EDUCATION

CHAPTER 11

THE UNITED STATES has some of the best schools and research universities in the world and produces top professionals in every industry. The public education system has effectively developed a workforce for the industrial age, and its graduates have helped the United States become the most prosperous nation in the world.

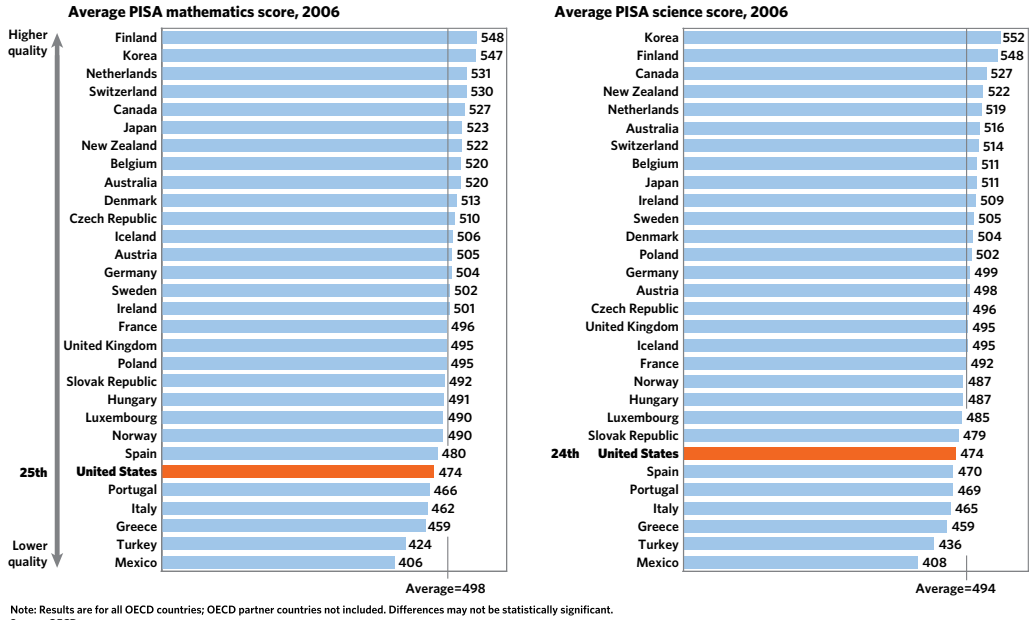
However, the demands of the new information-based economy require substantial changes to the existing system. American businesses have pointed to a widening gap between the skills of graduates and modern workforce demands.[1] The U.S. Department of Labor predicts "occupations that usually require a postsecondary degree or award... to account for nearly half of all new jobs from 2008 to 2018."[2] The 21st century workplace requires both a better-educated and a differently educated work force.[3]

While some U.S. students perform extremely well, the educational system as a whole faces huge challenges. Thirty-two percent of all public school students and nearly 50% of African American and Hispanic students fail to graduate from high school.[4] A significant gap in achievement persists, with African American and Hispanic students trailing white students of the same age by two to three years.[5] Measured against international benchmarks, the United States lags significantly behind other advanced nations in preparing its students, particularly in math and science (see Exhibit 11-A).[6]

Researchers have been studying these outcomes for years and have identified several factors that need to be addressed. These include a scarcity of well-trained teachers in key areas such as science, technology, engineering and mathematics (STEM),[7] inequitable distribution of highly qualified teachers[8] and a deficit of well-trained principals and administrators.[9] In addition, there is widespread inability to engage students in learning,[10] a lack of standards and assessments that measure learning effectively[11] and insufficient access to timely, individualized content for students.[12] Exacerbating these challenges are limited organizational transparency and accountability and the inability of teachers and principals to share best practices, content and strategies to improve achievement.[13] The escalating cost of education, measured against overall results, is also a critical issue.[14]

Exhibit 11-A: Programme for International Student Assessment (PISA) Rankings Show the United States Trailing Other Organisation for Economic Co-operation and Development (OECD) Countries

PISA rankings show United States trailing other OECD countries



Note: Results are for all OECD countries; OECD partner countries not included. Differences may not be statistically significant.
Source: OECD

Four core assurances drive the U.S. Department of Education's strategy to address these challenges:

- Making progress toward rigorous college- and career-ready standards and high-quality assessments that are valid and reliable for all students, including English-language learners and students with disabilities.
- Establishing pre-kindergarten to college and career data systems that track progress and foster continuous improvement.
- Making improvements in teacher effectiveness and in the equitable distribution of qualified teachers for all students, particularly those most in need.
- Providing intensive support and effective interventions for the lowest-performing schools.[15]

Broadband can be an important tool to help educators, parents and students meet major challenges in education. The country's economic welfare and long-term success depend on improving learning for all students,[16] and broadband-enabled solutions hold tremendous promise to help reverse patterns of low achievement.

With broadband, students and teachers can expand instruction beyond the confines of the physical classroom and traditional school day. Broadband can also provide more customized learning opportunities for students to access high-quality, low-cost and personally relevant educational material.[17] And broadband can improve the flow of educational information, allowing teachers, parents and organizations to make better decisions tied to each student's needs and abilities. Improved information flow can also make educational product and service markets more competitive by allowing school districts and other organizations to develop or purchase higher-quality educational products and services.

This chapter is arranged in three sections. Section 11.1 contains recommendations to help improve online learning opportunities, both inside and outside the classroom. Section 11.2 recommends ways to gather and provide information that fosters innovation. Section 11.3 recommends changes to the E-rate program—which offers schools and libraries discounted telecommunications services, Internet access and internal connections to improve the broadband infrastructure available to schools.

RECOMMENDATIONS

Support and promote online learning

- The U.S. Department of Education, with support from the National Institute of Standards and Technology (NIST) and the Federal Communications Commission (FCC), should establish standards to be adopted by the federal government for locating, sharing and licensing digital educational content by March 2011.
- The federal government should increase the supply of digital educational content available online that is compatible with standards established by the U.S. Department of Education.
- The U.S. Department of Education should periodically re-examine the digital data and interoperability standards it adopts to ensure that they are consistent with the needs and practices of the educational community, including local, state and non-profit educational agencies and the private sector.
- Congress should consider taking legislative action to encourage copyright holders to grant educational digital rights of use, without prejudicing their other rights.
- State accreditation organizations should change kindergarten through twelfth grade (K–12) and post-secondary course accreditation and teacher certification requirements to allow students to take more courses for credit online and to permit more online instruction across state lines.
- The U.S. Department of Education and other federal agencies should provide support and funding for research and development of online learning systems.
- The U.S. Department of Education should consider investment in open licensed and public domain software alongside traditionally licensed solutions for online learning solutions, while taking into account the long-term effects on the marketplace.
- The U.S. Department of Education should establish a program to fund the development of innovative broadband-enabled online learning solutions.
- State education systems should include digital literacy standards, curricula and assessments in their English Language Arts and other programs, as well as adopt online digital literacy and programs targeting STEM.
- The U.S. Department of Education should provide additional grant funding to help schools train teachers in digital literacy and programs targeting STEM. States should expand digital literacy requirements and training programs for teachers.

Unlock the value of data and improve transparency

- The U.S. Department of Education should encourage the adoption of standards for electronic educational records.
- The U.S. Department of Education should develop digital financial data transparency standards for education. It should collaborate with state and local education agencies to encourage adoption and develop incentives for the use of these standards.
- The U.S. Department of Education should provide a simple Request for Proposal (RFP) online "broadcast" service where vendors can register to receive RFP notifications from local or state educational agencies within various product categories.

