

Transforming American Education

Learning

Powered by Technology

National Education Technology Plan 2010
Executive Summary

U.S. Department of Education
Office of Educational Technology

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Section 2422 of the *Elementary and Secondary Education Act* specifies that the secretary shall update and publish, in a form readily accessible to the public, a national long-range technology plan that describes how the secretary will promote: (a) higher student academic achievement through the integration of advanced technologies, including emerging technologies, into curricula and instruction; (b) increased access to technology for teaching and learning for schools with a high number or percentage of children from families with incomes below the poverty line; and (c) the use of technology to assist in the implementation of state systemic reform strategies. In addition, Section 2422 specifies that this report should also include a description of joint activities of the Department of Education and other federal departments or agencies that will promote the use of technology in education. In accordance with that requirement, the Office of Educational Technology of the Department of Education is publishing this report.

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U.S. Department of Education

Arne Duncan
Secretary

Office of Educational Technology

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Director

November 2010

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THE SECRETARY OF EDUCATION
WASHINGTON, DC 20202

November 2010

Dear Members of Congress:

Education is vital to America's individual and collective economic growth and prosperity, and is necessary for our democracy to work. Once the global leader in college completion rates among young people, the United States currently ranks ninth out of 36 developed nations. President Obama has articulated a bold vision for the United States to lead the world in the proportion of college graduates by 2020, thereby regaining our leadership and ensuring America's ability to compete in a global economy. To achieve this aggressive goal, we need to leverage the innovation and ingenuity this nation is known for to create programs and projects that every school can implement to succeed.

To that end, I am presenting you with the Administration's National Education Technology Plan, *Transforming American Education: Learning Powered by Technology*. The plan calls for applying the advanced technologies used in our daily personal and professional lives to our entire education system to improve student learning, accelerate and scale up the adoption of effective practices, and use data and information for continuous improvement.

The model of learning described in this plan calls for engaging and empowering personalized learning experiences for learners of all ages. The model stipulates that we focus what and how we teach to match what people need to know and how they learn. It calls for using state-of-the-art technology and Universal Design for Learning (UDL) concepts to enable, motivate, and inspire all students to achieve, regardless of background, languages, or disabilities. It calls for ensuring that our professional educators are well connected to the content and resources, data and information, and peers and experts they need to be highly effective. And it calls for leveraging the power of technology to support continuous and lifelong learning.

The National Education Technology Plan presents five goals with recommendations for states, districts, the federal government, and other stakeholders. Each goal addresses one of the five essential components of learning powered by technology: Learning, Assessment, Teaching, Infrastructure, and Productivity. The plan also calls for "grand challenge" research and development initiatives to solve crucial long-term problems that we believe should be funded and coordinated at a national level.

The plan's development was led by the Department of Education's Office of Educational Technology and involved the most rigorous and inclusive process ever undertaken for a national education technology plan. It builds on the insights and recommendations of a technical working group of leading education researchers, learning and assessment experts, and practitioners. We also engaged with and incorporated input received from hundreds of industry experts, thousands of educators, and the public. I urge you to consider this vision for transforming American education by using the best and most inclusive modern technology to power up the core functions of learning, teaching, assessment, and continuous improvement efforts, as described in this plan.

Sincerely,

/s/

Arne Duncan

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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:

- We will raise the proportion of college graduates from where it now stands (around 41 percent) so that 60 percent of our population holds a two-year or four-year degree by 2020.
- We will close the achievement gap so that all students 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 their success. Our regulations, policies, actions, and investments must be strategic and coherent.

Transforming American Education

The National Education Technology Plan 2010 (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.

The plan recognizes that technology is at the core of virtually every aspect of our daily lives and work, and we must leverage it to provide engaging and powerful learning experiences and content, as well as 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 should look to other kinds of enterprises, such as business and entertainment, that have used technology to improve outcomes while increasing productivity.

We also should implement a new approach to research and development (R&D) in education that focuses on scaling innovative best practices in the use of technology in teaching and learning, transferring existing and emerging technology innovations into education, sustaining the R&D for education work that is being done by such organizations as the National Science Foundation, and creating a new organization to address major R&D challenges at the intersection of learning sciences, technology, and education.

