White Paper
Post-Secondary Digital Learning
Education Transformation

Education

Bridging The Global Skills Gap Through Digital Learning

Reaching More Students, Engaging Them Deeply, and Improving Outcomes

New digital technologies are affecting all aspects of the global economy. Computers, peripherals, and digital tools are now used in virtually all industries. This digital shift is increasing the need for highly skilled workers, but traditional education systems cannot keep up with growing demands. As a result, essential jobs go unfilled, while far too many adult job seekers—on the wrong side of the digital skills gap—remain unemployed, and national economies and competitiveness are impaired.

Digital learning can help educators reach more potential learners, improve outcomes, and transform post-secondary education at universities, colleges, vocational schools, and job training programs. Digital learning also enhances opportunities for learners to "unbundle" education and access learning tools and resources any time, any place and at any pace—from after-school learning, remedial instruction and test preparation, to certification, professional development, continuing education, and lifelong learning.

Between one third and two thirds of the adult population lack the basic skills necessary for learning and working in modern economies.

2012 OECD report, Better Skills, Better Jobs, Better Lives (Organisation for Economic Co-operation and Development (OECD), 2012)

This document illustrates how leaders around the globe are reinventing post-secondary programs by harnessing digital learning and tools to engage students more deeply and to improve pathways from education to employment. It also provides a framework, developed by Intel, based on global trends in education, technology, industry and society, and on successful post-secondary program implementations and practices from around the world. This document explores:

1. Leadership
2. Policy
3. Information and Communications Technology
4. Digital Content
5. Assessment and Credentials
6. Professional Learning
7. Sustainability and Growth

"The new learning revolution is going to be a digital technology revolution."

Neelie Kroes, Vice-President, European Commission (Employment and Entrepreneurship Training Initiative)

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- Digital technology is disrupting all economic sectors and revamping the educational landscape.
- Digital learning can expand the reach and impact of post-secondary education.
- Harnessing Information and Communications Technology (ICT) in post-secondary education is essential to close the global skills gap and expand national economies.

Digital Technology is Disrupting All Economic Sectors and Revamping the Educational Landscape

Advancements in Information and Communications Technology (ICT) are putting pressure on all sectors of the economy in nearly every country to rapidly adopt digital techniques to trim costs and improve service. For potential learners, increased levels of device ownership, growing fluency in technology, and global connectivity can mean increased access to life-long learning.

"...computer chips—or more broadly defined, information and communications technology, including hardware, software, telecommunications, and the Internet—have been, are and will likely remain, for the foreseeable future, the dominant driver of growth and innovation in the United States and throughout the global economy."

Robert D. Atkinson and Luke A. Stewart, Information Technology and Information Foundation, 2014

The global economy has tipped toward enterprises driven by knowledge and information. Even agriculture and manufacturing are now massively influenced by technology and data. This trend places a greater reliance on intellectual and technological capabilities than on manual labor or natural resources. *(Powell & Snellman, 2004)*

Businesses are struggling to find skilled local talent in a world where ICT has permeated nearly every sector of the economy. According to a study conducted by the *Organisation for Economic Co-operation and Development* (OECD), most developed and emerging economies indicate that businesses are leaving 25 percent to 50 percent of essential positions unfilled because they cannot find skilled workers. Long-term investments in digital technology can transform education by engaging students and instructors more deeply, and better preparing them for real jobs in growing economies.

These trends will only accelerate as individuals and economies become more networked, more mobile, more data-driven, and more digital.

The ITU also reports a growing trend in the adoption of wired and wireless broadband—with roughly 3.1 billion subscriptions worldwide. At least one-third of the global population is connected to the Internet and 44 percent of the world's households have Internet access at home. The most recent ITU report indicates that Internet use continues to grow steadily, at 6.6 percent globally in 2014 (3.3 percent in developed countries, 8.7 percent in the developing world). The number of Internet users in developing countries has doubled in five years (2009-2014), with two thirds of all people online now living in the developing world. *(Measuring the Information Society Report 2014, 2014)*

No infrastructure matters more for job creation and economic growth in the 21st Century than the broadband Internet.[1] While the new "hyper-connected world" means 20th Century jobs may never return, studies show that broadband-related industries create 2.6 jobs for [every] one lost... Facebook* employs 2,600 people but has led to the creation of another 182,000 jobs... And while eBay* and Amazon* [together] employ 50,000 people, they provide a sales platform for up to 1 million entrepreneurs.

– US Federal Communications Commission (FCC) Julius Genachowski

1 While both the Deloitte study and the FCC Chairman's comments discuss "the Internet," their statements refer more broadly to the ICT revolution that includes smart devices, high-speed connectivity, rich applications and skilled users.

According to the International Telecommunications Union (ITU), in 2014, there were 6.9 billion cell phone subscriptions for a global population of 7.2 billion people. By 2015 the global number of cell phone subscriptions will be greater than the number of people on the planet.[2] Roughly one third of cellular subscribers have mobile broadband (83.7 percent of subscribers in developed countries have mobile broadband), whereas only 21.1 of subscribers from developing countries have broadband access via their cellular plans. *(Measuring the Information Society Report 2014, 2014)*

More people have more computing devices. The ITU no longer collects global figures on "computers per household" although this measure remains a core component of the ICT Development Index which ranks countries based on their overall ICT deployment and use. A 2013 study conducted by Future Source Consulting for Intel found that for the 300 million people currently engaged in tertiary education, including higher education and vocational students, faculty and administrators, there are currently 234 million desktops, laptops, and tablet computers. By 2018, this overall population is expected to grow at a rate of 4 percent annually, whereas the number of devices per 100 people is expected to increase at a rate of 15 percent a year. Future Source expects that by 2018, this population will be 365 million people with 421 million computing devices, another indication of the trend that couples technology more tightly with higher education.

In addition to driving overall economic development, the ICT sector itself is outpacing global growth rates and generating more jobs than any other sector of the economy. Across OECD countries from 1995 to 2008, the ICT sector's "gross value" grew faster than any other business sector. In 2010, "ICT-intensive occupations" accounted for more than 20 percent of all jobs in OECD countries. (*Organisation for Economic Co-operation and Development (OECD), 2013)* (See boxes below for key statistics gathered by the Information Technology and Innovation Foundation summarizing the economic benefits of ICT and the role of ICT as a driver for economic growth.)

While ICT creates pressure for changes in education, it also provides the means for that change. As society experiences the "digitization of everything," learning methods and models change, offering educators and institutions new digital tools such as virtual classrooms, personalized instruction, adaptive curriculum, and blended learning. Millennials, who grew up with technology, carry multiple devices and expect to be able to consume or produce information any time, any place, on and off campus. By encouraging the positive disruptions that ICT can bring to post-secondary education, leaders can expand both the reach and the impact of post-secondary programs.

Even more than 28 years after the first dot.com website was registered, information and communications technology (ICT) continues to drive prosperity.

(Atkinson & Stewart, 2013)

"The modern global economy doesn't pay you for what you know, because the Internet knows everything. The world economy pays you for what you can do with what you know."

– Andreas Schleicher, Deputy Director for Education and Skills, Special Advisor on Education Policy to the Secretary-General, Organization for Economic Development and Opportunity (OECD)

Economic Benefits of Information and Communications Technologies *(Atkinson & Stewart, 2013)*

- The Internet "industry" accounts for 3.4 percent of GDP across the large economies that comprise 70 percent of global GDP. *(Manyika & Roxburgh, 2011)*
- Global output from IT industries more than doubled, from USD 1.2 trillion in 1995 to USD 2.8 trillion in 2010, accounting for six percent of global GDP. *(National Science Board, Science and Engineering Indicators 2012, 2012)*
- IT was responsible for 75 percent of U.S. productivity growth from 1995 to 2002, and 44 percent from 2000 to 2006. *(Brynjolfsson & Saunders, 2010)*
- In 2011, the IT industry contributed about USD 650 billion to the U.S. economy, or 4.3 percent of GDP, increasing from 3.4 percent of GDP in the early 1990s. *(Shapiro & Mathur, 2011)*
- IT workers contribute three to five times more to productivity than non-IT workers. *(Atkinson & McKay, 2007)*

2 The ITU projects 6.9 billion cell phone subscribers in 2014 compared to a world population of 7.2 billion. This does not mean that 6.9 billion people have cell phones since a number of people hold more than one subscription.

Information and Communications Technology Drives Economic Growth *(Atkinson & Stewart, 2013)*

- The Internet alone accounted for 21 percent of the GDP growth from 2006 to 2011 across 13 leading economies—Brazil, Canada, China, France, Germany, India, Italy, Japan, Korea, Russia, Sweden, the UK, and the United States. *(Manyika & Roxburgh, 2011)*
- In 2011, benefits attributed to the expanded use of IT in other sectors of the US economy accounted for approximately USD 1 trillion, or 7.1 percent of U.S. GDP. *(Shapiro & Mathur, 2011)*
- Between 2002 and 2011, U.S. retail sales through e-commerce increased by 19.8 percent annually, in comparison to just 3.2 percent growth for total retail sales, reaching USD 193 billion in 2011. Total e-commerce retail sales continue to climb, and reached USD 293 billion for the 12 months ending 3Q 2014. *(Quarterly E-Commerce Report, 2012) (Quarterly Retail E-Commerce Sales - 3Q 2014, 2014)*
- Around 30 percent of people in the OECD buy goods or services over the Internet. More than half do so in the UK, Denmark, Norway, Korea, the Netherlands and Australia. *(The Future of the Internet Economy: A Statistical Profile, 2011)*

Digital Learning Can Expand the Reach and Impact of Post-Secondary Education

While technology has created demand for skills that exceeds current educational capacity and workforce capabilities, ICT has also created new possibilities for transforming education and accelerating learning. With digital learning tools, students in any location can study with the best teachers, access a wealth of information, collaborate with peers, and contribute to new thinking through networked learning and interactive research communities.

Digital Learning or e-learning refers to the use of electronic media, information and communication technologies (ICT) in education. Broadly, it includes all forms of educational technology in learning and teaching.

(Wikipedia, Retrieved 2014)

Digital learning tools minimize the constraints of time, place, talent, and cost in post-secondary education, and increase the ability to personalize instruction by matching students' interests, learning styles, and educational goals.

Bernard Luskin, a pioneer of e-learning, advocates that the "e" in e-learning should be interpreted to mean "exciting, energetic, enthusiastic, emotional, extended, excellent, and educational" in addition to "electronic." Eric Parks has suggested that the "e" should refer to "everything, everyone, engaging, easy." *(Wikipedia, Retrieved 2014)*

Digital Learning is Learner-Centric

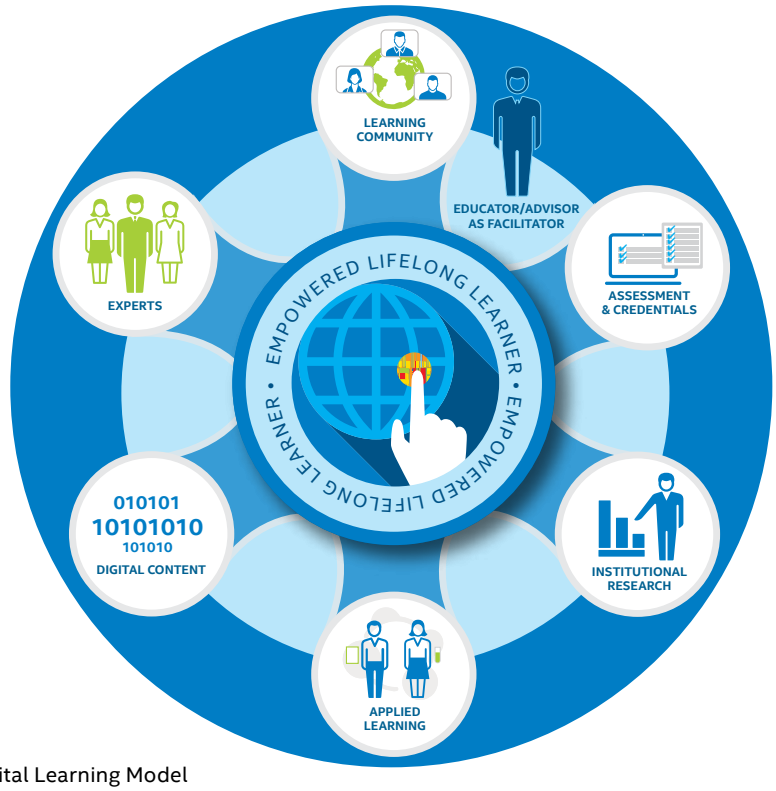
As depicted in the figure on page 8, 21st Century digital learning is learner-centered; it is built on peer collaboration; it offers easy access to global expertise and digital content; and it provides ample opportunities for students to sharpen skills through applied learning such as internships, apprenticeships, and institutional research.

The 21st Century post-secondary learning environment is unbundled. Empowered students can mix and match traditional and digital assets and approaches to best meet their learning goals. They can augment traditional classes with Open Education Resources; blend in online classes; explore topics with hyperlinked and adaptive digital content; access cloud-based "hang outs;" experience new simulated environments; drill basic concepts with digital flashcard or games; participate in webinars; and join thousands of other learners in Massive Open Online Classes (MOOCs).

"The power and reach of the virtual world is growing constantly. [With today's digital learning tools,] a student in a developing country can now access the libraries of prestigious universities anywhere in the world; an unemployed person can retrain and improve job prospects in other fields; teachers can gain inspiration and advice from the resources and experiences of others.

"With each of these achievements, the online world brings about another real-world victory for education, dialogue, and better understanding between peoples."

Dr. Hamadoun I. Touré, Secretary General, International Telecommunication Union (Broadband Commision Working Group on Education, 2013)



Post-Secondary Education Digital Learning Model

While digital learning gives students the tools to become lifelong learners, it also opens new possibilities and challenges in assessment and credentials, and it opens opportunities for educators to focus on facilitating and advising rather than on drilling facts and methods.

The digital learning "revolution" in post-secondary education is creating opportunities to change instructional paradigms and create empowered life-long learners. Through both formal and informal or self-driven models, digital learning can reach more post-secondary students, engage them more deeply, and improve outcomes.