Modernize educational broadband infrastructure

- The FCC should adopt its pending Notice of Proposed Rulemaking (NPRM) to remove barriers to off-hours community use of E-rate funded resources.
- The FCC should initiate a rulemaking to set goals for minimum broadband connectivity for schools and libraries and prioritize funds accordingly.
- The FCC should provide E-rate support for internal connections to more schools and libraries.
- The FCC should give schools and libraries more flexibility to purchase the lowest-cost broadband solutions.
- The FCC should initiate a rulemaking to raise the cap on funding for E-rate each year to account for inflation.
- The FCC should initiate a rulemaking to streamline the E-rate application process.
- The FCC should collect and publish more specific, quantifiable and standardized data about applicants' use of E-rate funds.
- The FCC should work to make overall broadband-related expenses more cost-efficient within the E-rate program.
- Congress should consider amending the Communications Act to help Tribal libraries overcome barriers to E-rate eligibility arising from state laws.
- The FCC should initiate a rulemaking to fund wireless connectivity to portable learning devices. Students and educators should be allowed to take these devices off campus so they can continue learning outside school hours.
- The FCC should award some E-rate funds competitively to programs that best incorporate broadband connectivity into the educational experience.
- Congress should consider providing additional public funds to connect all public community colleges with high-speed broadband and maintain that connectivity.

11.1 SUPPORTING AND PROMOTING ONLINE LEARNING

Broadband breaks down traditional barriers so that teaching and learning happen in new ways.

A student attending a rural school that does not offer an Advanced Placement (AP) calculus course can receive instruction online from a teacher in a different part of the state or even the country. That teacher, who is online because of her passion for the subject and because of her demonstrated ability to teach it, might not only provide lectures but may also use instant messaging and e-mail to communicate with the student. The teacher also might steer the student toward interactive tools that let students practice on their own. And the teacher might even pique the student's curiosity by using video showing how calculus applies to real-world examples such as a major league baseball player hitting a home run or how Isaac Newton developed calculus to understand gravity and the motion of the planets.

A student with a strong interest in Roman history might take an online class that includes video of an archaeologist demonstrating Roman glassmaking techniques. Outside of school hours, the student might monitor a blog the archaeologist writes while working on a dig and might e-mail the archaeologist questions and comments.

As these examples illustrate, broadband offers tremendous potential to improve education. Thanks in large part to the $2.25 billion per year in support provided by the E-rate program, virtually every school in the country has Internet access. However, computer and Internet access alone do not produce greater student achievement.[18]Access needs to be combined with appropriate online learning content, systems and teacher training and support.[19]

Carnegie Mellon University's Open Learning Initiative has shown that online learning, when "blended" with in-person instruction, can dramatically reduce the time required to learn a subject while greatly increasing course completion rates (see Exhibit 11-B).[20]

There is strong evidence that online learning classes do not sacrifice quality of instruction for convenience and efficiency. For example, students attending Florida Virtual Schools (FLVS) earned higher AP scores and outscored the state's standardized assessment average by more than 15 percentage points in grades 6 through 10 (see Exhibit 11-C).[21]

Students at Oregon Connections Academy met or exceeded state achievement averages,[22] and students in the Florida

Virtual Academy (unrelated to FLVS) have consistently outscored state test averages.[23] In its first year, the Missouri Virtual Instruction Program showed significantly improved achievement for its students compared with the same students' achievement in the same subject the previous year; greater percentages of these students scored 3 or higher on AP exams than their peers.[24]

Some school districts are finding that online systems can help with high dropout rates as well.[25] Aldine Independent School District in Texas was able to reach at-risk students and get them to take classes online that earned school credit. Salem-Keizer School District in Oregon has re-enrolled more than 50% of dropouts and at-risk students through its online Bridge Program annually. At FLVS, 20% of the program's students enrolled to earn remedial credit. The passing rate of students taking make-up courses was 90%.[26] In addition to dropout prevention, online systems provide flexibility to students who cannot be in school for health, child care, work or other reasons.[27]

Teachers also benefit from online professional learning communities, lesson development websites and certified professional development opportunities. This allows them to fulfill their learning requirements in more flexible and diverse ways. A 2005 Texas study found the Online Post-Baccalaureate Program was just as successful as traditional teacher preparation programs and was more successful in attracting more diverse candidates in terms of race and gender. It also was more successful in recruiting science and math teachers.[28]

But there are still major barriers to realizing the full potential of online learning:

- There is a limited pool of high-quality digital content that is easily found, bought, accessed and combined with other content to allow teachers to customize classroom materials to their students' needs.
- Students often have trouble obtaining course credit for online classes, and teachers licensed in one state may not be able to teach online courses in another.[29]
- Students and teachers may lack the digital literacy skills necessary to make use of broadband tools.[30]

The following recommendations, which expand digital content and online learning systems and promote digital literacy, will help address these barriers.

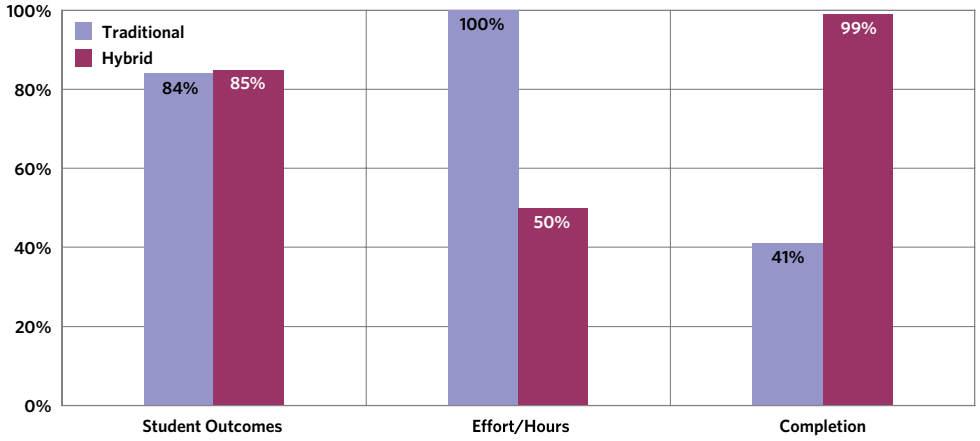
Expanding Digital Educational Content

The federal government can address the first barrier through three steps. First, it should define and adopt standards for finding and sharing digital educational content as well as licensing educational material for digital use. Teachers, students and other users should be able to easily find, purchase, access and combine any digital resources meeting the standards. Second, government should take steps to create a pool of digital educational resources meeting the U.S. Department of Education's standards. Third, government should encourage authors and private sector organizations to contribute their material within these standards.

RECOMMENDATION 11.1: The U.S. Department of Education, with support from the National Institute of Standards and Technology (NIST) and the Federal Communications Commission (FCC), should establish standards to be adopted by the federal government for locating, sharing and licensing digital educational content by March 2011.

As with the music industry[31] and, increasingly, with video[32] and books,[33] broadband can generate new models for creation, publication and distribution of educational resources. Greater flexibility in the way content can be accessed can have a direct

Exhibit 11-B: Carnegie Mellon Online Learning Initiative



impact in the classroom. For example, it allows for differentiated instruction that can help students with variable levels of subject-area mastery by providing more tailored learning opportunities.[34] A strong reader can be given more challenging material rather than wait while the rest of the class catches up. A weaker reader can be given material more appropriate to his level without holding back the rest of the class. Teachers can more easily select materials that fit the specific needs of different students. Digital content standards can help make that possible by offering a much wider choice of content than typically found in traditional printed curricular materials.