A Model of Learning Powered by Technology

The NETP presents a model of 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” R&D 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: Engage and Empower

The model of 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 and to enable continuous and lifelong learning.

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. Beyond that, students and educators should have options for engaging in learning: large groups, small groups, and work tailored to the individual goals, needs, interests, and prior experience of each learner. Technology should be leveraged to provide 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. It also should be used to enable 24/7 and lifelong learning.

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 such expertise 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. That involves developing deep understanding within specific content areas and making the connections among 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 the data 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: Measure What Matters

The model of 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.

The nation's governors and state education chiefs have begun to develop standards and assessments that measure 21st-century competencies and expertise 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. This can be done 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 and William 1998). 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 address 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 relevant data, and take appropriate action.

Teaching: Prepare and Connect

Just as leveraging technology can help us improve learning and assessment, the model of 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, classrooms are fully connected to provide educators with 24/7 access to data and analytic tools, and educators have access to resources that help them act on the insights the data provide.

Professional educators are a critical component of transforming our education systems, and therefore strengthening and elevating the teaching profession is as important as effective teaching and accountability. All are 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, it also can help us shift to a model of connected teaching.

In a connected teaching model, 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 in and out of 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 after-school 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 more options for all learners. This is accomplished by augmenting the expertise and competencies of specialized and exceptional educators with online and blended (online and offline) learning systems, on-demand courses, and other self-directed learning opportunities.

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 preservice 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: Access and Enable

An essential component of the 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

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 intertwinement 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. The infrastructure 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: Redesign and Transform

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 P–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 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 to come 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

This plan, 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 plan. 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 plan 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, students in rural and frontier schools, 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 four-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 or 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

To transform education in America, we must turn ideas into action. The NETP presents five goals that address the key components of this plan—learning, assessment, teaching, infrastructure, and productivity—along with recommendations for states, districts, the federal government, and other stakeholders in our education system for achieving these goals.

1.0 Learning: Engage and Empower

All learners will have engaging and empowering learning experiences both in and out 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:

1.1 States should continue to revise, create, and implement standards and learning objectives using technology for all content areas that reflect 21st-century expertise and the power of technology to improve learning.

Our education system relies on core sets of standards-based concepts and competencies that form the basis of what all students should know and should be able to do. Whether the domain is English language arts, mathematics, sciences, social studies, history, art, or music, states should continue to consider the integration of 21st-century competencies and expertise, such as critical thinking, complex problem solving, collaboration, multimedia communication, and technological competencies demonstrated by professionals in various disciplines.

1.2 States, districts, and others should develop and implement learning resources that use technology to embody design principles from the learning sciences.

Advances in learning sciences, including cognitive science, neuroscience, education, and social sciences, give us greater understanding of three connected types of human learning—factual knowledge, procedural knowledge, and motivational engagement. Technology has increased our ability to both study and enhance all three types. Today's learning environments should reflect what we have learned about how people learn and take advantage of technology to optimize learning.

1.3 States, districts, and others should develop and implement learning resources that exploit the flexibility and power of technology to reach all learners anytime and anywhere.

The always-on nature of the Internet and mobile access devices provides our education system with the opportunity to create learning experiences that are available anytime and anywhere. When combined with design principles for personalized learning and Universal Design for Learning, these experiences also can be accessed by learners who have been marginalized in many educational settings: students from low-income communities and minorities, English language learners, students with disabilities, students who are gifted and talented, students from diverse cultures and linguistic backgrounds, and students in rural areas.

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

New technologies for representing, manipulating, and communicating data, information, and ideas have changed professional practices in STEM fields and what students need to learn to be prepared for STEM professions. Technology should be used to support student interaction with STEM content in ways that promote deeper understanding of complex ideas, engage students in solving complex problems, and create new opportunities for STEM learning throughout our education system.

2.0 Assessment: Measure What Matters

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 States, districts, and others should design, develop, and implement assessments that give students, educators, and other stakeholders timely and actionable feedback about student learning to improve achievement and instructional practices.

Learning science and technology combined with assessment theory can provide a foundation for new and better ways to assess students in the course of learning, which is the ideal time to improve performance. This will require involving experts from all three disciplines in the process of designing, developing, and using new technology-based assessments that can increase the quality and quantity of feedback to learners.