Harnessing ICT in Post-Secondary Education is Essential to Close the Global Skills Gap and Expand National Economies

Post-secondary education is one of the keys to personal and societal growth and economic development. According to the *Education at a Glance 2013* report from the OECD, "The potential to earn more and see those earnings increase over time, along with other social benefits, is an incentive for individuals to pursue education and training. ...While relative earnings for individuals with higher education attainment tend to increase with age, relative earnings for people with less than upper secondary education tend to decrease with age." This is true across all OECD countries. *(OECD, 2013)* As noted in the boxes on page 9, studies show that post-secondary education offers significant lifetime benefits for people of all economic strata. Additionally, people with training in ICT-intensive fields do even better as those fields continue to out-pace other economic sectors.

> "Investing in education is the best way to invest out of poverty and into sustainable development."
>
> *- Irina Bokova, Director-General, UNESCO (Broadband Commission Working Group on Education, 2013)*

ICT and other factors are also driving changes the way that people work. People are now more likely to change jobs throughout their career, and even people who stay at a company will need new skills to adapt to changes in work requirements. In nearly every country and every job, workers need to refresh their skills every five years.

Long-term investments in digital technology can be a transformative tool to:

- Help post-secondary programs reach more students
- Engage students and faculty more deeply
- Increase collaboration and interactivity
- Customize instruction with targeted learning opportunities based on real jobs
- Better prepare students for skilled jobs in growing economies
- Meet employer needs and draw future investments based on skilled workforce

> "Education is the most powerful weapon which you can use to change the world."
>
> *– Nelson Mandela*

Making the transformation to purposeful digital learning requires investments in seven key areas: leadership, policy, ICT, digital content, professional learning for educators, assessment and credentials, and sustainability and growth.

This document outlines considerations in each of these seven areas and highlights global success stories in the application of digital learning in post-secondary programs.

Economic Benefits of Post-Secondary Education

- In Brazil, Greece, and the United States, people with less than upper secondary education generally earn less than 65 percent of the income available to those with upper secondary or post-secondary education. *(OECD, 2013)*
- Unemployment rates are nearly three times higher for individuals who do not have an upper secondary education (13 percent on average across OECD countries) than for those who have a tertiary education (5 percent). *(OECD, 2013)*
- In the United States, entry-level jobs that require post-secondary education offer more than twice the median wages paid for jobs that typically require a high school diploma or less. Positions that require post-secondary training are also growing at a faster rate: 14.1 percent compared to 9.1 percent for their less-skilled counterparts. *(United States Department of Labor, 2013)* Although the value of education varies from region to region, research from Abhijit Banerjee and Esther Duflo, documented in *Poor Economics*, suggest that the value of education is linear. *Each additional week of education results in an incremental increase in life-long earning potential for the recipient. (Banerjee & Duflo , 2011)*

ICT-intensive Jobs Outpace Overall Market *(Atkinson & Stewart, 2013)*

- Between 2001 and 2011, more than 565,000 IT-related jobs (in all industries) were created in the United States, an increase of 22.2 percent. IT jobs grew more than 95 times faster than employment as a whole, which grew by only 0.2 percent.
- In 2011, IT workers earned USD 78,584 a year, 74 percent more than the average worker (USD 45,230).
- In 2010, IT industries employed 5.8 percent of workers in Organisation for Economic Cooperation and Development countries, a 13 percent increase over the 5.1 percent they employed in 1995. *(OECD Information Technology Outlook 2010, 2010)*
- The Internet creates 2.6 jobs for every job it eliminates. *(Manyika & Roxburgh, 2011)*

1. Leadership

Key Take-Aways

- People will transform post-secondary education.
- Teamwork makes it happen.
- Success requires vision, engagement, evaluation, and determination.

People Will Transform Post-Secondary Education

While the context for this paper is that "digital technology is a disruptive force in education," it is also true that technology alone will not revolutionize education. Leaders will revolutionize education by creating an environment that makes widespread access to quality learning the highest priority. School presidents, boards, academic deans, IT directors, individual educators, and their partners in industry and government will drive the changes that improve post-secondary outcomes.

> "Disruption is a positive force. It is the process by which an innovation transforms a market whose services or products are complicated and expensive into one where simplicity, convenience, accessibility and affordability characterize the industry."
>
> *– Clayton Christensen, Curtis W. Johnson, Michael B. Horn, Disrupting Class, 2014*

Technology and digital learning tools can help create educational solutions that expand access, make learning more engaging and interactive, and ensure that curriculum and applied learning are well aligned with the opportunities of 21st Century life.

In their book, *Disrupting Class: How Disruptive Innovation Will Change the Way the World Learns*, authors Clayton Christensen, Curtis W. Johnson, and Michael B. Horn suggest "that disruption is a necessary and overdue chapter for our public schools." For advanced learners across the globe, technology disruption could increase the relevance and reach of post-secondary programs.

The arguments put forth in *Disrupting Class* are similar to the way that Intel CEO Andy Grove describes a strategic inflection point:

"a point in a business when a major change takes place in its competitive environment:

- A major change due to introduction of new technologies.
- A major change due to the introduction of a different regulatory environment.

The major change can be simply a change in the customers' values, or a change in what customers prefer.

Almost always [the change] hits the corporation in such a way that those of us in senior management are among the last ones to notice...

But what is common to all of them—and key—is that they require a fundamental change in business strategy, and that's almost a definition of a Strategic Inflection Point.

A Strategic Inflection Point is that which causes you to make a fundamental change in business strategy. Nothing less is sufficient."

(Grove, Only the Paranoid Survive: How to Exploit the Crisis Points That Challenge Every Company , 2010) (Grove, Intel Keynote Transcript, Academy of Management, Annual Meeting, 1998)

Global post-secondary education is at that strategic inflection point. The fundamental shift will come from a radical rethinking that uses the strategic power of networks, devices, and tools to make post-secondary education available to all. Digital learning brings to education the promise to disrupt current processes that are complicated and expensive, and to create new approaches where simplicity, convenience, accessibility, and affordability transform education for both learners and educators.

Successful, visionary leaders will fundamentally transform business and education models to keep pace and thrive in a climate of continued change and innovation. Nothing less is sufficient.

"Institutional leaders are increasingly seeing their students as creators rather than consumers."

– NMC Horizon Report Higher Education

Teamwork Makes it Happen

Transforming educational models requires vision, buy-in from all stakeholders, new partnerships with strategic supporters, and measureable results that show clear benefits to individuals and communities.

Post-secondary education meets a variety of societal purposes as varied as the institutions that offer programs and the students who participate in them. Stakeholders from government, business, education, and the community may have their own reasons for engaging in educational transformation. *(See sidebar for a summary of selected societal interests in post-secondary education.)*

Transformational programs are most successful when leaders from all of these sectors work together to design and implement strategies that identify and engage stakeholders and incorporate their input into the vision and subsequent plans.

Effective leaders bring together these diverse interests to create, implement, and sustain outstanding educational outcomes for everyone's benefit.

SOCIETAL INTERESTS IN POST-SECONDARY EDUCATION

- **Government** ministries understand the links between a skilled workforce, global investment, innovation and Gross Domestic Product (GDP). An educated workforce attracts foreign investment, drives innovation, and creates globally competitive solutions.
- **Businesses** invest in programs that provide a pipeline of skilled innovative workers.
- **Educators** may either embrace or resist change, but they are more likely to embrace programs that meet their needs, acknowledge and capitalize on the wisdom and experience they bring to the process, and offer opportunities for innovation.
- **Community leaders** want to attract start-ups, entrepreneurs, and enrich civic engagement.
- **Students** want to engage with learning opportunities that meet them where they are, support their educational goals, lead to prosperous futures, and are fun!

Interest in post-secondary education reaches beyond schools, faculty, and students, and into industry, government, and society. In addition to engaging educators and representatives from the education community, consider approaching a broad range of potential stakeholders, including industry leaders with jobs to fill, futurists predicting how markets will change, economists measuring and tracking sector growth, civic think-tanks looking at new programs, advocates representing specific

"If your actions inspire others to dream more, learn more, do more, and become more, you are a leader."

– J.Q. Adams

"The potential for innovation and economic development in a Knowledge Society lies in a more prominent role for the university, and in the hybridisation of elements from university, industry, and government to generate new institutional and social formats for the production, transfer and application of knowledge."

(Triple Helix Research Group, n.d.)

community populations, philanthropists, vendors, graduates, and others who can contribute to the vision and make change happen. Then create a small team that can work together to implement change.

While there are many models for engagement, educational programs offer opportunities to create a few key strategic partnerships that transcend the planning phase and carry through to implementation and beyond. Researchers at Stanford University suggest that partnerships deeply engaging industry, government, and education sectors, create a "triple helix of innovation":

According to Stanford studies, this hybridization of academia, business, and public interest drives innovation and economic development. This is a model used successfully by many of the projects cited in this paper, including post-secondary programs in Senegal, Spain, the People's Republic of China, Vietnam, and the United States.

Success Requires Vision, Engagement, Evaluation, and Determination

"If we hope to stay competitive—academically, economically, and technologically—we need to reevaluate our educational system, rethink our approach to learning, and reinvigorate our commitment to learning. In other words, we need disruptive innovation."

(Christensen, Hern, & Johnson, 2011)

Successful programs to transform educational systems through digital learning begin with strong leadership teams and bold visions. Five key tips can help achieve success.

1. **Be Bold**
   A bold vision, aligned with strategic purpose, built through engagement with key partners, is the starting point for change. When developing your program vision, be bold and stay focused on systemic changes that expand the reach and impact of education. Articulate approaches that simplify and streamline the ability for educators to connect with learners and for students to apply their learning to life and work. *(See sidebar for perspectives on the mission of post-secondary education.)*

   Review the vision regularly, update and revise as needed, and build in measurement and evaluation plans that align with and support the vision.

2. **Engage Educators**
   Everyone affected by an initiative has the potential to become a champion for the project.

   It is essential to engage professional teaching staff in the development phase of any new initiative: they bring valuable experience and insight to the process of shaping the vision for transforming education, and they ultimately deliver the programs through their teaching. Their participation from the outset strengthens their equity in the initiative. The result is a collaborative adoption of a shared vision rather than resistance to an ill-received (and possibly misguided) directive.

MISSION OF POST-SECONDARY EDUCATION

While each institution or program has its own mission and purpose, post-secondary programs generally meet some of these objectives:

- Prepare for a job or profession
- Develop skills for life, including learning to learn
- Conduct research and advance societal knowledge
- Pursue continuing education to improve skills and opportunities
- Provide the means for life transition, both social and professional
- Entertain and inspire the mind, and enrich life
- Network with like-minded people, or be stimulated by interacting with people who bring differing perspectives
- Refresh learning and continue to challenge both mind and body

With encouragement and support, faculty will want to be engaged in the full digital learning process. They will use digital tools themselves, develop their own pedagogy, incorporate digital learning into course design and assessment, and search out resources to develop the best ways to incorporate digital content and tools.

3. **Consider People, Processes, and Platforms**
   The successful leadership team will consider all program aspects, including those changes that impact people, processes, and platforms. Translate the broad vision for the program into specific objectives in each of these areas. Identify gaps and implement change management plans.
   - **People:** Who will be involved? How will they be engaged, supported, and trained?
   - **Processes:** What processes need to change? What systems or guidelines will be needed to fuel those changes? How will people and systems transition to new ways of doing things?
   - **Platform:** Which digital tools and data will be needed? Will physical infrastructure need to be changed? What networks will be needed? How will they be funded, maintained and upgraded?

4. **Communicate**
   Clearly explain the purpose of the initiative; listen to feedback from others, and incorporate their wisdom. Hold briefings for key partners, detailing project progress. Share information and collected data with peers and other stakeholders. Communication should be in person, online, formal and informal, at launch and throughout the program. Effective, two-way communication readies partners for change and informs team leadership when adjustments are needed.

5. **Assess, Reflect, and Revise**
   Effective leaders ensure that technology-based initiatives are targeted and productive. Programs need to establish a continuous process for assessment, reflection, and revision to drive continued improvements, relevance, and sustainability. A combination of focus and flexibility will help guide strategic program changes.

Examples

The case example, *"MIT's OpenCourseWare Opens Learning Library to the World,"* describes how the Massachusetts Institute of Technology in the United States set a vision, engaged faculty, and created systems and processes to make all course material for MIT courses freely and publicly available. MIT made the commitment to open up their course content in 2001, well before other open source initiatives came to the forefront in education. Implementation required commitment from faculty and staff, and systematic changes in platforms and processes. See case study page 14.

Intel thrives when others innovate. The case example, *"Intel's Global Challenge Calls on Universities to Innovate and Collaborate"* describes the Intel Global Challenge—a global program to encourage technology innovation and exploration. The Global Challenge aligns with Intel's bold vision to bring smart, connected devices to every person on earth. It is supported by strong partnerships, excellent processes and continuous communication. See case study page 15.

Case Study

Human Potential is Universal; Opportunity is Not.

MIT's OpenCourseWare Opens Learning Library to the World

Challenge:

How could a prestigious university in Cambridge Massachusetts extend the reach of their programs? In 2001, when few professors put their course material on the web, Massachusetts Institute of Technology (MIT) established "OpenCourseWare (OCW) with the vision that teaching tools of the world's top learning institutions should be freely available to all humanity: to study, to share, to build upon." With a strong history of championing open source technology, MIT committed to making materials from nearly every course in its catalog available online and freely available to students at other schools, educators, and independent learners worldwide. Confronted with a myriad of initial implementation concerns (intellectual property, time commitments, consistency, etc.), faculty and University leadership embraced OCW as an opportunity to explore open source solutions that use technology to expand their educational reach and impact.

Solution:

MIT OpenCourseWare includes lecture notes, problem sets, syllabuses, exams, simulations, even video lectures for more than 2,000 MIT courses. The information is available free to all, and is updated regularly. Although learners do not get MIT credit for taking OCW courses, they can use the courseware for personal learning and advancement. Educators from institutions around the world have used the MIT courseware to strengthen and improve their post-secondary programs.

Impact:

Qualitative user surveys provide details on how students, educators, and independent learners are using OCW to further their personal educational objectives. OCW has proven an effective resource. In addition to countless success stories, some of which are documented on the OCW site, OCW can claim the following impressive statistics:

- 2,150 courses, contributed by 70 percent of all tenured or tenure-track faculty
- 1,019 courses translated to other languages, and 349 mirror sites globally
- 1 billion page views from 150 million people
- 48 million video and audio files downloaded; 74 million YouTube views
- An increasing trend by other universities to provide their materials online for the greater good

Leadership Insight:

Behind this bold vision are strategic partnerships with industry and funders, and detailed plans to reach key audiences, place OCW everywhere, create open learning communities, and empower educators worldwide. By challenging the educational status quo, MIT continues to reinforce its leadership. With an undergraduate acceptance rate of 7.9 percent in 2014, making courses available for free has not hurt the value of an MIT education. "Human Potential is Universal; Opportunity is Not."