While digital content is available currently, there are significant challenges to finding, buying and integrating it into lessons. Content is not catalogued and indexed in a way that makes it easy for users to search. It is also hard for teachers to find content that is most relevant and suitable for their students. Even if one finds the right content, accessing it in a format that can be used with other digital resources is often difficult or impossible. And if the desired content is for sale, the problem is even harder because online payment and licensing systems often do not permit content to be combined. These three problems—finding, sharing and license compatibility—are the major barriers to a more efficient and effective digital educational content marketplace. These barriers apply to organizations that want to assemble diverse digital content into materials for teachers to use, as well as to teachers who want to assemble digital content on their own.

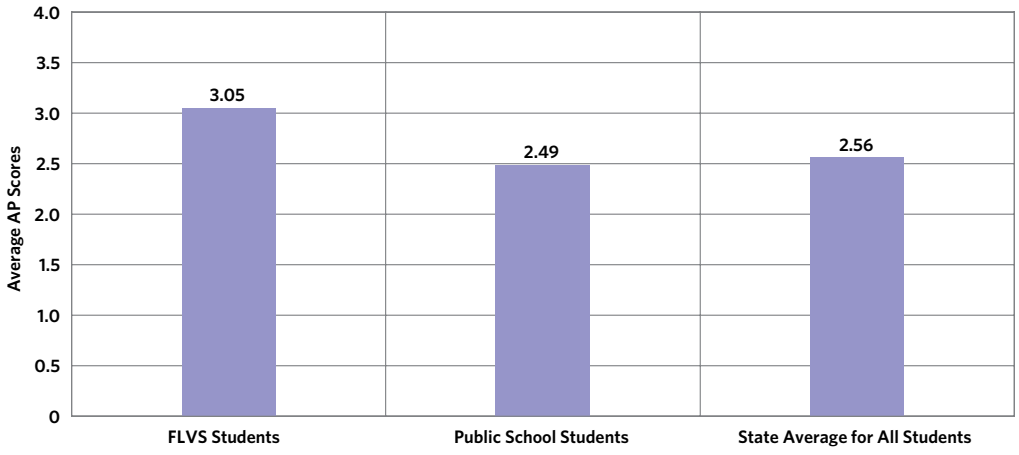
Digital content standards will make it possible for teachers, students and other users to locate the content they need, access it under the appropriate licensing terms and conditions, combine it with other content and publish it. This way, a teacher preparing a presentation on greenhouse gas emissions could easily find and combine National Aeronautics and Space Administration (NASA) pictures and videos on the impact of global warming on the polar ice caps with U.S. Department of Energy (DOE) graphs on fossil fuel consumption and a textbook chapter on clean energy sources.

The U.S. Department of Education should select standards for digital educational content after consulting with other government agencies, the educational community and the private sector. Once the standards are selected, the federal government should ensure all educational content it develops or sponsors is compatible with those standards. The following recommendation lays out specific steps the U.S. Department of Education can take to achieve this.

RECOMMENDATION 11.2: The federal government should increase the supply of digital educational content available online that is compatible with standards established by the U.S. Department of Education.

- **The Executive Branch should make digital educational resources they own available online in a format compatible with the standards defined in Recommendation 11.1.**
- **Whenever possible, federal investments in digital educational content should be made available under licenses that permit free access and derivative commercial use and should be compatible with the standards defined in Recommendation 11.1.**
- **The U.S. Department of Education should encourage vendors that sell paper-based educational materials to sell digital versions or provide digital rights independent of rights on printed materials; whenever possible this content should be aligned with the standards defined in Recommendation 11.1.**

Exhibit 11-C: Florida Virtual Schools Students Taking Distance-Learning Courses Get Higher AP Scores



Many federal agencies own and develop new educational content. Making this content available online—in accordance with standards that allow for discovery, sharing and license compatibility—has two effects. It benefits end-users as it makes it easier for them to use the content. And it may encourage third parties such as universities, publishers and individuals to ensure the digital resources they own and produce comply with the same standards.

Millions of digital learning resources already are available under open and commercial licenses. Publishers of digital content include NASA, DOE, the Corporation for Public Broadcasting, universities nationwide,[35] large publishing houses and authors.[36] By providing greater access to a broad set of educational content, the federal government can give teachers and schools more tools to address their instructional challenges. This also can create business opportunities for companies to develop new educational solutions without the costs of re-creating educational content that already exists.

In addition, the U.S. Department of Education should provide grants and other incentives to vendors to offer their materials in digital formats compatible with the standards it adopts. The ultimate goal of such incentives is to provide more choice for customers and a more competitive market. The Department could use incentives and other strategies to help identify and make available the highest-quality and most relevant digital content to educators so that teachers can find what they need with less effort and have a greater impact in the classroom.

RECOMMENDATION 11.3: The U.S. Department of Education should periodically reexamine the digital data and interoperability standards it adopts to ensure that they are consistent with the needs and practices of the educational community, including local, state, and non-profit educational agencies and the private sector.

Recommendation 11.2 above could lead to the creation of a large enough pool of digital educational content to catalyze the private sector to adopt the same set of standards or standards that are compatible with those chosen by the federal government. Whether or not this will in fact occur is not certain. Because of the quickly changing nature of this space, it is also possible that in the future the private sector will develop and adopt standards that are fundamentally different from those chosen by the U.S. Department of Education in the near term.

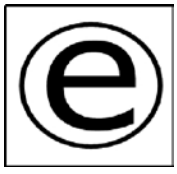
Therefore, in addition to evolving its standards definitions and implementations to take into account incremental market and technology changes, the U.S. Department of Education should set a specific timeline to re-examine its overall choice for digital educational content (e.g., every 5 years). This re-examination should take into account both the success and effectiveness of the chosen standards and the evolution of digital educational content in broader contexts such as local, state, non-profit and commercial content.

RECOMMENDATION 11.4: Congress should consider taking legislative action to encourage copyright holders to grant educational digital rights of use, without prejudicing their other rights.

New broadband-enabled solutions are transforming how teachers and students use content and media. But copyright law must keep pace as new technologies and media are developed. In part due to a lack of clarity regarding what uses of copyrighted works are permissible, current doctrine may have the effect of limiting beneficial uses of copyrighted material for educational purposes, particularly with respect to digital content and online learning. In addition, it is often difficult to identify rights holders and obtain necessary permissions. As a result, new works and great works alike may be inaccessible to teachers and students. For instance, a film containing archival and documentary footage of Martin Luther King, Jr. and the struggle to end segregation could no longer be shown or distributed because of the expense and legal complications of license renewals related to "orphan works" (copyrighted works whose owners are difficult or impossible to identify).[37] Teachers seeking to use Beatles lyrics to promote literacy, employing music as a cultural bridge, could not afford the $3,000 licensing fee charged by the rights holders.[38] Text-to-speech features for the Amazon Kindle e-book reader were shut off because of a copyright dispute–While both parties to the dispute raised legitimate concerns, several universities chose not to provide the device to students. That, in turn, slowed the adoption of lower-cost e-textbooks and eliminated a useful tool for the visually impaired.[39] Penalties for copyright infringement can be substantial,[40] but the boundaries between permissible and impermissible uses of copyrighted works in educational contexts—particularly with respect to digital content and online learning—are not always clear. That produces a chilling effect on teachers, schools, and school districts, which limits the use of cultural works for educational purposes.