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

Technology can support measuring performances that cannot be assessed with conventional testing formats, providing our education system with opportunities to design, develop, and validate new and more effective assessment materials. Building this capacity can be accelerated through knowledge exchange, collaboration, and better alignment between educators (practitioners) and experts.

2.3 Conduct research and development that explores how embedded assessment technologies, such as simulations, collaboration environments, virtual worlds, games, and cognitive tutors, can be used to engage and motivate learners while assessing complex skills.

Interactive technologies, especially games, provide immediate performance feedback so that players always know how they are doing. As a result, they are highly engaging to students and have the potential to motivate students to learn. They also enable educators to assess important competencies and aspects of thinking in contexts and through activities that students care about in everyday life. Because interactive technologies hold this promise, assessment and interactive technology experts should collaborate on research to determine ways to use them effectively for assessment.

2.4 Conduct research and development that explores how Universal Design for Learning can enable the best accommodations for all students to ensure we are assessing what we intend to measure rather than extraneous abilities a student needs to respond to the assessment task.

To be valid, an assessment must measure those qualities it is intended to measure and scores should not be influenced by extraneous factors. An assessment of science, for example, should measure understanding of science concepts and their application, not the ability to see print, to respond to items using a mouse, or to use word processing skills. Assessment and technology experts should collaborate to create assessment design tools and processes that make it possible to develop assessment systems with appropriate features (not just accommodations) so that assessments capture examinees' strengths in terms of the qualities that the assessment is intended to measure.

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

Every parent of a student under 18 and every student 18 or over should have the right to access the student's own assessment data in the form of an electronic learning record that the student can take with them throughout his or her educational career. At the same time, appropriate safeguards, including stripping records of identifiable information and

aggregating data across students, classrooms, and schools, should be used to make it possible to supply education data derived from student records to other legitimate users without compromising student privacy.

3.0 Teaching: Prepare and Connect

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 Expand opportunities for educators to have access to technology-based content, resources, and tools where and when they need them.

Today's technology enables educators to tap into resources and orchestrate expertise across a school district or university, a state, the nation, and even around the world. Educators can discuss solutions to problems and exchange information about best practices in minutes, not weeks or months. Today's educators should have access to technology-based resources that inspire them to provide more engaging and effective learning opportunities for each and every student.

3.2 Leverage social networking technologies and platforms to create communities of practice that provide career-long personal learning opportunities for educators within and across schools, preservice preparation and in-service education institutions, and professional organizations.

Social networks can be used to provide educators with career-long personal learning tools and resources that make professional learning timely and relevant as well as an ongoing activity that continually improves practice and evolves their skills over time. Online communities should enable educators to take online courses, tap into experts and best practices for just-in-time problem solving, and provide platforms and tools for educators to design and develop resources with and for their colleagues.

3.3 Use technology to provide all learners with online access to effective teaching and better learning opportunities and options especially in places where they are not otherwise available.

Many education institutions, particularly those serving the most vulnerable students and those in rural areas, lack educators with competencies in reaching students with special needs and educators with content knowledge and expertise in specialized areas, including STEM. Even in areas where effective teaching is available, students often lack options for high-quality courses in particular disciplines or opportunities for learning that prepare them for the modern world. Online learning options should be provided to enable leveraging the best teaching and make high-quality course options available to all learners.

3.4 Provide preservice and in-service educators with professional learning experiences powered by technology to increase their digital literacy and enable them to create compelling assignments for students that improve learning, assessment, and instructional practices.

Just as technology helps us engage and motivate students to learn, technology should be used in the preparation and ongoing learning of educators to engage and motivate them in what and how they teach. This will require synthesizing core principles and adopting best practices for the use of technology in preparing educators. Technology also should be an integral component of teaching methods courses and field experiences rather than treated as a discrete skill distinct from pedagogical application.

3.5 Develop a teaching force skilled in online instruction.

As online learning becomes an increasingly important part of our education system, we need to provide online and blended learning experiences that are more participatory and personalized and that embody best practices for engaging all students. This creates both the need and opportunity for educators who are skilled in instructional design and knowledgeable about emerging technologies. Crucial to filling this need while ensuring effective teaching are appropriate standards for online courses and teaching and a new way of approaching online teacher certification.