"MIT's goal for the next decade is to increase our reach ten-fold: to reach a billion minds. We aspire by 2021 to make open educational resources like MIT OpenCourseWare the tools to bridge the global gap between human potential and opportunity, so that motivated people everywhere can improve their lives and change the world."

Case Study

Intel® Global Challenge Calls on Universities to Innovate and Collaborate

Challenge:

In 1965, Intel co-founder, George Moore, predicted that "the number of transistors incorporated in a chip will approximately double every 24 months." Since that time, advancements attributed to Moore's Law have driven the rate of progress in the semiconductor industry to far surpass nearly all other industries, driving fundamental shifts in computing, networking, and communication—and consequently nearly every other economic and social sector—including education. Moore's Law is at the heart of Intel's mission to utilize the power of Moore's Law to bring smart, connected devices to every person on earth. This compelling vision inspires people at Intel. The Intel® Global Challenge is just one approach to inspire others to translate ideas into sound business plans to meet needs and change the world.

Solution:

Intel enlisted support from the University of California, Berkeley to develop a program to nurture global innovation and entrepreneurship. Through the Intel Global Challenge, engineers and scientists from research universities develop plans to make the world a better place through innovations and entrepreneurial skills. While much of the collaboration is place-based in students' home countries, budding entrepreneurs have access to online curriculum developed by UC Berkeley, and they connect and collaborate online.

Impact:

Now in its tenth year, the Global Challenge drew 18,000 entries in 2013 from more than 60 countries. The 2013 winner is just one example of innovation inspired and supported by the Challenge: "Mobile Monitoring Station," a health data collection and analysis system for miners in Chile. Team members from engineering research and development company SoluNova, Chilean mining company Codelco, and the University of Chile, created a set of portable sensors that collects industrial workers' biomedical data, such as heart rate, in real time. The sensors, applied directly to the workers' clothes, transmit valuable biomedical information to devices such as smartphones, which then push the data to the cloud. The solution will be offered as a service, supplying industrial sites with the hardware and software for a monthly fee per worker. Driven by the lack of existing data on industrial workers' exposure to health risks, the winning team expects the sensors to result in a considerable improvement in worker health and safety.

Leadership Insight:

Intel realized they needed an education partner to bring the Global Challenge to scale. They selected the University of California, Berkeley's Lester Center for Entrepreneurship—a group dedicated to developing new ideas and knowledge in technology and business. Together, Intel and UC Berkeley enrolled research Universities and affiliates in more than 60 countries who host local programs based on the Entrepreneurship curriculum. Participants connect and collaborate in person and through Cloud services.

2. Policy

Key Take-Aways

- Government, industry and education policies can accelerate—or slow—reforms.
- Policies that increase ICT investment can improve access and innovation.
- Institutional policies can enhance educational opportunities and improve ICT effectiveness.

Government, Industry, and Education Policies can Accelerate Educational Reforms

Policies that influence post-secondary education are developed by a myriad of organizations and leaders in government, industry, and education. Leaders need to understand the organizations and policies that shape their work, and endeavor to influence those policies that can bring positive, large-scale education reforms.

Effective policies can drive systemic changes—at scale—increasing access to ICT, encouraging ambitious educational programs, and ensuring program accountability. At each level, these policies set the context for educational programs and can serve either as enabling factors or as constraints to manage.

Policies from national and local governments, businesses and corporations, and educational institutions can also have significant impact on effective investment in ICT and education programs. Well-planned policies can motivate reforms, increase access, and improve post-secondary programs.

The clear alignment between a skilled and innovative workforce and economic interests leads governments at all levels to take increasingly important roles in education policy. In addition to policies that relate directly to education and workforce development, both feasibility and success of technology-enabled post-secondary programs are affected by ICT tax and import policies, infrastructure investments in broadband and wireless technologies, and requirements for professional licensing and certification.

The box on page 17 highlights educational policy frameworks from the People's Republic of China and the United States of America—high level statements that set the stage for further programmatic investments and reforms.

Two Examples of Government-Led Educational Policy Reforms: People's Republic of China and United States of America Strengthen Education Policies

Example: People's Republic of China

The *National Plan for Medium and Long-term Education Reform and Development* for the People's Republic of China sees education as instrumental to both "higher quality growth" and "more inclusive growth." The PRC plan states that:

"A nation's enduring future hinges on education. Education is the cornerstone of national rejuvenation and social progress, and a fundamental way to improve citizens' quality and promote their all-round development, bearing the hope of millions of families for a better life. Education must be enhanced if a nation is to prosper. Giving priority to developing education and raising its modernization level are key to attaining the goal of building a moderately prosperous society in all respects, and making China a prosperous, strong, democratic, culturally advanced and harmonious modern socialist country."

– National Plan for Medium and Long-term Education Reform and Development for the People's Republic of China

Among the many goals and objectives in China's plans are goals to strengthen vocational education, increasing its availability and driving more enthusiasm for learning. *(17th Communist Party of China National Congress, 2010)*

Example: United States of America

As part of broader educational reforms, President Obama proposed new policies for the United States that would make the first two years of post-secondary community college free "to all students who want to work for it." That proposal suggests five strategies to realize this goal including working with industry to strengthen career pathways, creating more educational partnerships, improving remediation and basic skills training, personalizing learning and developing online courses and materials "such as interactive tutors, simulations, and multimedia software that can help students learn more, and learn better, in less time."

"In an increasingly competitive world economy, America's economic strength depends upon the education and skills of its workers. In the coming years, jobs requiring at least an associate degree are projected to grow twice as fast as those requiring no college experience. We will not fill those jobs – or keep those jobs on our shores – without the training offered by community colleges."

–Barack Obama, President, United States of America (Building American Skills Through Community Colleges, 2015)

Policies that Increase ICT Investment can Improve Access and Innovation

Governments can leverage tax policy, general operating budgets, and special funds to increase education-aligned ICT investments. They can also use their national reach and convening power to create a national vision, and a broader call for action that draws more resources and increases focus on educational issues and opportunities.

Two specific enabling policies can increase ICT investments and support education-aligned projects: reducing ICT taxes and duties, and using special funding for ICT investments.

"The emerging ICT-enabled employment opportunities matter because countries around the world are looking to create more good jobs, which have positive economic and social implications for workers and for society."

– Chris Vein, Chief Innovation Officer for Global ICT, World Bank

1. Spurring ICT Investment through Reduced Import Duties and Taxes
Extending access to—and encouraging the use of—ICT is fundamental in The World Bank mission: to stimulate sustainable economic growth, improve service delivery, and promote good governance and social accountability. In a World Bank policy note, the ICT group recommends five policy "levers" to maximize the positive impact of ICT on employment and education. *(Connecting to Work: How ICTs Are Expanding Job Opportunities Worldwide, 2013)*

1. Human capital systems: investing in ICT skills for workers.
2. Infrastructure systems: considering broadband a basic utility like water and power.
3. Social systems: creating and sustaining trust, transparency and personal freedoms.
4. Financial systems: making funds available for innovation; ensuring accountability.
5. Regulatory systems: establishing policies that ensure equity and protect rights.

One policy example that employs financial and regulatory levers is a global agreement between 73 nations to reduce tariffs on Information and Communications Technology (ICT) products such as semiconductors, computers, and telecommunications equipment, called the Information Technology Agreement (ITA). "The ITA was found to increase trade more than 10 percent annually, from USD 1.2 trillion to USD 4.0 trillion, from 1996 to 2008. Moreover, the Agreement has played a critical role in promoting ICT trade and investment, which in turn has driven innovation, boosted productivity, increased employment, accelerated economic growth, and produced prosperity for all nations." *(Ezell, 2012)*

2. Using Universal Service Funds to Expand Access
Some governments have used a Universal Service Fund (USF) to subsidize broadband network deployment and increase access to computing devices. The USF is a fund, created through a surcharge on telecommunications services, used to help make telecom services available to all—including people in rural or hard-to-serve areas, and those with limited funds. Many countries now operate a USF, and most are moving beyond basic telephony to focus on broadband and Internet-connected devices—further evidence that computing and broadband have become the new basic utility in the digital age.

Examples

The case example, *"Senegal's Education Ministry Launches Virtual University to Reach More Students,"* describes how the Ministry of Higher Education and Research in Senegal used VAT tax reductions, USF funding, and changes in educational programs and funding to provide more educational opportunities for Senegalese learners. See case study page 19.

The case example, *"Companies in Chengdu High Tech Zone Collaborate to Promote Further Learning"* demonstrates the collective use of human capital, social, financial, and regulatory policy levers to improve educational access and outcomes. See case study page 20.

Case Study

Senegal's Education Ministry Launches Virtual University

Reaching More Students Through VAT Reductions and Loan Guarantees for Educational Computing

Challenge:

With public universities packed at 400 percent of capacity, and 40,000 new students ready to enter the university system annually, the Senegalese Ministry of Higher Education and Research had a huge gap between the "supply" of university seats and the "demand" for higher education. Classes were crowded, thousands of students were left out, educational quality was suffering, and there were recurrent tensions between students and the ministry. The Ministry sought a program that would meet demand quickly, ensure that eligible students could move directly to university, access online courses, increase collaboration, and improve educational outcomes.

Solution:

In 2012, the Ministry worked with faculty, local partners, the World Bank, and technology partners to create the access to university education via online learning, and equip all students with computers. In addition to expanding access to education, the program aims to strengthen educational outcomes, increase peer learning, and deepen the educational experience. The creation of the Senegal Virtual University increases the students' need for a personal computer, but it also opens new pathways for learning.

Impact:

Student enthusiasm for the new programs has been huge. Already more than 7,000 students have enrolled in the Senegal Virtual University; 10,000 more students are expected to enroll in 2015. Students from Senegal's brick and mortar universities have leapt at the chance to purchase subsidized computers to support their studies. Nearly 20,000 students in both programs are now using new laptops to access educational content, to create new material, and to collaborate with peers. Students are excited about the program and optimistic about future possibilities. Campuses that once were fraught with student demonstrations now host orderly processes for acquiring PCs, ubiquitous Wi-Fi, and an increasing portfolio of digital programs.

Policy Insight:

The Senegalese government used a number of policy levers to launch and sustain the program. The government waived VAT taxes on educational devices, resulting in an effective 30 percent discount on student computers. The World Bank joined this initiative as a government partner, creating a loan guarantee fund at local banks. The Ministry used Universal Service Funding to provide additional loan guarantees at banks which, in turn, provided student loans for computers. The Ministry used existing educational funding to cover initial device costs for students in the Virtual University. National and university policies outline eligibility requirements, student responsibilities, and procurement processes.

Case Study

Companies in Chengdu High Tech Zone Collaborate to Promote Further Learning

Training Union Established to Support Migrant Workers

Challenge:

In the booming High Tech Zone (HTZ) in the city of Chengdu, Sichuan Province, People's Republic of China, further education is of great importance to workers, companies, and the government. People who migrate to this region to work want opportunities to strengthen job skills and advance, but they need educational opportunities that are affordable, accessible, and relevant. Growing businesses, many working in ICT-intensive industries, needed skilled employees who continue to grow with changing job requirements. Government stakeholders see education as an important part of the PRC's strategic goals, and a driver for local economic growth. "Education is the key to increase worker skills and salaries, and to help people achieve the China Dream: 'improvement of people's livelihoods, prosperity, and construction of a better society.'" *(Outline of China's National Plan for Medium and Long-term Education Reform and Development 2010-2020, 2010)*

Solution:

The Chengdu Enterprise Training Union (CETU) was created to draw on the collective expertise of Chengdu industries and universities to enhance in-person and online learning for migrant workers with onsite vocational courses, online university partnerships, and PC purchase options—all supported by local businesses and the Chengdu government.

Impact:

The CETU has generated enthusiastic support from workers, companies, the Chengdu government, and university partners. Intel and 22 other companies have collaborated to make 60 new courses available to workers in the Chengdu High Tech Zone. Three prestigious universities are offering online degree programs and providing onsite support for potential students. Thousands of Chengdu workers have attended local events, indicating their interest in being part of the training union. Additionally, 30 educators from more than 20 companies have completed a train-the-trainer program, some of whom will then offer the Intel® Learn Easy Steps digital literacy programs to their staff. As students meet university requirements, they are enrolling in degree programs and participating in online classes; over 100 learners have already enrolled and started university classes!

Policy Insight:

All the institutional players supporting the CETU have created or adapted new policies to support and scale this program.

- **Business support:** Intel and other HTZ companies have opened up classes to CETU; CETU then makes classes available to employees of HTZ companies.
- **Government support:** The government of Chengdu has provided incentive funding for PC purchases and higher education; students can earn discount "credits" through their participation in CETU classes.
- **University support:** Universities have offered CETU students a tuition discount, and provided on-site support for registration.

Taken together these policy changes set the stage for a scalable approach that could increase educational access and further learning for migrant workers in Chengdu, and possibly be replicated in other growing regions of PRC.

Institutional Policies can Enhance Educational Opportunities and Improve ICT Effectiveness

Business and Corporate Policies

Whether through direct investment, employee benefits, business requirements, specific job requirements, or direct collaboration with educators, businesses play a significant role in creating policies that drive educational reforms.

Businesses create implicit policies that shape post-secondary education through specific job requirements, online application processes, and mandatory certifications for workers. Business policies can actively encourage educational access and transformation.

Starbucks* Corporation in the United States (see case study on page 23), and the Chengdu High Tech Zone (HTZ) in the People's Republic of China (see case study on page 20) offer two very different examples of institutional policies that maximize educational opportunities and ICT effectiveness. Starbucks partnered with Arizona State University to support employees who would like to earn a bachelor's degree online. Companies in the Chengdu HTZ are supporting partnerships with three of China's most prestigious universities for online studies, and making their internal vocational classes available to the Chengdu community to support further learning. These firms created and implemented new policies to increase educational access and promote digital proficiency and learning.

Educational Programs and Institutional Policies

Nearly every curriculum in every genre of post-secondary education requires that students have ICT proficiency. Some of the most successful programs require advanced ICT, coding, and media and digital skills.[3] ICT proficiency provides a platform for deeper learning in all subject areas—from music and manufacturing to engineering and healthcare.