Increasing voluntary digital content contributions to education from all sectors can help advance online learning and provide new, more relevant information to students at virtually no cost to content providers. Congress should consider ways for

Exhibit 11-D: Proposed Copyright Notice Permitting Free Educational Use



educators to interact with their students using new educational content contributed by the public in the following ways:

- *Update TEACH Act.* Congress could consider updating the TEACH Act[41] to better allow educators and students to use content for educational purposes in distance and online learning environments without prejudicing the other rights of copyright holders.
- *New Copyright Notice.* Congress could consider directing the Register of Copyrights to create additional copyright notices to allow copyright owners to authorize certain educational uses while reserving their other rights (see Exhibit 11-D).
- *Facilitate Licensing.* Congress could consider providing a statutory framework to facilitate identification of copyright holders and securing of permissions in an efficient and cost-effective way, while retaining existing protections for educational uses without exceeding permissible exceptions and limitations under copyright law.

Expanding Online Learning Systems

Effective broadband-based solutions exist. But they often are deployed only in limited ways for various reasons, including regulatory barriers, market forces, limited resources and capacity constraints. Many promising ideas and applications have been developed in ways that do not foster wide-scale use and adoption or integration into the classroom. The following recommendations propose steps to bring online learning opportunities to scale.

RECOMMENDATION 11.5: State accreditation organizations should change kindergarten through twelfth grade (K–12) and post-secondary course accreditation and teacher certification requirements to allow students to take more courses for credit online and permit more online instruction across state lines.

Educational opportunities in the United States are distributed inequitably, usually because of unequal access to high-quality teachers and curricula.[42] Online learning can help reduce such disparities.

In a survey of more than 10,000 school districts, 70% of respondents saw distance learning[43] as important for delivering courses not otherwise available in their schools; 60% cited AP courses. Forty percent cited distance learning as a way to provide certified teachers when not enough are available for face-to-face instruction.[44] Rural and high-poverty schools often have difficulty placing highly qualified teachers in every classroom.[45] Rural districts, in particular, strongly identify distance learning as important for meeting the needs of their students, who do not always have access to specialized teachers.[46] These schools, as well as charter and small schools, have difficulty affording teachers for advanced classes because of limited budgets and programming flexibility.[47]

Despite the benefits of distance learning, students often have trouble obtaining course credit for online classes. Also, teachers licensed in one state may not be able to teach online courses in another.[48] Although many states and districts offer make-up courses online, very few virtual schools are able to grant high school diplomas.[49]

It is unusual for a teacher certified in one state to be allowed to teach in another without recertification. If a teacher experienced in a specific subject is available in one state but the student is enrolled in a different state, current regulations can make it difficult and sometimes impossible for the student to obtain course credit. Additionally, many states have course hour requirements that make it challenging to obtain course credit from online solutions that do not track "seat time" in the same way as traditional classes.

While states need to change their requirements, the U.S. Department of Education should help states work together to achieve the national goal of improving online education opportunities.

RECOMMENDATION 11.6: The U.S. Department of Education and other federal agencies should provide support and funding for research and development of online learning systems.

Online learning systems too often are deployed without effective research and development strategies. Moreover, designs are often not improved over time based on quantitative data.[50] Because online learning can take place "anytime, anywhere," research has proved to be more difficult than for in-class instruction.[51] The federal government can help by supporting, requiring and publishing data on the effective—and ineffective—aspects of online learning systems.

As online learning systems are deployed, research must be designed to measure their effectiveness—including "real-time, interaction-level data on how [students] are learning to inform further course revisions and improvements."[52] The U.S. Department of Education and state governments can play a key role in this process by using field research and other data to highlight the most promising systems.

RECOMMENDATION 11.7: The U.S. Department of Education should consider investments in open licensed and public domain software alongside traditionally licensed solutions for online learning solutions, while taking into account the long-term effects on the marketplace.

Cost is a significant problem for online learning solutions: Utah's state government said that it "lack[s] affordable digital asset management systems that will be able to take full advantage of public repositories of information such as that

made available from the PBS Digital Learning Library and the vast treasure trove of online content yet to be harvested from other public repositories like the National Archives and the Smithsonian Institution."[53] Traditionally, licensed commercial products can cost 10–13% more in total cost of ownership than open-source equivalents, while delivering equivalent capability.[54] Although adopting open-source software has unique risks, it can also offer significant benefits when implemented appropriately.

Some federal and state agencies have already found open-source software to be cost-effective across a wide array of applications. The Department of Defense determined in 2006 that it was inadvertently increasing its own software costs "by not enabling internal distribution" of open-source technologies.[55] By funding development of innovative educational software applications under open-source licenses, the U.S. Department of Education may, in some cases, be able to accelerate the deployment of new technologies until they are mature enough to be resold by the educational vendor community.

Where suitable commercial online learning products are already available, it may be cheaper to buy product licenses rather than develop new open licensed solutions. However, open licensed investments can offer an additional strategy that can be pursued alongside licensing to strengthen the solutions available to the educational market. Ensuring that private capital continues to enter the educational online learning market needs to be an important consideration when the federal government considers open licensing strategies.

RECOMMENDATION 11.8: The U.S. Department of Education should establish a program to fund development of innovative broadband-enabled online learning solutions.

Currently, the educational technology market suffers from "a classic market failure . . . that discourages private industry from heavily investing in basic research to exploit emerging information technologies for learning . . . This situation requires a federal research investment to do for learning what the National Science Foundation does for science, the National Institutes of Health does for health and what the Defense Advanced Research Projects Agency (DARPA) does for defense."[56] Education markets, however, are "notoriously difficult to enter [because] they are highly fragmented and often highly political."[57]

Government investment in other sectors has helped fill gaps in private investment.[58] For example, federal funding for research in broadband technologies has encouraged numerous innovations, creating billions of dollars of economic value.[59]

Several examples exist of government funding of innovation in education. The American Graduation Initiative bill proposes $50 million over 10 years to finance an Online Skills Laboratory (OSL) to develop innovative learning solutions for Community Colleges. OSL's proposed focus on solutions that are free for use and resale will help ensure that the innovations that emerge can be used widely. The U.S. Department of Education's Race to the Top and Investing in Innovation funds are also good examples. But these programs have limited funding cycles. Attention and funding must be given over an extended period to ensure that the best ideas, products and businesses survive to become marketable and sustainable.

Establishing such an "ARPA-ED"[60] educational broadband investment fund with a longer lifetime—eight years, for example—to make seed loans and grants to early-stage education companies or nonprofits can help stimulate sector-wide progress.

Promoting Digital Literacy

In an increasingly digital world, literacy must be defined more broadly to include fluency in digital skills and information. Digital literacy is "the ability to find, evaluate, utilize, and create information using digital technology."[61] Additional skills include "the ability to read and interpret media (text, sound, images), to reproduce data and images through digital manipulation and to evaluate and apply new knowledge gained from digital environments."[62] It can include the ability to analyze and reflect critically on digital media.[63] Digital citizenship and safety are often included in definitions of digital literacy as well. A detailed consideration of digital literacy can be found in Chapter 9 of this plan. The following recommendations address strategies to promote digital literacy for educators and students.

RECOMMENDATION 11.9: State education systems should include digital literacy standards, curricula and assessments in their English Language Arts and other programs, as well as adopt online digital literacy and programs targeting STEM.