4.0 Infrastructure: Access and Enable

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 students and educators have broadband access to the Internet and adequate wireless connectivity both in and out of school.

Students and educators need adequate broadband bandwidth for accessing the Internet and technology-based learning resources. “Adequate” should be defined as the ability to use the Internet in school, on the surrounding campus, throughout the community, and at home. It should also include simultaneous use of high-bandwidth resources, such as multimedia, communication and collaboration environments, and communities. Crucial to providing such access are the broadband initiatives being individually and jointly managed by various federal agencies.

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

Only with 24/7 access to the Internet via devices and technology-based software and resources can we achieve the kind of engagement, student-centered learning, and assessments that can improve learning in the ways this plan proposes. The form of these devices, software, and resources may or may not be standardized and will evolve over time. In addition, these devices may be owned by the student or family, owned by the school, or some combination of the two. The use of devices owned by students will require advances in network filtering and improved support systems.

4.3 Support the development and use of 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.

The value of open educational resources is now recognized around the world, leading to the availability of a vast array of learning, teaching, and research resources that learners of any age can use across all content areas. Realizing this value will require new policies concerning the evaluation and selection of instructional materials so that digital resources are considered and processes are established for keeping educational resource content up to date, appropriate, and tagged according to identified content interoperability standards.

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

Building an infrastructure for learning is a far-reaching project that will demand concerted and coordinated effort. The effort should start with implementing the next generation of computing system architectures and include transitioning computer systems, software, and services from in-house datacenters to professionally managed data centers in the cloud for greater efficiency and flexibility. This will require leveraging and scaling up the human talent

to build such an infrastructure, which should ultimately save money and enable education IT professionals to focus more on maintaining the local infrastructure and supporting teachers, students, and administrators.

4.5 Develop and use interoperability standards for content and student-learning data to enable collecting and sharing resources and collecting, sharing, and analyzing data to improve decision making at all levels of our education system.

Fragmented content and resources and student-learning data siloed in different proprietary platforms and systems, along with a lack of common standards for collecting and sharing data, are formidable barriers to leveraging resources for teaching and learning. These barriers exist because we lack common content interoperability standards and tools to enable use of such standards. The lack of common standards affects the quality of tools because developers limit their R&D investments into narrow markets and are not able to leverage overall market advancements in research and development. Interoperability standards are essential to resolving these issues.

4.6 Develop and use interoperability standards for financial data to enable data-driven decision making, productivity advances, and continuous improvement at all levels of our education system.

Just as content, resources, and student learning data are fragmented in disconnected technology systems and throughout our education system, the same is true for financial data. Therefore, we also need financial data interoperability standards and tools that enable the use of these standards.

5.0 Productivity: Redesign and Transform

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 outcomes, along with improved policies and technologies for managing costs, including those for procurement.

Education has not incorporated many of the practices other sectors regularly use to measure outcomes, manage costs, and improve productivity, a number of which are enabled or enhanced by technology. As other sectors have learned, we are unlikely to improve outcomes and productivity until we define and start measuring them. This starts with identifying what we seek to measure. It also requires identifying costs associated with components of our education system and with individual resources and activities so that the ratio of outcomes to costs can be tracked over time.

5.2 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.

To realize the full potential of technology for improving performance and increasing productivity, we must remove the process and structural barriers to broad adoption. The education system must work to identify and rethink basic assumptions of the education system. Some of these include measurement of educational attainment through seat time, organization of students into age-determined groups, the structure of separate academic disciplines, the organization of learning into classes of roughly equal size, and the use of time blocks.

5.3 Develop useful metrics for the educational use of technology in states and districts.

Current data on the use of educational and information technology in our system consist of records of purchases and numbers of computers and Internet connections. Very little information on how technology is actually used to support teaching, learning, and assessment is collected and communicated systematically. Only by shifting our focus to collecting data on how and when technology is used will we be able to determine the difference it makes and use that knowledge to improve outcomes and the productivity of our education system.