Learners outfitted with laptops, tablets or 2-in-1 devices are better equipped for today's classrooms and tomorrow's workplace. With the appropriate technology, students can take advantage of the digital learning opportunities that increasingly define modern education. Sound educational technology policies provide the foundation for improved 21st Century learning outcomes.

The question is not:

- *Is technology important to post-secondary learning outcomes?*

The questions is:

- *How can we most effectively harness technology to accelerate and improve post-secondary teaching, learning and outcomes for all?*

Thoughtful policies, grounded in real-world practicality, set the stage for educators to teach and students to learn. Students, faculty, and administrators must have the right devices for teaching and learning, in a connected and safe environment, with the software, services, and application support needed to access the world's information and contribute to it.

The *policy* questions are:

- What policies will foster the most beneficial use of technology-enabled learning?
- How will programs ensure that educators and students have the technology and tools they need to learn?
- What device usage models best meet educational objectives, e.g., shared-use computer labs, loaner devices, one-to-one devices?
- What will the school's role be in maintaining and sustaining the IT environment?
- How will the program meet the need for high-capacity wireless Internet access on campus and in other learning environments at home and in the community?

3 One collaborative example curated by Mozilla defines three categories of web Literacy Standards to explore, build and connect on the web. https://wiki.mozilla.org/Learning/WebLiteracyStandard

- What local computing is needed to provide "always on" learning when broadband connectivity is lacking? How will the institution ensure that technology access is not a barrier to learning?
- If students and faculty "bring their own" devices, programs, and apps, what role will the school take in supporting those tools?
- How will they authenticate access, ensure interoperability, and ensure that student, faculty and institutional data is secure?
- What security and privacy policies are needed?
- What student data should be collected and used to improve learning? What confidentiality policies are needed to protect students and faculty?
- What policies are needed for "acceptable use," social media, or intellectual property?
- How will programs use ICT for assessment and evaluation?

Examples

The case example, *"Starbucks* College Achievement Plan Expands Educational Access,"* describes how a United States corporation expanded their employee benefit program to offer all employees the opportunity to pursue a bachelor's degree through online programs through Arizona State University Online. See case study page 23. *(Starbucks College Achievement Plan)*

Case Study

Starbucks* College Achievement Plan Expands Educational Access

Online ASU Degree Available to Eligible Employees[4]

Challenge:

Nearly 50 percent of college students in the U.S. today fail to complete their degrees due to mounting debt, a tenuous work-life balance and lack of support. A number of Starbucks employees face such circumstances.

Solution:

The Starbucks* College Achievement Plan was created specifically for the company's partners [employees] and provides an excellent academic foundation along with the flexibility, financing, and comprehensive support that working students need to complete their degree. *(Starbucks College Achievement Plan)*

Impact:

Four thousand employees from all over America applied to be part of the first semester of ASU classes as part of the Starbucks College Achievement Plan. Through online learning options, all were able to participate—from their home locations—and continue working at their jobs.

Policy Insight:

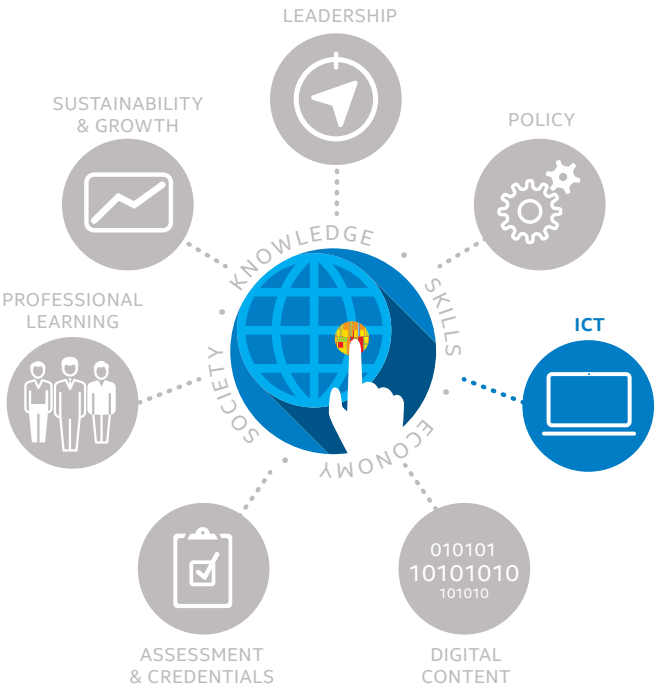
In 2014 Starbucks announced a new program to support all Starbucks employees in the United States to earn a college degree through online programs at Arizona State University. Starbucks' investment is designed to support the financial and educational needs of their employees as well as generating economic benefits to the company and communities across the nation.

> *"In the last few years, we have seen the fracturing of the American Dream. There's no doubt, the inequality within the country has created a situation where many Americans are being left behind. The question for all of us is, should we accept that, or should we try and do something about it," said Schultz. "Supporting our partners' [employees'] ambitions is the very best investment Starbucks can make. Everyone who works as hard as our partners do should have the opportunity to complete college, while balancing work, school and their personal lives."*

– Howard Schultz
CEO, Starbucks

[4] The Starbucks College Achievement plan is available to "eligible partners who are based in the U.S., working in our support centers, plants or at any of our company-operated stores (including Teavana, La Boulange, Evolution Fresh and Seattle's Best Coffee stores), and do not yet have a bachelor's degree can apply. Partners admitted as a junior or senior, according to ASU's admission requirements, will earn full tuition reimbursement for each year of coursework they complete toward a bachelor's degree. Freshmen and sophomores will receive a partial scholarship and need-based financial aid toward the foundational work of completing their degree. Partners will have no commitment to remain at Starbucks past graduation.

3. Information and Communications Techology



Key Take-Aways

- Students and faculty need the right devices for learning and teaching.
- High-speed Internet is critical for digital learning and innovation.
- Exponential growth in devices and anytime anyplace access requires an increased IT focus on security and manageability.

"Education is not the learning of facts, but the training of the mind to think."

–Albert Einstein

Modern education is no longer a roomful of eager students passively receiving information from learned authorities. Effective educators today strive to empower students to think critically, research deeply, innovate, and create, often in collaboration. This shift toward an active, student-centered learning environment is due, in part, to the wealth of information now at our fingertips, easily accessible through high-speed Internet and smart devices.

Information and Communications Technology (ICT) is no longer a "back office" or administrative function. ICT forms the core communications foundation for research, collaboration, peer learning, and innovation that are the hallmarks of a modern post-secondary program. ICT connects people to each other, helps people shape and share ideas, and gives access to a nearly unlimited array of resources for anyone with a computing device and Internet connection. Creating and maintaining a strong ICT infrastructure is critical to extend educational opportunities, improve outcomes, and enhance program relevance.

The technology to support digital learning and innovation is available now, along with effective models for planning, funding, establishing, maintaining, and using the technologies effectively.

"The democratization of information technology means that faculty and students have not only the desire but also the means to reshape the ways they use technology in their work; that all members of the campus community want ubiquitous access to computing; and that presidents, provosts, and trustees expect to use information technology to help realize their institutions' strategic visions."

– Susan Grajek, Educause

An environment that supports digital learning anytime, anyplace, and at any pace includes devices, Internet access, robust computing architectures, and attention to security and manageability.

Students and Faculty Need the Right Devices for Learning and Teaching

Technology-enabled education is generative: it creates new ideas, new understandings, and new ways of teaching, learning, and sharing information. Most students preparing for professional life need a flexible learning platform that enables them to directly apply knowledge acquired through their studies to the broader world. With the rapid growth and changes in device availability, it is important that faculty and students have personal computing devices that support their educational pursuits.

Students need the *right* computing devices for gathering information, collaborating with others, and creating new information, new media, new inventions, and new ideas. Tools once considered the domain of a single profession are now used in a variety of trades and professions. For example, tools for editing and creating graphics and video, once the sole purview of designers, are now universally available to journalists, bloggers, artists, and business owners. Anyone who uses text, graphics, voice, or video can use mobile devices to develop and share complex, illustrated messages. Financial analysts have always used data analytics in their work. Now, all businesses—from boutique shops and start-ups to larger businesses and nonprofits—expect to make data-driven decisions, leverage big data, and show measureable results.

SELECTING THE RIGHT DEVICE FOR LEARNING AND TEACHING

1. **Survey the learning environment:** Review applications, interfaces, and system compatibility needs. Ask faculty and partners about future plans and trends; make sure the specified devices will meet learning needs for the next three to five years.
2. **Assess manageability and deployment:** How will your organization's IT team provide support for student devices?
3. **Evaluate device functionality:** What features are needed to ensure that teachers and students can accomplish their everyday tasks, and what features are needed to support deep learning and creative expression?
4. **Get to the bottom line:** Look at Total Cost of Ownership (TCO), including support costs, upgrade paths, and life cycle.

While there are many considerations, generally a tablet is streamlined for consuming content; a notebook or laptop is better for creating content; a two-in-one device offers the flexibility for both creation and consumption.

As computing devices become an integral part of everyday life, institutions are exploring new options to ensure that all students and faculty have the digital tools they need to explore and excel in post-secondary learning. *(See sidebar for tips on selecting the right device for learning and teaching.)*

While there are many variations in tools and practices, most institutions use a combination of these four approaches to ensure that students have affordable access to computing devices:

- **Student, Faculty, Parent, or Employee Purchase Programs:** These programs encourage device ownership through subsidies, volume-discounts, or financing, often coupled with a selection of recommended and approved computing devices, bundled software, centralized support teams, and intensive information campaigns. Programs often provide a number of configurations that all meet basic requirements, and provide students with a range of "good, better, best" choices to meet more advanced user requirements.
- **Institutional Purchase Programs:** Institutional contracts can minimize capital costs and streamline training, interoperability, and support. Bulk purchase programs come in a variety of forms, extending across an entire institution or tailored to a particular field of study such as engineering, journalism, medicine, or business.

"Really [the Northern Michigan University laptop program] end(s) up unleashing our student's ability to explore and go wherever they want to go with their education."

–Gavin Leach, Vice President for Finance and Administration, Northern Michigan University

- **Bring Your Own Device (BYOD):** Many institutions leave the device purchase decision—and responsibility—to students and faculty. It's standard practice today for institutions with BYOD environments to provide minimum technology specifications to ensure students select a device that can access necessary institutional services and perform appropriate tasks for their studies.
- **Computer Labs and Loaners:** Computer labs and loaner programs often are used to supplement access and support specialized computing environments, such as systems for advanced Computer Aided Design, graphical editing, or advanced data manipulation. Device loan programs and labs can augment any of the other approaches to support students who do not otherwise have an appropriate device available.

Guidelines for Students

If students are expected to supply some of their own computing tools, admitting institutions and leaders of post-secondary programs have an obligation to specify and inform students of the requirements for hardware, software and connectivity they'll need for their studies.

When defining specifications, institutions should look beyond today's minimum requirements to develop specifications that will meet students' needs for the duration of their programs. Whether for an eight-week training or a four-year degree, computing devices should meet all requirements for learning throughout the program, and help students transition quickly to the industry or business environment they will enter upon completion.

As shown in the box on page 27, and supplemented in the Appendix, ASU Online—the online program associated with Arizona State University in the United States—provides basic technology specifications for all online programs, and additional requirements for selected areas of study. (ASU Online)

ASU Online Shares Guidelines for BYOD – Bring Your Own Device

Arizona State University Online states the device requirements for participating in online programs:

> "At minimum, you need access to a computer that can access the Internet, preferably with a high-speed connection. You should have access to email, and word processing, power point, and other applications needed to perform a variety of educational functions."

The recommendations on the FAQ sheet provided from ASU Online Technical Support are typical for most e-learning programs:

> ***Do I need a computer?*** Can I access my courses from a mobile device? You will need a desktop or laptop computer to access your classes. A mobile device will not provide the access and functionality necessary for ASU Online courses.
>
> ***Do I need high-speed Internet?*** Yes. Most ASU Online courses use multimedia tools that are best viewed with high-speed Internet, so having the proper connection is essential. It is also important to have a reliable Internet connection at home, or at a place where you can access the Internet on a consistent basis. We also recommend having a back-up plan if your Internet connection becomes unavailable, e.g., going to a library, friend/relative's house. Take this into consideration before enrolling in a fully online program.
>
> ***Are there requirements for web browsers?*** Students should have at least two browsers on their computer. Any browser will work, though preferred browsers are Firefox and Chrome, which can be downloaded for free online.
>
> ***Do I need to purchase software for ASU Online courses?*** In general, course access and assignments do not require any special software; however, certain degrees may require specific software programs. ASU students have access to Google Drive (My Drive via My ASU), where they can create and share Google documents, presentations, spreadsheets and more. Students also have access to hundreds of software titles at no cost through My Apps, via My ASU. *(ASU Online)*

Often, schools for engineering, law, business, design or medicine will have additional requirements for student devices. For example, in addition to describing the hardware and software requirements for online study at the W.P. Carey School of Business at Arizona State University, the school provides a link+ to test students' devices against the minimum requirements for the school. See Appendix.

While these requirements change over time, specifications include minimum requirements for the Operating System, Screen Resolution, and Internet Bandwidth, as well as configuration and software requirements, such as the ability to accept "cookies," and run Java script or Adobe Flash. One can expect that as e-learning is deployed more broadly and deeply in post-secondary education, more programs will provide specific requirements for hardware, software and connectivity. *(ASU Online)*

+ http://profile.wpcareyonline.com/profile/index.cfm?bhcp=1

Examples

The case example, *"Personal Devices are Part of Tuition at Northern Michigan University,"* shows how one university structured their computing environment to ensure equity in access for all learners as part of a move to integrate digital learning and digital content more fully into all aspects of curriculum. See case study page 28. *(Intel, 2014)*

The case example, *"Migrant Workers in PRC Gain Opportunities to Purchase Devices and Enhance Professional Skills"* is an example of an employee purchase program designed to support expanded learning opportunities for workers. See case study page 29.