Digital literacy skills are required to take full advantage of online learning systems[64] and future job opportunities. But students and teachers often lack such skills.[65] While today's students may be competent with some technology, they are far from expert when it comes to locating and using information.[66] Internet skill levels and usage rates among young people in the European Union now exceed those of their peers in the United States.[67]

Many U.S. students can handle computer keyboards and wireless devices, but digital literacy involves more than the ability to use a device. Students must be able to analyze problems so they can determine what information is needed to perform an academic or work task; access, assimilate, organize and analyze the information; interpret the information; conduct research; and effectively communicate their understanding and interpretation of the information to others.[68] Integrating digital literacy into existing subject areas such as

English Language Arts allows for these skills to be used and developed in a practical manner, without taking time away from other subjects by creating stand-alone courses. Students must also understand their ethical responsibilities online and know how to stay safe while using advanced broadband technologies.[69] To succeed in the 21st century workplace, students must be digitally proficient at developing, advancing and applying their own knowledge and skills within virtually any field or profession.[70]

RECOMMENDATION 11.10: The U.S. Department of Education should provide additional grant funding to help schools train teachers in digital literacy and programs targeting STEM. States should expand digital literacy requirements and training programs for teachers.

Achieving digital literacy goals for students means teachers also must be digitally literate (see Box 11-1). While teacher use of technology continues to grow, most teachers still do not use technology in their classrooms for many key activities.[75] Teachers without digital literacy skills find it difficult to incorporate online learning solutions into instruction. Similarly, it is hard for students who lack such skills to engage with the systems to learn.[76]

Teachers report that teaching online requires different skills than teaching in a bricks-and-mortar classroom.[77] Students also need training in online learning methods. Consequently, teachers need training both as online instructors and in teaching methods that combine online and face-to-face learning.[78] Online courses at the secondary level often serve younger-than-average students seeking access to accelerated courses in math or science that are not available in their regular schools. Online courses also serve older-than-average students needing a slower pace and more individualized attention.[79] This variability in students' skills, combined with the geographical distribution that occurs in an online environment, provides additional challenges for which teachers must prepare.

BOX 11-1:

Online Learning Can Support Investment in STEM

Expertise in STEM will be critical to maintaining the United States' competitive edge in the 21st century.[71] A critical shortage of highly qualified math and science teachers, particularly in low-income urban school districts and rural districts, threatens this competitive edge.[72] Providing access to more online learning systems, coursework and materials in STEM can improve opportunities for students who are interested in working in these areas but lack local, high-quality learning opportunities.[73] The Executive Office of the President recently announced a $250 million public-private investment for STEM teacher recruitment, professional development and the use of innovative teaching methods such as online learning. This is an excellent example of the kind of investment that should be made in this area.[74] In addition, improved online solutions for professional development of teachers can help train new teachers and give existing teachers new techniques and resources for instruction in these fields.

11.2 UNLOCKING THE POWER OF DATA AND IMPROVING TRANSPARENCY

Ideally, a teacher would have real-time access to accurate information about each student's mastery of skills, course grades, test scores and progress over time. Other pertinent information would include the student's behavior and learning style, his or her prior experiences in school and more. As students transfer among multiple classrooms during the year—something more likely to happen with at-risk children—the same information would be available as soon as the child walks through the door. In addition, if an issue arose that was outside a teacher's experience—for instance, providing alternative teaching strategies for an individual student—the teacher would have instantaneous access to online information about the issue and, perhaps, to experts and colleagues who could offer advice.

In addition to benefiting individual students and teachers, the creation of a large-scale pool of electronic educational records could potentially transform education. Anonymized records with detailed data on schools, educators and students would allow educators to determine in a fact-based fashion what works and when, and what the actual costs and benefits are of different practices. It would allow researchers to learn from the best practices and brightest ideas of every great teacher and principal in America. It would help educators determine when improved educational outcomes are a consequence of practices and techniques that are transferable to different contexts or due to factors not directly associated with educational practices.

At the moment, however, schools run on a patchwork of proprietary data systems that make sharing meaningful information about students slow and difficult. Disjointed administrative systems and processes currently keep schools, school systems, colleges and universities from conducting fast,

efficient transfers of student data and related information.[80] Consequently, teachers often have only bare-bones information about their students. "Only 37 percent of all teachers reported having electronic access to achievement data for the students in their classrooms in 2007."[81] This results in a situation where "a significant proportion of teachers still do not have access to the data necessary for making instructional decisions."[82] Any design of electronic educational records should account for parent and student privacy and rights to control their information, as well as the need for schools and researchers to share data.

Schools suffer from other data issues, too. They lack adequate market data about vendors, products and services, making purchases of technology and resources inefficient.[83] The difficulty in obtaining overall market data means federal and state policies are not always informed by up-to-date information about what products and services are in use, which product categories are growing quickly and where rapid turnover in product choices might indicate underlying problems that policy could address.

The recommendations that follow address a number of the barriers preventing the free and efficient flow of information in education.

RECOMMENDATION 11.11: The U.S. Department of Education should encourage the adoption of standards for electronic educational records.

- **The U.S. Department of Education should support and accelerate the adoption of electronic educational records capability among states and local education agencies. It should also set standards for sharing this information so data can be transferred across states.**
- **The U.S. Department of Education should support any secure authentication strategy developed by the Federal Chief Information Officer that permits private, decentralized identification of educational agencies, students and their data records.**
- **The U.S. Department of Education should recommend to Congress updates to student data privacy and protection laws that would improve online educational services.**

The health care and education sectors face similar problems: Just as educators lack important information about students' histories, doctors and nurses are often in the dark about the needs of new patients who arrive for treatment for the first time. These patients may have long, complicated histories of symptoms and treatments, many of which may not be readily apparent without careful interview and diagnosis. And the risks of missing an important issue are severe. The federal government is making significant investments in electronic health records (see Chapter 10).[84] The federal government should also encourage development of electronic educational records to allow schools to support each student with a more complete digital picture.

Information in an electronic educational record could include student demographic and academic information as well as course history, student work, attendance and health data. Electronic educational records also could include information about teachers, schools, curriculum and other administrative data. Currently, these data often are stored in a variety of systems across a school or district and sometimes are available only on paper.

Data stored in these systems typically cannot be transferred from one system to another. This means it is expensive and time-consuming to look at all the different data together. Consequently, it can be difficult or impossible to analyze data for trends about what kind of instruction seems to be producing the best results. The inability to share data in a standardized form also makes it hard to identify students requiring special attention, especially those who change schools frequently.

Complete pictures of student performance need to be available to teachers, principals, districts, states, the federal government, research communities and colleges and universities.[85] More effective tools and standards are needed to create a national network of data systems to manage and transfer data between organizations while maintaining student privacy.

The U.S. Department of Education, along with a number of states, independent standards groups and other organizations, have been working toward developing educational data-sharing solutions for more than a decade.[86] The U.S. Department of Education is currently working on a National Educational Data Model, which is a critical step toward data sharing and interoperability. The Schools Interoperability Framework Association, IMS Global Learning Consortium and others continue to advance important technical standards. Numerous components remain undeveloped. And many of the existing incentives for local education agencies and states to adopt electronic educational records are insufficient to justify the cost and risk associated with implementation. A more comprehensive solution is required. The U.S. Department of Education is positioned to convene the necessary stakeholders to develop an effective national solution that accommodates the different needs of the educational agencies across the country.

The federal government needs to:

- Develop standards for electronic educational records and the ability to share this information through interoperability.
- Encourage state and local adoption of electronic education records consistent with these standards.
- Integrate digital authentication.
- Strengthen and modernize privacy and protection laws.

Working toward the goal of national educational data sharing, the U.S. Department of Education should convene stakeholders to adopt the standards by implementing them in ways that make it easier for schools to satisfy reporting requirements or by funding projects that help vendors test and implement the standards in their products.