5.4 Design, implement, and evaluate technology-powered programs and interventions to ensure that students progress seamlessly through our P–16 education system and emerge prepared for college and careers.

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. Achieving this target will require dramatically reducing 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' decisions to leave school or to disengage from learning, and no one strategy will prevent every separation from the education system. Collaboration between P–12 and higher education institutions and practices supported with technology are crucial to addressing the problem.

Getting Started Now

The Department of Education has a role in identifying effective strategies and implementation practices; encouraging, promoting, and actively supporting innovation and best practices in states and districts; and nurturing collaborations that help states and districts leverage resources so the best ideas can be scaled up. To help ensure the successful implementation of this plan, the Department of Education can take action around the following priorities:

Convening education stakeholders, in person and online, to share content, insights, and expertise and to collaborate on key elements of this plan. Ideas and best practices that emerge from these convenings will be shared throughout our education system.

The Department of Education can

Convene learning science researchers, developers of educational technology, curriculum developers, public and private sector organizations, and Universal Design for Learning experts to share information and research for developing the next generation of technology-based learning platforms, resources, courses, and tools.

Facilitate collaboration between states and private and public sector organizations to design, develop, validate, and scale up new technology-based assessment resources for both formative and summative uses. These efforts should include exploring the use of embedded assessment technologies, such as simulations, collaboration environments, virtual worlds, and games in new assessment resources.

Convene P–12 and higher education institutions, states, and districts to collaborate on strategies for creating persistent student electronic learning records and using student data for continuous improvement.

Facilitate collaboration between states, districts, universities, other research and development organizations, other agencies, and the commercial sector to develop and leverage open educational resources. Designs for use and reuse and new business models will be included.

Convene states, teacher accreditation organizations, colleges of education, and organizations representing online learning providers to promote states' consideration of voluntary standards for online courses and for online teaching. This activity should include the promotion of reciprocity agreements between states for certifying online teachers.

Convene states and education leadership organizations to identify and rethink basic assumptions in our education system, starting with but not limited to the measurement of educational attainment through seat time. Other assumptions that should be reexamined are the organization of students into static age-determined groups and the organization of learning into classes of roughly equal size, as well as the structure of separate academic disciplines. The use of online learning and combining offline and online learning to provide options for flexibility, additional learning time, and more effective use of the time allotted should be explored.

Convene states, districts, and education and technology experts from the academic, private, and public sectors to define useful metrics for the use of technology in support of teaching and learning and improved operations that states and districts can use to guide technology purchases.

Promote collaboration between two- and four-year postsecondary education institutions, P-12 programs, and educational technology developers in the private and public sectors to design programs and resources to engage and/or reengage students and motivate them to graduate from high school ready for postsecondary education. Facilitate collaboration on alternative programs that take advantage of technology to reconnect with students and help them complete learning programs.

Supporting efforts to ensure that all students and educators have 24/7 access to the Internet via devices, including mobile devices, and that states, districts, and schools adopt technologies and policies to enable leveraging the technology that students already have.

The Department of Education can

Endorse and actively support the broadband initiatives of the *American Recovery and Reinvestment Act of 2009*, which are intended to accelerate deployment of Internet services in unserved, underserved, and rural areas and to strategic anchor institutions, such as schools, that are likely to provide significant public benefits. These initiatives are the Broadband Technology Opportunities Program of the Department of Commerce's National Telecommunications and Information Administration, the Rural Development Broadband Program of the Department of Agriculture, and the interagency National Broadband Plan developed by the Federal Communications Commission.

Work with districts, states, and the private sector to articulate effective technology support models for 24/7 access including using school- and student-owned devices. New support models for this type of access will require improved security systems, more intelligent filtering systems that allow blocking and enabling access within this type of infrastructure, and personnel and/or systems capable of providing around-the-clock support for school-, student-, and educator-owned devices used for learning.

Participating in efforts to ensure that transitioning from predominantly print-based classrooms to digital learning environments promotes organized, accessible, easy-to-distribute and easy-to-use content and learning resources.