Case Study

Personal Devices are Part of Tuition at Northern Michigan University

Ensuring Access for All and Building Skills for the Future

Challenge:

Maybe the remote location in Michigan's Upper Peninsula is one reason why computing and connections are so important to Northern Michigan University (NMU). As described on their web site, "Northern Michigan University's vision for education in the 21st Century is a learning environment that embraces technology to enhance student access, promote the development of independent learners, and encourage greater student-faculty communication and collaboration. To help achieve this vision, the university provides a technology package that ensures students and faculty have a standard set of tools (hardware and software) that meets a majority of their computing and telecommunications needs, promotes communication, and enables quality support."

Solution:

NMU implemented a one-to-one laptop program in 2000, where all students and faculty are provided laptop computers, with the device costs bundled into the overall program tuition. In addition to an extensive Wi-Fi network on campus, NMU also operates a community wireless network to strengthen connections for students living off-campus.

Impact:

NMU is one of the largest notebook computer campuses in the United States, with all full-time students receiving either a ThinkPad* or MacBook* as part of tuition. The university has been cited as one of the "most wired and most densely wireless campuses in the country."

The integrated technology environment at NMU provides a comprehensive foundation for learning and collaborating. Gavin Leach, Vice President for Finance and Administration, said, "We have 130 course-specific software [applications] that we use, so it has become a big component of our teaching and learning on campus... The rich learning environment, as a result of the technology... sets us apart from any [other] institution. When you graduate from Northern Michigan University, no matter what your curriculum is, you have been immersed in technology; you have been immersed in wireless access. Having your own personal mobile device allocated to you as part of your tuition really prepares you for the job market."

ICT Insight:

At the start of each fall semester, full-time NMU undergraduate and graduate students are supplied with a mobile device loaded with a standard set of applications, and access to the campus network. Devices are leased and insured by NMU with costs bundled into tuition and fees. This institutional approach ensures equity and access, and drives efficiencies for students, faculty and University administration. NMU continues to support and improve "specialty labs" as a function of need and resource availability. These are labs designed to meet the needs of specific academic programs that require special equipment and software (e.g., graphic design, computer science, GIS, CAD, and others). *(Intel, 2014)*

Case Study

Migrant Workers in PRC Gain Opportunities to Purchase Devices and Enhance Professional Skills

Challenge:

Annually, more than sixty million people migrate from rural regions in the People's Republic of China to the coastal areas where they work at large manufacturing facilities like Foxconn, Quanta, Honda, and Toyota. With roughly 1,675 industrial parks, the coastal region attracts a steady stream of migrant workers. Many workers arrive prepared for entry-level positions, but lack the core foundational skills, training, and experience needed to advance. Digital learning and online programs can help rural workers increase their skills, create new regional opportunities, and support China's goal of driving "inclusive growth." This concept is consistent with the PRC goal of "building a flexible, open system for lifelong learning."

Solution:

Intel worked with the public and private sectors to develop and deploy an employee purchase program for migrant workers. This program strives to make technology and e-learning available to employees in the nation's manufacturing facilities. Workers are predominantly young, motivated, committed, hardworking, and advancing their lives and family well-being, but these new employees often lack the training and experience needed for more highly skilled positions.

Impact:

In 2013, a program promotion and awareness campaign reached three million migrant workers in 200 factories across 13 provinces, with more than 200,000 migrant workers participating in the program.

ICT Insight:

Intel worked with several leaders in the technology sector to create an awareness campaign including "on-campus" promotional tours, incentives, and a worker purchase program that encourages device ownership, expands user education, and enhances skill development. The campaign promotes the benefits of technology and education, and includes relevant support, training, and content bundles. In addition to active support from the government and factories, Intel, Lenovo, Asus, Dell, and Tong Fang supported the collaboration to provide highly motivated workers with the tools for learning.

High-Speed Internet is Critical for Networked Learning and Research

High-speed connectivity, wired and wireless, on-campus and off, is critical for communication, collaboration, content creation, access to global resources, and research. While the creation of national broadband networks falls outside the purview of most educational institutions, educators are critical stakeholders in telecommunications programs, policies, and pricing. They are also in a strong position to influence policy decisions by business and government partners.

> The knowledge economy is the future of the world economy, and the Internet is its backbone.
>
> *– Deloitte*

Not long ago, computer use was measured as the ratio of computers to households. Now a more appropriate measure would be the number of devices per person: students are likely to arrive on campus with multiple Internet-enabled devices. All those devices crave bandwidth.

National or regional, public or private, successful broadband projects include the deployment, adoption, and use of high-capacity networks, as well as long-term funding for sustainability and maintenance. User adoption is driven by service pricing, available devices, digital skills, and meaningful use. While a number of factors can influence the business case or sustainability of a broadband project, key factors include geography and topography, density of users or customers, technology and deployments costs, ongoing operational costs, service quality, pricing, and use. The Organization for Economic Co-operation and Development (OECD) has provided Principles for Internet Policy Making, and tracks statistics related to broadband penetration, usage, coverage, pricing, services and speeds. *(OECD, 2014)* As noted in the World Economic Forum's 2012 *Global Information Technology Report,* countries are increasingly harnessing Universal Service Funds (USF) to subsidize broadband deployment costs, offer discounted service, and/or subsidize devices. *(Carvalho & Thomas, 2012)*

Network Considerations

The online user experience is only as strong as a network's weakest link, so it is essential to create a well-coordinated, highly compatible system for all users and needs. We'll explore considerations for campus, regional, and national networks, nonprofit research networks, and public hot spots.

Practically speaking, the broadband network is neither universal nor unlimited. This unevenness in service gives rise to opportunities to use different types of computing and storage models to enable anytime, anyplace learning. Support for a range of computational models (local, remote, or "in the cloud") and working conditions (online, offline) are necessary to enable reliable and persistent access to education services and resources for a variety of learning conditions.

Campus Networks

Information Technology managers surveyed by the nonprofit Educause listed "addressing access demand and the wireless and device explosion" high on their list of the Top 10 IT issues for 2014. *(Grajek, 2014)* While this publication targets only a subset of post-secondary programs, the challenge of managing Wi-Fi upgrades to keep up with exploding demand is universal. Maintaining high quality wireless access for students and faculty requires a rigorous program of telecommunication monitoring, security, maintenance, and expansion. Investments in wired and wireless network infrastructure must be factored into continuing program costs.

Regional Networks

Corporate, government, and local leaders need to make policy decisions that encourage robust investments in reliable connectivity. To ensure that students can fully use technology-enabled learning models beyond the campus, regional "middle-mile" networks in communities need robust "last-mile" connections to the home. Additionally, interactive learning and peer collaboration require upload speed on par with download speed, or users experience delay and jitter in sensitive video applications and cloud services.

Nonprofit Research and Education Networks

Realizing that affordable high-capacity connections between research universities, other institutions, and industry can open critical pathways for innovation and collaboration. A number of countries, regions, and states build and manage dedicated fiber networks for research and education.

While business models vary, one thing that differentiates these networks from their commercial counterparts is the close planning relationships between network operators and university researchers. Dave Lambert, President and CEO, Internet2, a nonprofit backbone network that connects universities throughout the United States, describes their network's role in innovation this way: "Innovation starts with an idea that travels, engages, grows and develops without constraint."

> "Research and education networks provide "the ability to collaborate with anybody, anywhere without constraint."
>
> *- Jim Bottum, CIO, Clemson University*

Open Public Access

While universal high-speed broadband access is a noble objective, affordability, deployment costs, and network failures leave gaps in coverage. To close these gaps, a good connectivity plan includes some levels of free, public Internet access in safe spaces, in classrooms and in communities where people live. Post offices, public libraries, churches, and community centers can offer many people access to the Internet for research, collaboration, and online learning.

The ITU report, *Measuring the Information Society 2014*, indicates that 43.6 percent of post offices provide public internet access. In the developing world, post offices are critical Internet access points with 78.4 percent of post offices providing Internet access. *(Measuring the Information Society Report 2014, 2014)* In the United States, nearly all public libraries provide computers and free Internet access. According to a study from the University of Maryland's Information & Policy Access Center, 62 percent of libraries report that they provide the only source for free Internet access in their communities. *(Digital Inclusion and Public Libraries, 2014)*

Developed and emerging economies are continuing to see increased investments in broadband access technology – sometimes through systemic programs that drive availability and adoption, and sometimes through targeted programs that address student affordability.

Examples

The case example, *"United States Stimulates Broadband Deployments, Jobs, and Digital Skills,"* describes a government program to incent broadband adoption and stimulate additional deployments in rural and remote areas of the country where connectivity is limited or absent. See case study page 32. *(ASR Analytics, 2014)*

The case example, *"Morocco Harnesses USF Funds to Strengthen Graduate Studies with Programs that Include Expanded Student Computer and Broadband Access"* describes a national program to include digital learning by changing curricula and subsidizing technology costs for university students. See case study page 33.

The case example, *"Monash University Uses Google Docs and Cloud Computing to Unite Nine Campuses Across Four Countries,"* describes how an Australian university uses cloud computing to drive increased collaboration across disciplines, campuses, and continents. See case study page 34. *(Google, 2014)*

Case Study

United States Stimulates Broadband Deployments, Jobs, and Digital Skills

Challenge:

A national recession prompted the United States government to consider ways to stimulate the economy, create jobs, and lay a foundation for future growth. Investments in broadband were a small but significant part of the resulting program.

Solution:

On February 17, 2009, the United States government passed the American Recovery and Reinvestment Act. The essential goal of the Recovery Act was to provide a "direct fiscal boost to the help lift [America] from the greatest economic crisis in our lifetimes, and lay the foundation for future growth.[1]" The Act directed the Federal Communications Commission to create a National Broadband Plan, and directed the U.S. Department of Commerce to issue USD 4.2 billion in grants as part of the Broadband Technologies Opportunities Program (BTOP). Commerce was directed to create a national map of broadband availability and adoption, to drive broadband into rural and remote areas of the county, and to encourage broadband adoption and use.

Impact:

As of the end of 2013, BTOP grantees had built or upgraded more than 113,000 miles of fiber—enough to circle the earth four and a half times, or get you halfway to the moon. They connected nearly 25,000 community anchor institutions, including libraries, schools, health clinics, government buildings, and public safety facilities. They established or upgraded 3,000 public computer centers, trained more than 4 million people and helped roughly 735,000 households sign up for broadband. The National Broadband Map continues to inform regulatory and policy decisions that aim to increase broadband coverage, adoption and service quality.

Schools and libraries figured prominently in BTOP projects. Thousands of libraries provided public access facilities to help adults learn digital skills, retool resumes and look for work. A third-party evaluation of the project found that "community anchor institutions, like schools and libraries, served by BTOP infrastructure grantees in the sample experienced significantly increased speeds and lower costs. As an example, the median price paid by libraries in the sample was USD 233 megabits-per-second (mbps)/month before BTOP, at a median speed of 3 mbps. As a result of the grant, the median price dropped to USD 15 mbps/month and median speed increased to 20 mbps." (ASR Analytics, 2014)

ICT Insight

Some important themes emerged through the BTOP program, principles that focused on investment and impact:

1. **Serve the Underserved –** Resources were invested in areas with little or no broadband access, or to serve people who were not yet online.
2. **Take a Holistic View –** Projects included infrastructure and broadband adoption, public access centers, mapping, and evaluation.
3. **Encourage Partnerships –** Partnerships drove near-term impact and longer-term sustainability.
4. **Strengthen Community Anchor Institutions –** By focusing on community anchors, such as schools, the anchors became hubs for connectivity and services.
5. **Open Access –** Open access requirements further stimulated the market by driving commercial and nonprofit partnerships, peering, and resale.
6. **Ensure Sustainability –** BTOP grants provided a one-time infusion of funds, so sustainability plans were required. Helping with up front capital costs often gave providers enough of a boost to provide ongoing cash-positive services.

Case Study

Morocco Harnesses Universal Service Funds (USF) to Strengthen Graduate Studies

Programs Include Expanded Student Computer and Broadband Access

Challenge:

Although the Moroccan Ministry of Education recognized that ICT skills were integral to success in most professions, many of their students were completing degree programs without acquiring sufficient technology skills. Lack of access to computing devices and broadband connectivity was a barrier to learning, employment, and economic growth. Affordability was the chief concern for students, especially in graduate programs in medicine, science, and engineering. These fields required computers and high-speed mobile broadband for full participation in intensive programs to ensure students graduated with professionally relevant digital skills.

Solution:

The Ministry of National Education worked with three other national agencies including the National Telecommunications Regulatory Agency (ANRT), with Intel and local and national vendors, and with public and private universities, to create INJAZ—or إنجاز—the Arabic word for achievement. Since the Ministry of Education believes that digital learning is critical to achievement, their goal was to "equip 100 percent of students in engineering and science with PCs and Internet by 2013." To address affordability concerns, the Ministry developed partnerships with wireless 3G providers and technology vendors to create a suite of options for technology access, a Web presence, an awareness campaign, and a subsidy using Universal Service Funds (USF) to offset initial device and Internet service costs.

Impact:

The success of this program can be measured in its reach, its continued expansion and sustainability, and in the impact on its graduates. In the four years since the program was created, more than 110,000 students have benefited from the program, representing well over 80 percent of eligible students. More important, according to the Ministry, "The INJAZ program contributes to enhance the quality of education and, consequently, the effective employability of the winners." Planning is currently under way to develop the next phase of the program.

ICT Insight:

There are a number of elements to the INJAZ ICT approach:

- **Partnership –** Program leadership came from four government agencies working in partnership with Intel, technology and telecommunications partners to create a scalable and sustainable program.
- **Affordability –** USF subsidizes up to 70 percent of the costs for broadband access and devices, making the equipment affordable for students, and driving growing use of wireless 3G.
- **Bundled Solutions –** Telecom operators Meditel and Maroc Telecom provide 3G broadband access, and allow students to order a bundled solution that includes devices from HP, Dell, Toshiba, and Samsung via local reseller, Accent. All devices come preloaded with Intel® Learn Easy Steps for digital literacy, and the British Council's English language learning content.
- **Sequential Rollout –** By rolling out the program sequentially for specific student groups, students and faculty are able to ensure that all students have the right device for learning, and adapt curricula to take advantage of digital learning opportunities.

Case Study

Monash University Uses Google Docs* and Cloud Computing

Uniting Nine Campuses Across Four Countries

Challenge:

With four campuses in Australia, additional campuses in Malaysia and South Africa, International Centers in India, Italy, and China, and an increasing number of students completing online classes, Monash University sought a way to create a common learning structure and encourage collaborations among students and faculty.