Privacy and data protection laws for students and their families need to be modernized to reap the full benefit of improved information flow about student performance while still fully protecting student data. For example, organizations offer tutoring and supplemental services to students, but the legal status of the data they collect is unclear. Issues include whether parents and regulators have the same rights to the data as they have with school records. A relatively small change in the law to allow parents to combine data from outside sources with school data would provide a richer picture of students' learning needs so all providers can support them effectively. There may also be cases in which fine-grained levels of privacy control are appropriate. For example, students should be able to select and share their best work with other educational institutions, the military or future employers from within their digital portfolios or other materials linked to electronic educational records.

RECOMMENDATION 11.12: The U.S. Department of Education should develop digital financial data transparency standards for education. It should collaborate with state and local education agencies to encourage adoption and develop incentives for the use of these standards.

The public education system is highly decentralized, with total annual spending of hundreds of billions of dollars.[87] Escalating expenditures in education have not resulted in improvement in student gains.[88] Public education finances are a matter of public record. But it is difficult—if not impossible—to aggregate this information because it is stored in a distributed manner across thousands of county, district and regional administrative agencies. As a result, decisions about how to invest resources in education are often made without the benefit of understanding what investments have the greatest impact.

The benefits of improving access to these financial data over the Internet could be significant. State and local education agencies, academic researchers and others could more easily gather and analyze financial data to inform resource allocation decisions at the school, district, state and national levels, as well as research and policy questions about the educational impact of financial decisions. In addition, the availability of school expenditure data in machine-readable format may motivate the development of new applications and tools for school communities, districts and other support organizations to help them manage finances more effectively.

In some circumstances, making financial information—including product pricing—easier to access, compare and analyze can lead to tacit price collusion among competing providers and to overall higher prices.[89] Delaying publication of these data, or aggregating them in ways that still allow meaningful and actionable tracking and comparison, could help reduce the chances that collusion will occur while still providing the benefits of making financial data more accessible. In developing standards and procedures for collecting and sharing educational financial data in digital form, the U.S. Department of Education should determine the appropriate level of aggregation for financial data collection[90] and amount of time that should elapse between expenditure and publication, based on trends in market pricing.

RECOMMENDATION 11.13: The U.S. Department of Education should provide a simple Request for Proposal (RFP) online "broadcast" service where vendors can register to receive RFP notifications from local or state educational agencies within various product categories.

In addition to financial data transparency standards for education, the federal government can provide RFP notification services—similar to RSS feeds on the traditional Internet—where vendors could register to receive notifications of new RFPs and where local educational agencies (LEAs) could transmit their RFPs when they want to receive maximum exposure and bidding for a purchasing contract.[91] This would make it easier for LEAs to find vendors with products or services they want to purchase. Past RFPs could be stored in a central repository as they are posted, providing useful historical data.

This product pricing information database and RFP broadcast service could together give many LEAs the opportunity to improve their ability to find and acquire the best product or service at the best price.

11.3 MODERNIZING EDUCATIONAL BROADBAND INFRASTRUCTURE

Congress directed the FCC in 1996 to provide discounts on telecommunications and other services "to elementary schools, secondary schools and libraries for educational purposes"[92] and authorized the FCC to support broadband services as part of that program.[93] In response, the FCC developed the Schools and Libraries universal service support mechanism (also

known as E-rate), which offers schools and libraries the chance to receive telecommunications services, Internet access and internal connections at a discounted rate. Thousands of schools and libraries have received billions of dollars since the E-rate program began 12 years ago.

As a result, Internet access is nearly universal in the nation's schools and libraries. Today, about 97% of public schools have access to the Internet.[94] In classrooms, more and more students have access to Internet-connected computers, and 94% of instructional rooms have at least some Internet access.[95] In addition, in-school use of the Internet and technology by students and teachers is growing rapidly.[96] Public schools are connected to a district network 92% of the time. Types of connections from schools to districts include direct fiber (55%), T-1 or DS1 lines (26%) and wireless connections (16%).[97]

Eighty-four percent of districts have district-wide networks. These districts have connections to Internet service provider(s) via T-1 or DS1 lines (42%), direct fiber (37%), wireless connections (18%), broadband cable (13%) and T-3 or DS3 lines (12%). Direct fiber connections are found in a larger percentage of city districts than in suburban, town or rural districts (62% versus 49%, 46% and 24%, respectively). More rural districts than city districts report T-1 or DS1 connections (51% versus 18%).[98]

However, inadequate connectivity speeds and infrastructure issues are frequently reported,[99] and bandwidth demands are projected to rise dramatically over the next few years.[100] Moreover, there is pent-up demand in schools and communities for access to more broadband content and tools. This demand has not been met in part because applicants require greater bandwidth to use these tools; E-rate provisions do not always support the latest strategies for deploying broadband networks (which have evolved significantly since 1996); the application process is cumbersome; and the E-rate program is oversubscribed.[101]

Additionally, many schools will need significant upgrades to meet projected broadband bandwidth demands in the future.[102] Online educational systems are rapidly taking learning outside the classroom, creating a potential situation where students with access to broadband at home will have an even greater advantage over those students who can only access these resources at their public schools and libraries. The E-rate program needs to be updated and strengthened to ensure the rapid growth of online learning and data sharing in education are not limited by insufficient bandwidth.

This section recommends a number of changes to the E-rate program to address these challenges and the opportunities presented by new broadband-enabled technologies.

Three key goals should drive modernization of the E-rate program:

- Improve flexibility, deployment and use of infrastructure
- Improve program efficiency
- Foster innovation

Improve Flexibility, Deployment and Use of Infrastructure

RECOMMENDATION 11.14: The FCC should adopt its pending Notice of Proposed Rulemaking (NPRM) to remove barriers to off-hours community use of E-rate funded resources.

Currently, FCC rules require schools seeking support under the E-rate program to certify that services funded by E-rate "will be used solely for educational purposes."[103] Schools are the site of many community activities. Use of school networks should be permitted when such activities do not interfere with the educational use of the network. Moreover, such access should be available free of charge because the school's excess capacity is otherwise unused. For example, adult job-training programs by community nonprofits are currently discouraged from using school network facilities because of network cost-sharing requirements—even though night-time programs would have no impact on students' network use. Schools should have the option to use their broadband resources in this way. Numerous organizations have cited the benefits these changes would bring to schools and communities.[104]

The FCC recently approved an order to temporarily waive the rules dealing with these barriers, and it should adopt its pending NPRM to implement this recommendation.

RECOMMENDATION 11.15: The FCC should initiate a rulemaking to set goals for minimum broadband connectivity for schools and libraries and prioritize funds accordingly.

All schools and libraries should provide sufficient broadband Internet access to their students and patrons. Setting minimum service goals for schools and libraries can help ensure adequate services to all communities. Minimum service goals for schools and libraries should not be set based on speed and quality of service alone. Factors including the number of peak active users as well as the type and quantity of broadband services consumed should be factored into defining these minimum service goals. The minimum service goals for schools and libraries should be adjusted regularly (every three to five years) because broadband bandwidth requirements change frequently.[105]

Some schools and libraries need help making the transition to broadband. Data from the Universal Service Administrative Company (USAC) for FY2009 show the E-rate program received at least 200 requests for funding for dial-up access to the Internet. The FCC should investigate the reasons behind those funding requests. For example, the FCC should explore whether those schools and libraries lack access to the physical infrastructure necessary for broadband, whether it is simply an issue of funding and/or whether they lack the other resources,

such as hardware, to make the best use of faster connectivity speeds. The FCC should also examine whether there are economic and social characteristics of the communities relevant to those 200 requests that are common. For example, do they tend to be communities with a large percentage of residents that are lower-income? The FCC should determine if there are other communities that may have similar characteristics and may need this funding.

