educators will be supported individually and in teams by technology that connects them to data, content, resources, expertise, and learning experiences that enable and inspire more effective teaching for all learners.

To meet this goal, we recommend the following actions:

3.1 Design, develop, and adopt technology-based content, resources, and online learning communities that create opportunities for educators to collaborate for more effective teaching, inspire and attract new people into the profession, and encourage our best educators to continue teaching.

3.2 Provide pre-service and in-service educators with preparation and professional learning experiences powered by technology that close the gap between students' and educators' fluencies with technology and promote and enable technology use in ways that improve learning, assessment, and instructional practices.

3.3 Transform the preparation and professional learning of educators and education leaders by leveraging technology to create career-long personal learning networks within and across schools, pre-service preparation and in-service educational institutions, and professional organizations.

3.4 Use technology to provide access to the most effective teaching and learning resources, especially where they are not otherwise available, and to provide more options for all learners at all levels.

3.5 Develop a teaching force skilled in online instruction.

4.0 Infrastructure

All students and educators will have access to a comprehensive infrastructure for learning when and where they need it.

To meet this goal, we recommend the following actions:

4.1 Ensure that students and educators have adequate broadband access to the Internet and adequate wireless connectivity both inside and outside school.

4.2 Ensure that every student and educator has at least one Internet access device and software and resources for research, communication, multimedia content creation, and collaboration for use in and out of school.

4.3 Leverage open educational resources to promote innovative and creative opportunities for all learners and accelerate the development and adoption of new open technology-based learning tools and courses.

4.4 Build state and local education agency capacity for evolving an infrastructure for learning.

4.5 Support "meaningful use" of educational and information technology in states and districts by establishing definitions, goals, and metrics.

5.0 Productivity

Our education system at all levels will redesign processes and structures to take advantage of the power of technology to improve learning outcomes while making more efficient use of time, money, and staff.

To meet this goal, we recommend the following actions:

5.1 Develop and adopt a common definition of productivity in education and more relevant and meaningful measures of learning outcomes and costs.

5.2 Improve policies and use technology to manage costs including those for procurement.

5.3 Fund the development and use of interoperability standards for content, student learning data, and financial data to enable collecting, sharing, and analyzing data to improve decision-making at all levels of our education system.

5.4 Rethink basic assumptions in our education system that inhibit leveraging technology to improve learning, starting with our current practice of organizing student and educator learning around seat time instead of the demonstration of competencies.

5.5 Design, implement, and evaluate technology-powered programs and interventions to ensure that students progress through our K-16 education system and emerge prepared for the workplace and citizenship.

A New Kind of R&D for Education

To design and implement more efficient and effective education system, this plan calls for an organization with the mission of serving the public good through research and development at the intersection of learning sciences, technology, and education (Pea & Lazowska, 2003).

The Higher Education Act (P.L. 110-315) passed in August 2008 authorizes establishment of the National Center for Research in Advanced Information and Digital Technologies (also called the Digital Promise). Housed in the Department of Education, the center is authorized as a 501(c)3 that would bring together contributions from the public and private sectors to support the R&D needed to transform learning in America. The Digital Promise's intent of involving private sector technology companies in precompetitive R&D with the center can be realized only if the federal government provides the funding that would demonstrate its own commitment to a major program of R&D addressing the complex problems associated with redesigning our education system.

The Defense Advanced Research Projects Agency (DARPA) offers an example of how such a research agency can promote work that builds basic understanding and addresses practical problems. DARPA sponsors high-risk/high-gain research on behalf of Department of Defense agencies, but it is independently managed and staffed by individuals from both industry and academia who are experts in the relevant research areas. DARPA program officers are given considerable discretion, both in defining the research agenda and making decisions about the funding and structuring of research (Cooke-Deegan, 2007).

In a similar manner, the National Center for Research in Advanced Information and Digital Technologies should identify key emerging trends and priorities and recruit and bring together the best minds and organizations to collaborate on high-risk/high-gain R&D projects. It should aim for radical, orders-of-magnitude improvements by envisioning the impact of innovations and then working backward to identify the fundamental breakthroughs required to make them possible.

Grand Challenge Problems

This plan also urges the national research center to focus on grand challenge problems in education research and development. “Grand challenge problems” are important problems that require bringing together a community of scientists and researchers to work toward their solution.

The following grand challenge problems illustrate the kinds of ambitious R&D efforts that should be coordinated at a national level. Notably, although each of these problems is a grand challenge in its own right, they all combine to form the ultimate grand challenge problem in education: establishing an integrated end-to-end real-time system for managing learning outcomes and costs across our entire education system at all levels.

1.0: Design and validate an integrated system that provides real-time access to learning experiences tuned to the levels of difficulty and assistance that optimizes learning for all learners and that incorporates self-improving features that enable it to become increasingly effective through interaction with learners.

2.0: Design and validate an integrated system for designing and implementing valid, reliable, and cost-effective assessments of complex aspects of 21st century expertise and competencies across academic disciplines.

3.0: Design and validate an integrated approach for capturing, aggregating, mining, and sharing content, student learning, and financial data cost-effectively for multiple purposes across many learning platforms and data systems in near real time.

4.0: Identify and validate design principles for efficient and effective online learning systems and combined online and offline learning systems that produce content expertise and competencies equal to or better than those produced by the best conventional instruction in half the time at half the cost.