Solution:

Monash University adopted Google Docs* to increase collaboration and simplify administration across their global learning community. Google Docs is a cloud-based set of tools—or apps—for e-mail, calendar, word processing, presentations, and cloud storage for collaboration and productivity between students and faculty anywhere.

Impact:

The unified tools, and the ability to synchronize device data to the cloud, simplify administration and amplify collaboration. According to Susan Zolezzi, Manager, Communications and Change, at Monash University, "Going Google has helped us turn campuses across four countries into one University by providing a platform [with] greater opportunities for active engagement between students, staff and researchers, producing 'world- and work-ready' graduates. Apart from the collaboration and educational benefits to the Monash community, Google Apps has been better, faster, and cheaper than we could have hoped for, delivering cost and time efficiencies across the University."

ICT Insight:

The Monash implementation takes a "hybrid approach" to network architectures: it is cloud-based and locally cached; based on a standard commercial platform, augmented with University-specific tools. By offering a comprehensive set of commercial tools hosted by Google, the university saves on systems costs, and creates a standard environment for applications and services. Using these resources, the Monash IT team and faculty developed tools, websites, spreadsheets, processes, and forms to support academic and administrative tasks such as onboarding students, facilitating lab assignments, managing course evaluations, and completing group assignments. Local caching and synchronization allow students to work offline when they don't have broadband access; and all campuses are blanketed with high capacity wireless. (Google, 2014)

"The key thing that Google Apps has allowed staff and students to do is to change the culture to make collaboration more ingrained in it."

- Samantha Garrett, Business Analyst, Monash University

Exponential Growth in Devices and Anytime Anyplace Access Requires an Increased Focus on IT Security and Manageability

As indicated in the Educause Center for Analysis and Research (ECAR) report, Study of Undergraduate Students and Information Technology 2014, "technology is omni-present in the lives of students." Most students arrive on campus with a high technology inclination. They are comfortable using technology in their lives and they expect to be able to bring that experience into academic settings.

That study also reports "today's campus networks need to accommodate different types of devices and operating systems, as well as growing numbers of devices per student. More than half of undergraduates (54 percent) say they typically connect at least two devices to the college/university network at the same time. Younger students are the power-users of college/university networks; nearly twice as many students under 25 years of age connect two or more devices at a time to the network (61 percent, compared with 35 percent for students 25-plus). About 1 in 10 students (8 percent) try to connect three or more devices to the network at the same time, and this will likely increase as wearable technology and the Internet of Things matures into everyday devices that students can use and afford." (Dahlstrom & Bichsel, 2014)

According to researchers from Dell KACE, one key tactic to address manageability in the BYOD environment is "integrating endpoint security functionality—along with traditional systems management capabilities—to identify vulnerabilities more easily across all servers, desktops, laptops, and tablets."

> "The consumerization of technology and the Bring Your Own Device (BYOD—or even bring your own Everything [BYOE]) trend means that students have a highly competitive market from which to choose their device brand and operating system."
>
> *– Dahlstrom and Bichsel, Educause Center for Analysis and Research*

> "The key for our … higher-ed customers around the globe is the assurance that embracing BYOD and personalized learning strategies can be done safely because apps running on different devices across multiple operating systems are configured, secured, updated and managed properly."
>
> *– Bill Odell, Vice President, Marketing, Endpoint Systems Management, Dell Software*

These trends point to a need to manage an increasingly diverse and mobile IT environment—one with a variety of different platforms, operating systems and applications. Doing so requires an enterprise-wide approach to managing devices, systems and applications. A rigorous process to authenticate users is required, as well as tools to provide access to all services, both on campus and remotely, for students and faculty. Additionally, careful security techniques are essential to ensure that data is protected both in the enterprise and on end-user devices.

- **Enterprise Mobility Management (EMM)** goes beyond Mobile Device Management to create an all-encompassing approach to securing and enabling smartphones, tablets, laptops and desktop computers. EMM supports mobile devices, systems apps, and content management, as well as providing secure access to academic resources.
- **Identity and Access Management (IdM)** describes the management of individual users, their authentication, authorization, and privileges within or across system and enterprise boundaries.
- **Remote Access** is especially important to ensure that users have access to applications on and off campus, often provided over a secure connection such as a Virtual Private Network.
- **Virtual Desktop Interface (VDI)** also supports remote or mobile access, allowing a client to access a user-desktop environment on remote servers or PCs.
- **Security** includes blocking spam and malware, finding endpoint vulnerabilities, and encrypting enterprise data residing on end-points. The focus is to monitor, preempt, and fix any corruption or problem with user data.

The explosive growth in smart devices, an increasingly mobile culture, and the increased use of "big data"—or data analytics—create new pressures for Information Technology professionals. These changes move information technology from the "back office" to the "front lines" of digital learning.

> "The democratization of information technology means that faculty and students have not only the desire but also the means to reshape the way they use technology in their work, that all members of the campus community want ubiquitous access to computing, and that presidents, provosts, and trustees expect to use information technology to help realize their institutions' strategic visions."
>
> *–Susan Grajek, EDUCAUSE*

Along with educators, IT managers are invested in student outcomes, and have become champions of technology integration. They are aggressively seeking new staffing and funding models that will support the infrastructures essential to meet the ever-higher expectations of students and faculty in digital learning environments.

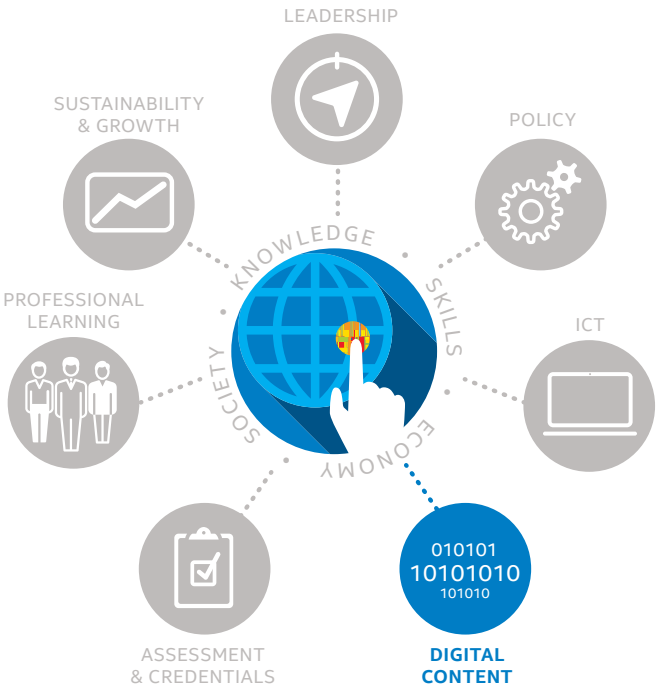
The topics cited by IT Directors surveyed for the *EDUCAUSE Top 10 IT Issues 2015* reflected the topics IT managers continue to address everywhere as they design IT infrastructures that support 21st Century learning. In describing the 2015 Top 10 list, Susan Grajek noted three meta-trends. First is an inflection point where the trends that "have motivated thought-leaders and early adopters are now cascading into the mainstream. A second dimension of change is the shifting focus of IT leaders and professionals from technical problems to business problems, along with the ensuing interdependence between the IT organization and business units. Underlying all this strategic change, the day-to-day work of the IT organization goes on. But change dominates even the day-to-day, where challenges are in some ways more complex than ever. This 'new normal' is the third theme of change." *(Grajeck, 2015)*

1. Hiring and retaining qualified staff, and updating the knowledge and skills of existing technology staff.
2. Optimizing the use of technology in teaching and learning, in collaboration with academic leadership, including understanding the appropriate level of technology to use.
3. Developing IT funding models that sustain core services, support innovation, and facilitate growth.
4. Improving student outcomes through an institutional approach that strategically leverages technology.
5. Demonstrating the business value of information technology, and how technology and the IT organization can help the institution achieve its goals.
6. Increasing the IT organization's capacity for managing change, despite differing community needs, priorities, and abilities.
7. Providing user support in the new normal: mobile, online education, cloud, and BYOD environments.
8. Developing mobile, cloud, and digital security policies that work for most of the institutional community.
9. Developing an enterprise IT architecture that can respond to changing conditions and new opportunities.
10. Balancing agility, openness, and security. (Grajeck, 2015)

Programs and services offered by EDUCAUSE, the Intel IT Center, IT@Intel, and vendors such as Dell KACE are among the many resources available to support post-secondary information technology staff who are building and maintaining an infrastructure for digital learning.

Selected Sources for Security and Manageability Expertise	
EDUCAUSE	EDUCAUSE is a nonprofit association that works to advance higher education through the use of information technology. This organization focuses on the campus-wide uses of IT for academic, administrative, research, and business purposes, as well as issues such as governance, policy, and cybersecurity. Among EDUCAUSE's 2014 priorities are strengthening the educational IT profession through professional development and peer learning, and helping to harness IT as a "game changer" in higher education.
Intel IT Center	The Intel IT Center is designed to provide straightforward information to help IT professionals implement strategic projects, including virtualization, data center design, intelligent clients and cloud security. The Center recently published a planning guide titled, Consumerization Security for the Changing Enterprise, which includes guidelines for building layered protection in networks that support diverse multi-device access architectures.
IT@Intel	IT@Intel connects IT professionals around the world with their IT peers inside Intel. The Intel IT department solves some of today's most demanding and complex technology issues. Intel staff are committed to sharing lessons-learned directly with fellow IT professionals in open peer-to-peer forums.

4. Digital Content



Key Take-Aways

- Educational content is making the digital shift—and fast!
- Standards, IP, copyright, and security are important considerations when going digital.
- Digital content is at-the-ready to support different teaching and learning needs.

Educational Content is Making the Shift to Digital—and Fast!

New ways to present and share digital content have resulted in an explosion of new possibilities for digital learning. Educators, programmers, and entrepreneurs across the globe are continually creating new platforms and applications for digital learning and teaching. The opportunities for digital content are increasing apace.

Digital technology removes constraints of time, place, talent, and cost. At the same time it increases the potential to adapt and personalize instruction to students' passions, learning styles, and goals.

The rapid shift to digital is driven by a number of factors. Here are ten major trends driving educational content digital.

1. **Digital is native for more learners.** For Millennials, who have grown up with ready access to smart devices, using those tools for reading, researching, and sharing online is natural, everyday behavior. Shifting back to static—and expensive—textbooks seems foreign to these students. This is a trend affecting more than Millennials. A 2012 report from the Pew Internet & American Life Project found that 78 percent of American adults over the age of 16 had read a book in the past year, but those who read e-books read significantly more. "The average reader of e-books says she has read 24 books (the mean number) in the past 12 months, compared with an average of 15 books by a non-e-reader consumer." *(Rainie, Zickuhr, & Purcell, 2012)*

> Online-based education is revolutionary because it marks the critical convergence of multiple vectors: the right learning models, the right technologies, the right customers, and the right business.
>
> *(Christensen & Weise, 2014)*

2. **Smart devices put learning and information in our hands at all times.** The same Pew report found that readers [and learners] are omnivores. They read print books, electronic texts, news, fiction, and nonfiction. For those who read electronic content, 41 percent used an e-reader, 29 percent read on their cell phone, and 23 percent read on a tablet or computer. While the Pew report focused on e-text and e-reading, this same trend is driving increases in the use of educational game, video, and collaboration tools.
3. **Digital formats engage us.** Digital formats provide pathways for students to engage with information, collaborate, create or share. Improvements in video capture have made it easier to produce and view lessons in video as a vehicle to enrich learning or "flip" a classroom. This could mean using an interactive infographic to understand changes in the world's economy over time, learning lab safety procedures through an online video, or using hyper-linked text to explore topics in history or science. *(See sidebar for a summary of how the Intel Kno™ platform makes digital content more engaging and effective.)*
4. **Digital curriculum is flexible and current.** A two-year-old textbook based on content that was already a year old when first printed need not guide curricula. By leveraging digital content, educators and students can adapt curriculum on the fly to bring in the latest research, or to adapt instructional paths to meet student interests.

DIGITAL IS ONLY THE BEGINNING
KNO™ TEXTS ENERGIZE LEARNING

A growing presence in the e-book field, Kno.com offers students more than 200,000 titles that are compatible with iOS, Windows,* and Android* devices and most web browsers. Kno provides publishers with tools to make their content more engaging, relevant, and measurable.

Kno is more than an e-book platform. Kno™ digital books include embedded video, embedded flashcards, powerful context-sensitive online search, study guides, optional student highlight functions, peer and educator collaboration tools, and a personal dashboard. These enhancements make digital learning engaging, and bring new energy to traditional texts.

The Kno platform provides administrators and teachers with the tools they need to easily assign, manage, and evaluate how learning content is being used. Inboard analytics capture students' reading and learning habits, adapting content to accommodate different learning styles. In-line assessments provide students and faculty with immediate feedback on learning outcomes. Kno can energize learning for students and faculty.

Kno is part of Intel® Education.

5. **Digital content is modular.** With the explosion of open source and for-fee educational content, students and educators can select resources and learning modules that meet their learning goals, and create customized learning pathways. This wealth of available content disintermediates learning, removing the "middleman" and putting learners and educators at the center of the learning process.
6. **Digital content is participatory.** With web 2.0 tools, learners are authors and content creators."Making, creating, and producing are powerful paths to deeper learning and understanding. Connected learning asks learners to experiment, to be hands-on, and to be active and entrepreneurial in their learning, recognizing that this is now essential to be successful in work and in life." *(Learning, 2014)*
7. **Analytics are built in.** Most digital content includes built-in analytics so that an educator or learner can modify learning paths based on learning velocity or assessment results. Built-in analytics provide educators, students, and administrators with the real-time feedback needed to create relevant, responsive learning paths.
8. **Digital content could be more cost effective.** Most educators and program administrators say that saving money is not driving their move to digital: it is a side benefit. A digital curriculum can leverage a world wide web of open source and commercially available content that is contemporary and engaging, while saving money on printed textbooks.

9. **Digital content is global and local.** While standard digital formats make the world's information available to anyone and everyone at any time in any place, those same standards and tools make it easier to produce and share local content, and to translate existing content into different languages or accessible formats.
10. **Digitization and digital access are accelerating.** The 2012 Pew study on e-reading found that there were "four times more people reading e-books on a typical day now than was the case less than two years ago." *(Rainie, Zickuhr, & Purcell, 2012)* At the same time, there are at least three major initiatives to catalogue more of the world's knowledge and make it globally accessible for scholars and learners. These programs include the Digital Public Library of America, Europeana, and Southeast Asia Digital Library as well as countless other programs that are working to capture history and make it open and available for all. Some estimate that the world's knowledge will soon be doubling every 12 hours, a rapid increase in knowledge-creation velocity from the 25-year knowledge doubling curve of the mid 1900's.