The Department of Education can

Support the development of an open architecture mapping and navigation platform that will enable the visual depiction of learning progressions across all content areas and reflect 21st-century expertise. Accessible online, these learning progressions can be used to reenvision content, resources, assessments, curricula, and professional learning for teachers and encourage the sharing of best practices and new approaches to improve teaching and learning. This platform would encourage a variety of mashups and spur innovation.

Initiate an interagency effort to create, publish, and maintain open standards for content, student learning, and financial data interoperability. State and district requests for proposals for assessment and data systems should require appropriate use of these standards.

Create a learning registry, an open-standard registry of all content developed by various agencies throughout the federal government so that states, districts, and schools can access and leverage it and combine it with their own repositories of content.

Expand the availability of digital-learning content, resources, courses, and tools and ensure their continuous improvement by funding the research and development of open educational resources. Facilitate states working together to pool resources for identifying and evaluating or issuing requirements for developing open educational resources.

Support research and evaluation efforts focused on the effectiveness of online and blended learning environments at all levels.

Encourage the use of technology and online learning courses and resources in federally funded programs that expand learning opportunities for underserved populations and others who need it most.

Encourage states, districts, P–12 programs, and postsecondary education institutions to experiment with such resources as online learning, online tutoring and mentoring, games, cognitive tutors, immersive environments, and participatory communities and social networks both within and across education institutions to give students guidance and information about their own learning progress and strategies for seamless completion of a comprehensive P–16 education.

Funding online communities of practice to ensure that teachers are connected to data, resources, experts, and peers to prepare and enable connected teaching.

The Department of Education can

Fund a contract for design research on online communities of practice and apply the design to a series of at least six communities of practice in order to leverage the use of educational technology and social networking to improve teaching, assessment, learning, and infrastructure in schools. The communities of practice will be designed to ensure teachers and other education professionals are highly connected to data, resources, content, experts, peers, and just-in-time expertise on a variety of topics.

Leverage the design work on online communities of practice to inform contracts and grants for providing technical assistance throughout the Department of Education.

Ensuring a sustained focus on R&D for education, including scaling up and sustaining innovations, technology transfer, and grand challenge problems.

The Department of Education can

Implement an approach to R&D for education that focuses on five areas:

- Transferring existing and emerging technology innovations from sectors such as business, consumer, and entertainment into education.
- Transferring appropriate developments from the Department of Defense Advanced Research Projects Administration to the public education sector.
- Supporting and sustaining the education R&D that is currently happening throughout the National Science Foundation by designing a commercialization strategy.

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- Creating a new organization (the National Center for Research in Advanced Information and Digital Technologies) with the mission of serving the public good through R&D at the intersection of learning sciences, technology, and education.
 - Providing competitive grants for scaling up innovative and evidence-based practices through the Department of Education's Investing in Innovation Fund.

Encouraging states and districts to move to more integrated use of technology in teaching and learning.

The Department of Education can

Encourage states to assign responsibility for educational technology to senior-level individuals who will provide leadership in connecting the planning for educational and information technology to the core functions of curriculum and instruction, assessment, and professional learning and in ensuring that the most efficient and effective purchases are made. These individuals will be invited to participate on a cross-functional team organized by the Department of Education to share insights and best practices and collaborate on technology for teaching and learning.

Encourage every federal grant program and expenditure to consider how technology can be a multiplier for support and scale in education.

Leading a national initiative to identify strategies for increasing productivity in education and work with states, districts, and schools to build their capacity for implementing them.

The Department of Education can

Start a national initiative and develop an ongoing research agenda dedicated to improving productivity in the education sector. The initiative will focus on defining productivity in education and establishing new and more useful metrics and methods for measuring it. The initiative will promote continuous improvement and data-driven decision making, leveraging technology to plan, manage, monitor, and report spending so that education decision-makers can be provided with a reliable, accurate, and complete view of the financial performance of our education system at all levels.

Encourage states to adopt common cost accounting standards to allow benchmarking and analysis of costs and provide a platform for sharing strategies for cost saving and productivity improvement and highlight policies at the federal, state, and local level that might inhibit progress, for example, in procurement.

Develop new and better ways of assessing the efficacy of technology in teaching and learning and in the financial operations of education institutions.

The Department of Education's mission is to promote student achievement and preparation for global competitiveness by fostering educational excellence and equal access.

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