Once the barriers to access and adoption have been identified, the FCC should develop strategies to address those barriers. For example, the FCC could give additional funding to or place a higher priority on schools and libraries using dial-up so that they could transition to broadband services. Such a plan could also be used to upgrade schools and libraries with low-tier broadband services.

RECOMMENDATION 11.16: The FCC should provide E-rate support for internal connections to more schools and libraries.

The E-rate program provides two "priorities" for discounting telecommunications services. Priority 1 is for external telecommunications connections and Priority 2 is for internal connections and wiring. While the E-rate program has always been able to fund all Priority 1 requests, Priority 2 funding requests have exceeded the E-rate program's cap in every year but one during the program's existence. In the past 10 years, only the neediest schools and libraries have received funding for the internal connections necessary to utilize increased broadband capacity, and the vast majority of requests for internal connections have gone unfunded. For example, in funding year 2007, applicants requested more than $2 billion for internal connections and internal connections maintenance but only $600 million was authorized for funding. Only schools or libraries at a discount level of 81% or higher received funding.

The result is that the vast majority of schools and libraries, while receiving discounts to help pay for broadband services, do not receive funds for the internal infrastructure necessary to utilize increased broadband capacity. In order to ensure that schools and libraries have robust broadband connections and the capability to deliver that capacity to classrooms and computer rooms, the FCC should develop ways that Priority 2 funding can be made available to more E-rate applicants.

RECOMMENDATION 11.17: The FCC should give schools and libraries more flexibility to purchase the lowest-cost broadband solutions.

Numerous E-rate applicants have provided input in the National Broadband Plan record, asserting that current E-rate rules do not always make it possible for them to acquire the lowest-cost, highest-value broadband available to them. Applicants should be able to acquire the lowest-cost broadband service, whether it is a fully leased or a mixed lease/own solution. For instance, the current ineligibility of dark fiber prevents applicants from pursuing lower-cost mixed lease/own strategies for broadband infrastructure. Allowing funding for ownership or leasing of dark fiber and associated communications equipment could allow recipients to use locally underutilized commercial or governmental capacity to provide lower-cost, high-value broadband instead of leased services currently eligible for E-rate discounts. The FCC should re-examine specific E-rate rules that appear to limit the flexibility of applicants to craft the most cost-effective broadband solutions based on the types of broadband infrastructure, services and providers available in their geographic areas.

For example, the Mukilteo School District in the state of Washington reports that it currently uses dark fiber (without support from E-rate) at a cost of $0.0009/student/Mbps/month, which is 1/300th of the cost charged by a telecommunications carrier for a similar E-rate-approved service (costing $0.27/student/Mbps/month).[106] The district indicates its costs include maintenance and service level agreements providing equivalent service to an E-rate-eligible service. Similarly, the Council of Great City Schools noted the flexibility to lease dark fiber from providers and own the related equipment would permit "the most cost-effective pricing" for schools and libraries.[107] The state of Wisconsin said E-rate should prefer the most cost-effective solution.[108] Other commenters expressed support for giving recipients more flexibility to use dark fiber as part of their broadband solutions. These organizations also said participants need more flexibility to reduce the overall cost of broadband, increase bandwidth and participate in local and regional networks using dark fiber.[109]

The E-rate program already has a three-year amortization rule for "special construction" fees that E-rate applicants pay carriers that construct infrastructure to serve them. This is done to avoid front-loading the E-rate fund with expenses tied to such long-lasting projects. Extending this rule to situations where recipients receive funding for broadband solutions that may involve ownership or mixed lease/ownership of network components—such as the need to purchase equipment to light leased dark fiber—could reduce the short-term impact on the fund.

Improve Program Efficiency

RECOMMENDATION 11.18: The FCC should initiate a rulemaking to raise the cap on funding for E-rate each year to account for inflation.

The current program's annual spending has fallen by about $650 million in inflation-adjusted dollars since the program began.[110] It also is significantly oversubscribed, leaving most internal wiring requests unmet each year. Annual funding applications consistently have exceeded the cap by nearly a two-to-one margin. Some applicants do not apply for internal wiring (Priority 2) funding because they know from experience the cap is reached before many Priority 2 requests are funded.[111] The E-rate program should be indexed to the inflation rate to prevent continued depreciation.[112]

RECOMMENDATION 11.19: The FCC should initiate a rulemaking to streamline the E-rate application process.

The FCC has reduced administrative burdens on applicants over the past several years. However, procedural complexities still exist, sometimes resulting in applicant mistakes and the imposition of unnecessary administrative costs. These complexities also may deter eligible entities from even applying for funds in the first place. The FCC should continue to protect the E-rate program from waste, fraud and abuse. However, straightforward modifications to the program can improve the administration, allocation and disbursement of funds while still ensuring that funding is used for its intended purpose.

Some existing application requirements may be unduly burdensome and also may result in applicants duplicating their efforts in order to meet other federal or state requirements. The FCC can ease burdens on applicants for Priority 1 services that enter into multiyear contracts. Applications for small amounts could be streamlined with a simplified application similar to the "1040EZ" form the Internal Revenue Service makes available for some taxpayers. The FCC should also work with other relevant federal agencies, including the U.S. Department of Education and the Department of Agriculture, to streamline requirements between agencies and ensure that schools and libraries do not have to duplicate work because of uncoordinated deadlines or other requirements that differ only slightly.[113]

RECOMMENDATION 11.20: The FCC should collect and publish more specific, quantifiable and standardized data about applicants' use of E-rate funds.

Currently, USAC obtains from applicants applying for E-rate funding certain basic information about their Internet connectivity but does not analyze the responses in the aggregate.[114] As a result, the FCC lacks comprehensive knowledge of the different types or capacities of broadband services that are supported through the E-rate program. The collection of this type of information from E-rate program participants will enable the FCC to determine how the E-rate program can better meet applicants' needs. Therefore, the FCC should modify the relevant FCC forms to determine more accurately how schools and libraries connect to the Internet, their precise levels of connectivity and how they use broadband. The collection of this additional information will enable the FCC to continue to improve the management and design of the program as network technologies and uses change in the future.

RECOMMENDATION 11.21: The FCC should work to make overall broadband-related expenses more cost-efficient within the E-rate program.

The FCC should encourage schools and libraries to use state, regional, Tribal and local networks to increase school and library purchasing power.[115] It should support the establishment of state, regional, Tribal and local networks through the E-rate program. In addition, better collaboration among state and federal programs, including the FCC's Rural Health Care Program, could reduce the potential waste of federal resources and maximize available federal funding for broadband-related projects.[116] The FCC should explore creative solutions to aid schools and libraries in reducing their broadband-related costs so that they can purchase the maximum amount of broadband for their limited dollars. For example, the FCC could establish a website that facilitates an exchange of information among federal agencies, state networks and schools and libraries so that the state networks can provide consulting support and share best practices for efficient technological solutions for broadband needs. The same website could also allow state networks to collaborate and share information with federal agencies so that federal funding for broadband projects can be better utilized.[117]

RECOMMENDATION 11.22: Congress should consider amending the Communications Act to help Tribal libraries overcome barriers to E-rate eligibility arising from state laws.