"Buckminster Fuller created the 'Knowledge Doubling Curve;' he noticed that until 1900 human knowledge doubled approximately every century. By the end of World War II knowledge was doubling every 25 years. Today things are not as simple, as different types of knowledge have different rates of growth. For example, nanotechnology knowledge is doubling every two years and clinical knowledge every 18 months. But on average human knowledge is doubling every 13 months. According to IBM, the build out of the 'Internet of Things' will lead to the doubling of knowledge every 12 hours."

– David Russell Shilling (Schilling, 2013)

Standards, IP, Copyright, and Security are Important Considerations When Going Digital

Recent years have seen an explosion in availability of digital content at-the-ready to support educators and learners, as well as a myriad of increased uses for that content as part of post-secondary curricula.

Broadly, digital content includes:

- Digital textbooks or e-texts
- Learning objects, such as pictures, videos, audio clips, infographics, quizzes, and tests
- Open source materials
- Apps and games
- Online assessments

These basic content types are defined in the table below. *(The Center for Digital Education, 2014)*

Types of Digital Content	
Digital textbooks or e-texts	Textbooks viewable on mobile devices or computers, with material either provided by commercial or independent publishers, created by instructors, found online, or a mixture of all three resources. E-texts can include information on a single topic, a full lesson, or a complete textbook.
Learning objects	Pictures, videos, audio clips, and other multimedia elements; graphs, charts, and infographics; quizzes and tests; exercises and activities are all examples of learning objects.
Apps and games	Game-based learning can be engaging and fun for students. This includes the use of adaptive software that collects data and adjusts to student responses.
Online assessments, testing and test preparation	Formative assessments are considered a form of digital curriculum. Real-time feedback on student performance during assessments plays a critical role in personalized learning.

(The Center for Digital Education, 2014)

Key Considerations When Going Digital

Looking at digital content from another perspective, each of these content types is created and used based on a continuum of business models and licensing, or terms of use.

At one end of the spectrum, commercially produced content, normally under copyright protection, is either sold outright or licensed based on specified terms of use. Open Education Resources are generally made available for free and are often governed by Creative Commons or Open Source agreements which make that material available for educational and non-commercial use, with attribution. User-generated content can be either commercially licensed, copyrighted, offered via Creative Commons and/or distributed privately.

> Creative Commons develops, supports, and stewards legal and technical infrastructures that maximizes digital creativity, sharing, and innovation.
>
> *(About Creative Commons)*

Whether content comes from traditional educational vendors and publishers, is created by new entrants, created or remixed by staff and students in post-secondary programs, there are several things that need to be considered (many beyond the scope of this paper) to ensure that digital content meets educational, economic, and societal goals. Some of these include:

1. **Teach safety and responsibility.** While the benefits of digital learning are significant, the rapid connections that proliferate information can also create personal, institutional, or even national risks. Students and faculty need to learn techniques to protect personal data, third party assets, and project research. Many also need guidance on the etiquette, ethics, and values of being a constructive participant in Web 2.0 communities. Post-secondary programs are poised to model and educate students on the ethics and practices of living and working in a digitally connected world.
2. **Industry standards drive interoperability.** Whether content is developed using PDF, ePUB2, ePUB3, or HTML5 digital content built to standards will operate on a range of devices, and communicate or exchange data as needed. Issues with device-aware content delivery, backwards compatibility, and interoperability will be eased when developers support industry standard environments.
3. **Systems must protect intellectual property and copyright.** While some digital content is intentionally licensed for use under Creative Commons, other materials reserve copyright protection to control use. Understanding Digital Rights Management (DRM) is foundational for any program that uses digital content for learning and teaching. Protecting intellectual property (IP) is also part of fostering innovation, trust, and safety in an educational setting. This applies to student- and faculty-generated content, and other content used in educational programs. Post-secondary programs need to respect, teach, and support IP rights and DRM.
4. **Security, privacy, transparency, and trust are fundamental to learning.** While data analytics can help software adapt to learning styles, and provide faculty with real-time assessments of learning gaps, digital services and analytics also can cross the line by collecting too much student information and putting that data at risk. Student data should always be managed securely, and when that data is used, students should have the opportunity provide informed consent or have their data masked or deleted.

> "A 2010 meta-analysis published by the U.S. Department of Education suggests that students exposed to both face-to-face and online education were more successful than students entirely in one camp or the other."
>
> *(Te@chThought, 2013)*

Digital Content is At-the-Ready to Support Different Teaching and Learning Needs

Perhaps more interesting than a survey of content types and licensing approaches is a review of the ways digital content is used to support post-secondary outcomes.

Digital content plays an important role in expanding the reach of post-secondary programs, engaging students more deeply, and improving outcomes. Digital content is also at-the-ready to support different teaching and learning needs, such as building foundational skills, supporting self-directed or informal learning, or as part of a formal, standards-based degree or certificate program.

1. **Building Foundational Skills**
   Digital Content is playing a huge role in helping people build foundational skills such as digital literacy, financial literacy, basic math, writing, and language skills. Building basic skills and moving remediation to an online and open format reduces institutional costs for remediation while it also improves access, and enables students to learn at their own pace. Digital literacy is a foundational skill to fully harness online and digital content in education. Learners in twenty countries start their digital journey with Intel® Learn Easy Steps. The basic course is designed to be delivered as a facilitated course that is modular and highly flexible. Activity cards are available to augment the class or for use by independent learners.

One example of online remediation is the Maths Help Modules developed by the Open University in the UK. Previously, students would review remedial math during the beginning of the course; this was not enough time for some students and they would fall behind. The school decided to make all remedial lessons available online to everyone, at any time. That way, students could start practicing math before class started, and instructors could begin teaching new material at the beginning of each term. Taking advantage of early enthusiasm, counselors advise students to start reviewing math as soon as they register for a math course. Now students are more prepared to start classes, making the process more efficient for students and faculty. (Lowe & Holmes, 2010)

2. **Self-Directed and Informal Learning**
   Today's learners are taking advantage of new content and sources to create and manage their own learning path. For example, a student having trouble with algebra can watch Kahn Academy videos to reinforce theory, complete practice problems on CK12, and then run through major concepts using digital flashcards on StudyBlue. If that student is interested in coding, he or she can learn C++, JavaScript, or HTML via online classes at Lynda.com. More advanced learners can access course materials from distinguished faculty at the Massachusetts Institute of Technology or Carnegie Mellon University using MIT's OpenCourseWare or CMU's Open Learning Initiative.

   Learning new languages is one area that has seen rapid growth in the global use of digital learning products and services. Digital English language learning products in Asia encompass self-paced learning, collaborative learning, digital reference, mobile learning apps, and mobile language services. The huge repertoire of digital language tools available to global learners is making it easy to learn a language, to practice and engage with others, and to explore the world. The research firm Ambient Insight notes: with a growth rate of 23.6 percent over the past five years, China is now the top-buying country for digital English language products worldwide. Revenues for this product category alone will likely double to USD 1.6 billion by 2018. *(ICEF Monitor, 2014)* Learn English, from the British Council, is one of the more popular free programs. This extensive website includes videos, lessons on grammar and vocabulary, games, and mobile apps as well as specialized content for teens, for kids, for business professionals, and for educators. The site even includes material to support the International English Language Testing System (IELTS)—the most popular English test for higher education and global migration.

3. **Formal Standards-Based Degree or Certificate Programs**
   Educators can harness digital content to meet specific degree requirements as part of any post-secondary program—or offer an entire degree program online. Key to selecting digital content as part of a formal program is having a clear understanding of how the content or lesson fits into the overall course, and how it contributes to achieving curriculum requirements and standards.

   While the fully or partially online Master of Business Administration degrees are nearly commonplace, fully online degree programs have been less prevalent in technology fields. In May 2013, the Georgia Institute of Technology College of Computing (in the U.S.) announced, "it will offer the first professional Online Master of Science degree in computer science (OMS CS) that can be earned completely online. The degree will be provided in collaboration with online education leader Udacity Inc. and AT&T." The program, which is still in a pilot phase, "will be delivered via the massive open online course (MOOC) format, with enhanced support services for students enrolled in the degree program. Those students will also pay a fraction of the cost of traditional on-campus master's programs; total tuition for the program is initially expected to be below USD 7,000....While courses related to the OMS CS will be available free of charge on the Udacity site, only those students granted admission to Georgia Tech will receive credit." *(Georgia Tech Annouces Massive Online Master's Degree in Computer Science, 2013)*

Examples

The case example, *"ALISON – A Platform for Sharing Certified Online Courses Anytime, Anyplace, at Any Pace, and Free"* demonstrates how one entrepreneur created a platform to share high quality content with learners and educators around the world. See case study page 42.

The case example, *"Washington State Makes Community and Technical College Course Materials Available to All in Open Course Library,"* describes a state-wide Open Education Resources program to make course material available at no charge for students in community college and technical schools. See case study page 43. *(Watters, Building Your Own Textbook, 2011) (Student PIRG, 2014)*

The case example, *"Iniciativa Program Blends In-class Mentoring, On-line Classes and Simulation to Create New Entrepreneurs in Spain"* describes a Spanish program to expand technical and business schools for young adults. See case study page 44. *(Employment and Entrepreneurship Training Initiative)*

Case Study

ALISON – A Platform for Sharing Certified Online Courses

Anytime, Anyplace, at Any Pace, and Free

Challenge:

Digital content allows publishers and content providers to reach many students with valuable content, but the proliferation of content makes it difficult for learners, institutions, and employers to assess the relative merit of different online programs. The ALISON platform hosts vetted content from well-known commercial publishers, and provides graduates with a learning certificate for those courses they complete successfully.

Solution:

"ALISON is a global social enterprise providing essential, certified, education and workplace training skills free to any individual, anywhere, over the web." ALISON, which stands for "Advance Learning Interactive Systems Online," was founded in 2007 and was recently referred to by the BBC as "one of the biggest education providers you've never heard of." ALISON is a content aggregation and sharing platform that supports four distinct user groups:

- Students who want further learning, to gain verifiable certification, or complete free aptitude tests
- Teachers who want to manage large student groups and automate testing
- Employers who want to verify a candidate's knowledge or upskill employees
- Publishers who want to reach more learners, and benefit from the advertising revenue model

Impact:

According to the ALISON web statistics as of January 2015, the platform already has a strong and growing reach:

- 4,000,000 learners educated
- 400,000 graduates
- 20 countries reached
- 600 courses published

One example of the responsiveness and reach of ALISON is a short course created by Advance Learning. Understanding the Ebola Crisis and How you Can Avoid It has already been competed by almost 20,000 learners, 10,000 from West Africa.

Digital Content Insight:

The digital content provided on ALISON is diverse, with more than 600 courses, in categories ranging from health and safety compliance to financial and economic literacy, and diploma courses in topics ranging from accounting controls to basic Chinese, from plumbing to project management. The ALISON platform provides common metadata for all courses, a consistent look-and-feel, user analytics, and a wide variety of supportive educational material and discussion forums that support learning at any pace, anytime, anyplace. ALISON is an Open Educational Resource (OER).

Case Study

Washington State Makes Community and Technical College Course Materials Available to All in Open Course Library

Challenge:

For students at community colleges or vocational schools, sometimes the cost of textbooks is so high that many students may need to take the class without the text—a compromise that makes it difficult for them to get the full benefit from the courses. The State Board for Community and Technical Colleges in Washington decided to take on this challenges by developing an Open Course Library (OCL) to ensure that all students had full access to the materials needed to succeed in school.

Solution:

The Open Course Library developed materials for 81 of the highest-enrollment courses across Washington State's community and technical colleges, creating a collection of complete, shareable course materials—all for under USD 30.00 per student. OCL course materials are developed by a collaborative design team that includes some of the best educators in the state. They hope that using OCL will help increase student engagement and improve retention and completion. This work was funded by the Washington State Legislature and the Bill & Melinda Gates Foundation.

Impact:

A third party evaluation found that the OCL met its institutional goals, saving money and making textbooks more available to students.

- OCL saved students USD 5.5 million since its inception, including USD 2.8 million in the 2012-2013 academic year alone.
- OCL materials cost 90 percent less than the materials that faculty members used prior to adopting OCL, saving students USD 96 per class. The average OCL material costs USD 12 while the average traditional textbook replaced was USD 135.

Adoption continues to grow, with more schools in Washington State and in other states taking advantage of the state's OCL library to increase student access to educational resources. *(Student PIRG, 2014)*

Digital Content Insight:

The OCL is a collection of shareable course materials, including syllabi, course activities, readings, and assessments, designed by teams of college faculty, instructional designers, librarians, and other experts. Some of these Open Educational Resources (OER) are paired with low cost textbooks (USD 30.00 or less.) Unless otherwise noted, all materials are shared under a Creative Commons (CCBY) license. OCL courses and materials have undergone testing for accessibility, and have been designed using the industry standard Quality Matters (QM) rubric for assessing the quality of online courses. *(Watters, Building Your Own Textbook, 2011)*

Case Study

Iniciativa Program Blends In-Class Mentoring, On-Line Classes, and Simulation to Create New Entrepreneurs in Spain

Challenge:

In Q1 2013, the youth unemployment rate reached 57.22 percent in Spain—more than twice the global rate. While Spain's digital economy was growing, many young adults were unable to participate because they lacked business fundamentals and digital skills. A "Grand Coalition for Digital Jobs" was developed to bring stakeholders together to ensure the increased availability of ICT training as well as to create awareness about ICT careers among young people.

Solution:

The Madrid Initiative for Employment and Entrepreneurship offers training for young adults 24 to 30 years old, who have been unemployed for more than a year. The program goal is to increase youth employability and entrepreneurship by providing the tools and training to participate fully in the knowledge economy.

Impact:

A survey of program graduates found strong initial results:

- 100 percent of students successfully completed the program
- 65 percent of students found positions soon after completing the program
- 37 percent of students continue to develop their businesses plans

Students especially appreciated the way that the program was offered, including:

- Up-to-date and practical course modules
- Easy to understand, relevant documentation and teaching materials
- Full availability of methodological and technical tools to improve the teaching-learning process
- Entrepreneurial knowledge and expertise of the teaching personnel
- Opportunity to foster networking among students and teachers
- The degree of motivation and general support by the project organizers.