Current eligibility requirements for the E-rate program prevent Tribal libraries in some states from qualifying for E-rate funding.[118] Under the Communications Act, a library can be eligible for E-rate funding only if it is eligible for assistance from a state library administrative agency under the Library Services and Technology Act (LSTA). LSTA has two types of library grants that primarily relate to governmental entities: one for states and one for federally recognized Tribes and organizations that primarily serve and represent Native Hawaiians. To be eligible for E-rate funds, a Tribal library must be eligible for state LSTA funds and not just Tribal LSTA funds. However, some states preclude Tribal libraries from being eligible to

receive state LSTA funds, thus making Tribal libraries in those states ineligible for E-rate funding. Congress should consider amending the Act to allow Tribal libraries to become eligible for E-rate funding if they are eligible to receive funding from either a state library administrative agency or a Tribal government under the LSTA.[119] The FCC should also explore ways to remove technical barriers that may prevent some Tribal libraries from receiving E-rate support.

Foster Innovation

RECOMMENDATION 11.23: The FCC should initiate a rulemaking to fund wireless connectivity to portable learning devices. Students and educators should be allowed to take these devices off campus so they can continue learning outside school hours.

Online learning can occur anytime, anywhere. Research shows that home use of computers and broadband technologies for learning can be a significant factor in boosting math and reading achievement.[120] Use of computers and broadband at home for educational purposes has also been shown to motivate students and to increase the relevance of content during school hours—ultimately improving student achievement.[121]

E-rate should support online learning by providing wireless connectivity to portable learning devices so students[122] can engage in learning while not at school. Restricting student access to network services while on school grounds is becoming increasingly indefensible given the new educational opportunities presented by cloud-based desktops, smartphones, tablet PCs, netbooks and other highly portable solutions. Demand for wireless services in education is rapidly growing, and students without off-campus access to online educational services will be increasingly left behind in terms of skills, experience and confidence in their online capabilities.

Where applicant-managed hardware can use wireless services off campus, E-rate should provide appropriate Priority 1 discounts for those services. Potentially high demand for this service should be accounted for in the program design to ensure equitable overall distribution of E-rate funds. For example, providing a limited amount of funding for wireless services within a pilot program could help determine demand levels and cost-effectiveness.[123]

RECOMMENDATION 11.24: The FCC should award some E-rate funds competitively to programs that best incorporate broadband connectivity into the educational experience.

Competitive programs are an effective strategy in government and philanthropy to stimulate new ideas, reward the best applicants, spread new ideas and make efficient use of scarce resources. E-rate is designed to provide telecommunications services to all schools and libraries. It is also intended to ensure that advanced services are deployed and improved over time. By rewarding innovative ideas, the E-rate program can encourage more strategic integration of broadband into education by applicants as well as recognize and potentially spread best practices among applicants. Broadband-enabled solutions are demonstrating new pathways for innovation and research in education.[124] According to Philip R. Regier, Dean of Arizona State University's Online and Extended Campus program, the education system is "at an inflection point in online education"[125] with large increases in use and improvements in quality expected in the near future.

The U.S. Department of Education is encouraging similar innovation in education with its Race to the Top and Investing in Innovation programs. A competitive component to E-rate could foster similar innovative applications for use of broadband networks nationwide. Importantly, competitions should be designed to offer funding opportunities both to smaller institutions with fewer resources to develop competitive applications and larger institutions with the ability to undertake larger programs.

Providing Connectivity to Community Colleges

RECOMMENDATION 11.25: Congress should consider providing additional public funds to connect all public community colleges with high-speed broadband and maintain that connectivity.

Community colleges are anchor institutions for training a highly skilled 21st century workforce. Providing broadband connectivity to these institutions will help provide better services to students.[126] As of 2007, according to the Integrated Postsecondary Education Data System, there were 1,138 public two-year institutions in the United States.[127] These institutions operated an estimated 3,439 distinct campuses. Only 16% of these public community college campuses currently have high-speed broadband connections comparable to those of American research universities.[128]

Access to high-quality broadband connectivity and innovative online technologies will allow community colleges to extend their reach even further. They can offer powerful learning opportunities to even broader audiences. With adequate funding and innovative technology development, community colleges can offer college credit for online courses for advanced high school students; offer specialized science and technology online learning experiences in subjects where there are too few specialized K–12 teachers; support adult students through personalized career and technical programs while working

around the needs of their jobs and families; and extend continuing education programs by offering diverse, quality content to the public to foster job skills, community development and personal growth.

Community colleges with broadband connectivity and quality online instructional programs serve as learning and career development centers for the K-12 community and for local citizens. Community colleges also play integral roles in educating Americans about math and science and preparing students for their future careers as teachers. Forty percent of teachers have taken a math or science course at a community college, and 44% of science and engineering graduates attended a community college as part of their postsecondary education. Twenty percent of teachers begin their postsecondary education at community colleges.[129]

The most recent Notice of Funding Availability from the Department of Commerce related to the Broadband Technology Opportunities Program created an opportunity for community colleges to obtain funding to upgrade their levels of connectivity. After such funding is determined, Congress should evaluate whether additional action is warranted for community colleges.

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122 E-rate currently supports wireless data services to mobile devices for educators. That support should be harmonized with this support for student devices during any rulemaking.

123 Albuquerque Public Schools Comments in re NBP PN #15, filed Nov. 20, 2009, at 6; City of Chicago Comments in re NBP PN #15, filed Nov. 20, 2009, at 28; Michigan Department of Education Comments in re NBP PN #15, filed Nov. 20, 2009, at 4; National Internet2 K–20 Alliance Comments in re NBP PN #15, filed Nov. 20, 2009, at 1; Oregon Department of Education Comments in re NBP PN #15, filed Nov. 20, 2009, at 3; San Diego Unified School District Comments in re NBP PN #15, filed Nov. 20, 2009, at 2; Sprint Nextel Comments in re NBP PN #15, filed Nov. 20, 2009, at 5.

124 *See, e.g.*, Open Learning Initiative, Open Courses Backed by Learning Research, http://oli.web.cmu.edu/openlearning (last visited Feb. 28, 2010).

125 Steve Lohr, *Study finds that online education beats the classroom*, N.Y. Times, Aug. 19, 2009, http://bits.blogs.nytimes.com/2009/08/19/study-finds-that-online-education-beats-the-classroom.

126 American Association of Community Colleges and Educause Comments in re NBP PN #15, filed Nov. 20, 2009, at 4; California Public Utilities Commission Comments in re NBP PN #15, filed Nov. 20, 2009, at 3; City of Chicago Comments in re NBP PN #15, filed Nov. 20, 2009, at 25; National Internet2 K–20 Initiative Comments in re NBP PN #15, filed Nov. 20, 2009, at 1; New York Education Department Comments in re NBP PN #15, filed Nov. 20, 2009, at 2; Texas Education Telecommunications Network Ex Parte in re NBP PN #15, filed Feb. 19, 2010, at 1; Texas State Library and Archives Comments in re NBP PN #15, filed Nov. 20, 2009, at 1; Quilt and StateNets Reply in re NBP PN #15, filed Dec. 11, 2009, at 2.

127 *See* National Center for Education Statistics, Integrated Postsecondary Data System, http://nces.ed.gov/IPEDS/ (last visited Feb. 28, 2010).

128 Educause Core Data Service, Fiscal Year 2007 Summary Report 35 (2007) (reporting that only 16.1% of colleges offering an associate's degree have more than 45 Mbps in bandwidth, whereas 90.4% of institutions offering a doctorate have that level of connectivity), *available at* http://net.educause.edu/ir/library/pdf/PUB8005.pdf.

129 Madeline Patton, Community Colleges Impact K–12 STEM Teaching 4 (2008), *available at* http://www.aacc.nche.edu/Resources/aaccprograms/Documents/impactk12_2008.pdf.