Digital Content Insight:

The Youth Entrepreneurship curriculum included 70 hours of blended—in-classroom and online—training over five weeks. Topics included business, finance, digital literacy skills, Office productivity software, and an online business simulation. Vivero de Emprendedores is an online collaboration and social networking tool that allows users to perform several of the steps necessary to create a startup. It is a virtual space that simulates a real-world business incubator. The simulator allowed students to implement their acquired knowledge and test their business assumptions. Program analytics made it easy to monitor each student's progress with the material. *(Employment and Entrepreneurship Training Initiative)*

5. Assessment and Credentials

Key Take-Aways

- Unbundled learning creates new opportunities and challenges for assessment.
- Competency-based programs value skill acquired more than pedagogy, bringing new benefits to students, institutions, and potential employers.
- Institutions should be prepared to support in-person and virtual assessment.

Digital learning tools enable educators and students to "mix and match" tools, resources, and strategies to meet learning needs. This new freedom reaches far beyond traditional linear curricula, removing the boundaries of location and timing, and the familiarity of face-to-face contact between teachers and students. It also suggests the need for new ways to ensure that students acquire the necessary skills and meet instructional objectives.

Unbundled Learning Creates New Opportunities and Challenges for Assessment

"Unbundling" describes "how the ubiquity of mobile devices, Internet connectivity, consumer web technologies, social media, and information access are affecting older institutions such as education, broadcasting, newspapers, games, shopping, by 'break[ing] up' the packages they once offered, providing particular parts of them at a scale and cost unmatchable by the old order." Unbundling has been called "the great disruptor."

(Unbundling, 2014) (Watters, Unbundling and Unmooring: Technology and the Higher Ed Tsunami, 2012) (Chatfield, 2012)

The supply and demand equation for post-secondary education has shifted. On the demand side, the need for people to update, add, or build new skills throughout their careers has made lifelong learning a mandatory life skill. On the supply side, abundant digital content, new educational providers, and student-centered learning models give students the opportunity to unbundle rigid academic requirements for prescribed, outdated "education," and to re-bundle selected components in ways that meet their unique needs and interests. For example, a learner interested in software development—or any other topic—can enroll in traditional or online classes from a range of different providers, participate in MOOCs and webinars, and access Open Educational Resources to develop the specific skills and competencies they feel are important. In addition, students now can access remedial learning options when they need to catch up, or develop core and transferable skills that are necessary but might not be part of a degree itself, e.g., digital literacy, learning a second language, new software, and more.

Unbundled learning gives alternatives to the sequential process of traditional instruction, and creates new opportunities and challenges for assessment.

In their text, *Hire Better: Mastery, Modularization, and the Workforce Revolution*, Michelle R. Weise and Clayton M. Christensen suggest that unbundled education also creates new educational pathways. "As traditional institutions struggle to innovate from within, and education technology vendors attempt to plug and play into the existing system, online competency-based providers [can] release learning from the constraints of the academy. By breaking down learning into competencies—not by courses or even subject matter—these providers can cost-effectively combine modules of learning into pathways that are agile and adaptable to the changing labor market. [Understanding] the fusion of modularization with mastery-based learning is the key to understanding how these providers build a multitude of stackable credentials [and] programs for a wide variety of industries, scale them, and simultaneously drive down the cost of educating students for the opportunities at hand." *(Weise & Christensen, 2013)*

"The signaling effect of a college degree appears to be an imprecise encapsulation of one's skills for the knowledge economy of the times."

(Weise & Christensen, 2013)

While the unbundled education model creates new opportunities for assessment, credit and credentialing, it also creates new challenges. Unbundling invites educators to consider the value and relevance of student expertise developed outside of their controlled systems; it challenges them to find meaningful ways to measure achievement and to issue reputable credentials.

The McKinsey Report, *Education to Employment: Designing a System that Works*, discusses the dichotomy of very high youth unemployment at a time when employers have trouble hiring staff with the skills needed for their businesses. Chief among the report's recommendations is a focus on improving the pathways from "education-to-employment" through greater partnerships between educators and employers. The authors endorse new approaches to rethink credit and credentialing.

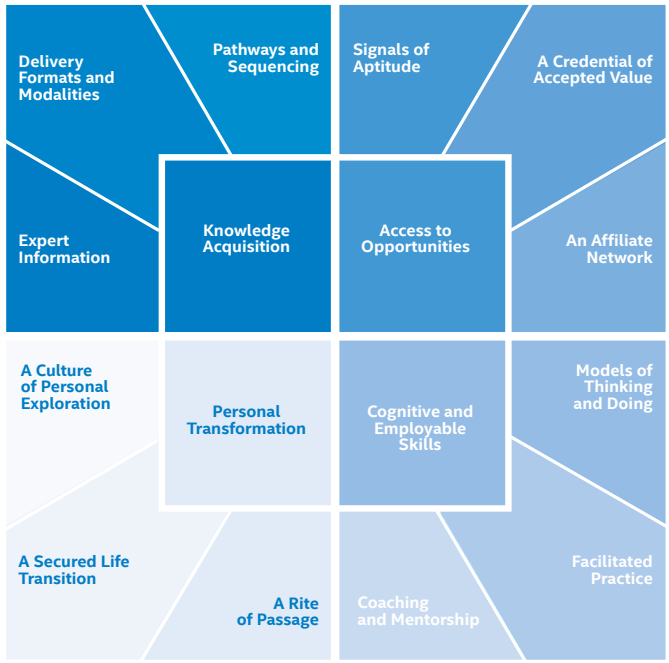
"Historically, the university, community college, or polytechnic diploma has acted as proxy for qualification; having a degree implied the possession of certain competencies. However, because most diplomas are based on completing a program that comprises many subjects and competencies over a long period of time, it is difficult for employers to identify exactly what skills a graduate possesses. While a diploma or degree still connotes a certain threshold of academic training (as well as personal drive), there is too much uncertainty and variance in outcomes."

(Mourshed, Farrell, & Barton, 2015)

Some argue that a traditional degree, certificate, or grade is a poor measure of mastery. They are, however, the traditional accepted measures of educational achievement. Educational and economic systems increasingly recognize the value of unbundled learning. At the same time, these systems also are challenged to redefine assessment, credit and credentialing. The challenge: identifying core competencies, recognizing the mastery that signifies achievement, and creating meaningful credentials for post-secondary pursuits.

As depicted in the model at right, Michael Staton suggests that the value-proposition for post-secondary education is moving away from "knowledge acquisition" and "access to opportunities" (shown in darker blue) toward "cognitive and employable skills" and "personal transformation" (shown in lighter blue.) Staton says that schools are still spending "a lot of time and resources on things that are about to get eaten by scalable Internet technologies." To remain academically viable and reduce educational costs, schools need to acknowledge this shift, relegate basic knowledge acquisition functions to the Internet, and reposition their energies to add value with higher level functions like facilitating practice, coaching and mentoring, creating a culture of personal exploration, and helping students execute secure life transitions. *(Staton, 2013)*

One approach to meeting the challenges of post-secondary credentialing is the new focus on competency-based learning and assessment. Another is the use of third party testing to verify student identity and assess knowledge and competence in well-defined skill areas.



The Evolving Value Proposition in Post-Secondary Education – Moving from knowledge acquisition toward personal transformation. *(Staton, 2013)*

Competency-Based Learning and Assessment Value Skills More than Pedagogy

Competency-based courses focus on what people know, not how, when, or where they learn it. According to Jamie P. Merisotis, President and Chief Executive of the Lumina Foundation, "the time-centered system says, 'if you take the coursework, get passing grades and meet our academic standards, you get the degree.' Competency is a student-centered, learning-outcome-based model. Where you get the education is secondary to what you know and are able to do." Competency-based courses can save students time and money, increase educational relevance and value for employers, and create a means to re-imagine post-secondary programs. *(Kamenetz, 2013)*

Digital learning brings two powerful tools to competency-based learning: in-line assessment and increased modularity. According to Weise and Christensen, "the vanguard of online competency-based learning providers is developing technology to ensure that time is truly the variable factor, and learning is fixed: assessments are built into the system to ensure students' proficiency; students can take assessments as many times as necessary until they have mastered the competency; and instructors can rely on an analytics dashboard and cater to students' needs like a personalized tutor when necessary." \Realistically, digital learning is no more "modular" than a traditional course or lesson plan, but the explosion of learning options and sources, and the opportunity for students to create their own learning pathways make digital learning appear to be more modular. The practical modularity of digital content allows students to transcend historical and sequential learning platforms and provides new opportunities to build in tests and assessments to help learners incrementally measure their progress and knowledge.

> "Competency-based programs have no time-based unit. Learning is fixed, and time is variable; pacing is flexible. Students cannot move on until they have demonstrated proficiency and mastery of each competency, but are encouraged to try as many times as necessary to demonstrate their proficiency."
>
> *(Weise & Christensen, 2013)*

One specific representation of competency-based learning is the increased use of digital badges. Pioneered by the Mozilla Foundation and the John D. and Catherine T. MacArthur Foundation, digital badges are a way to recognize skills and achievements. This is a growing field, but excellent resources are already available for organizations that want to explore using badges to recognize achievement. For example:

- Mozilla OpenBadges provide tools for people to earn, issue, and display badges.
- The Purdue Passport also provides a platform for creating badges for post-secondary programs.
- Intel Education offers Digital Badges for educators, and resources on digital badges.

> "Digital badges are a validated indicator of accomplishment, skill, quality, or interest that can be earned in various learning environments."
>
> *(Carey, 2012)*

This focus on skills over pedagogy can bring new benefits to students, institutions and potential employers. "Learning and work are becoming inseparable," argue the authors of a report from the Institute for Public Policy Research, "indeed one could argue that this is precisely what it means to have a knowledge economy, or a learning society. It follows that if work is becoming learning, then learning needs to become work—and universities need to become alive to the possibilities." *(Barber, Donnelly, & Rizvi, 2013) (Weise & Christensen, 2013)*

Institutions Should Be Prepared to Support In-Person and Virtual Assessment

As learning and teaching are transformed by changing technologies, new challenges for measurement arise: How can one truly assess learning, assign credit, or award a credential to a student never met? Without verified identification or physical supervision, how does one ascribe specific learning outcomes or test results to an individual student? Of course, such challenges also are bringing new creativity to instructional design and assessment.

Traditional testing and assessment are still important in post-secondary education. While some of that assessment can take place online, there is still a place for in-person evaluation. This assessment can take place within a post-secondary program, or through a partnership or contract with a testing agency that offers proctored tests with verified identification. In addition to commercial testing services like Certiport, many public libraries and post-secondary schools offer in-person testing services.

Examples

The case example, *"Purdue Nursing School Creates Educational Passports"* showcases a new credentialing system for nursing students who earn badges for specific skills, creating a digital portfolio of their achievements. See case study page 49. *(Thomas A., 2014)*

The case example, *"At Google, Grades are Good; the Ability to Learn is Critical"* provides insights on some of the soft skills valued in Google's hiring process, how Google assesses those candidate skills, and then how they assess their own in hiring process. See case study page 50. *(Friedman, 2014) (Bryant, 2013)*

The case example, *"Certiport is Making a Business out of Testing,"* describes how one firm is partnering with companies to provide in-person assessment and testing services worldwide. See case study page 51. *(Certiport, 2014)*

Case Study

Purdue Nursing School Creates Educational Passports

Measuring Learning and Achievement

Challenge:

Professionals at the Purdue School of Nursing in Indiana (USA) were keenly aware of the imprecision associated with a single grade or degree as a measure of skill, so they looked for a better way to demonstrate the true competencies of their nursing graduates and to help graduates communicate those skills to potential employers.

Solution:

Working in partnership with the IT@ Purdue, the Nursing department developed a set of mandatory and optional health care-related digital badges—icons that represent specific academic achievements and skills in finer detail than a college degree. The badging system is part of the IT@Purdue Passport application.

Impact:

The Purdue Passport system was launched in 2014, so results are still coming in. Student reception has been positive, with more than half of the students completing a number of "extra credit" or optional badges. Pam Karagory, Assistant Professor, Purdue School of Nursing, says "Badges can illuminate students' talent in innovation and research, and their commitment to safety and patient-centered care, which is absolutely what the health care system needs. Additionally, data that show what these students did and the impact they've had on the community will help employers visualize the ways in which these young men and women can identify tough problems and develop solutions."

Assessment Insight:

The IT@ Purdue Passport now provides a "digital portfolio" of students' work. Each badge includes metadata that shows who issued the badge, how it was earned, and when it was earned. Deliverables such as essays, certificates, and presentations can be attached to the badge to show what each learner accomplished in detail. Similar to certifications, badges allow learners to showcase their breadth of skills to employers in more detail than a traditional college transcript. Other Purdue departments are piloting digital badge programs, and Purdue is considering offering the Passport systems as a software service to other institutions. *(Thomas A. , 2014)*

"Technology is not driving the changes; the change in assessment and learning is driving the technology."

– Jason Fish, Director of Informatics, IT@Purdue

Case Study

At Google,* Grades are Good; the Ability to Learn is Critical

GPA is not a Predictor of Success

Challenge:

Google* has a great problem. As indicated in a New York Times op-Ed by Thomas L. Friedman, and based on an interview with Laszlo Bock, Senior Vice President of People Operations at Google, the "firm attracts so much talent it can afford to look beyond traditional metrics, like G.P.A." And Google has found that an employee's graduating Grade Point Average (GPA) is not at all correlated with their professional contribution to Google and its customers. The challenge for Google is how to hire excellent employees that will continue to innovate and learn. Bock says "For every job, though, the No. 1 thing we look for is general cognitive ability, and it's not I.Q. It's learning ability. It's the ability to process on the fly. It's the ability to pull together disparate bits of information. We assess that using structured behavioral interviews that we validate to make sure they're predictive."

Solution:

Google does look at grades and degrees and classes—and "many jobs at Google require math, computing and coding skills," but the Google hiring process looks beyond degrees and GPA, using structured behavioral interviews to assess skills in five main areas. "In an age when innovation is increasingly a group endeavor, [Google] cares about a lot of soft skills—leadership, humility, collaboration, adaptability and loving to learn and re-learn."

Impact:

Although internal measures of the impact of Google's assessment and hiring process are not available, the external indicators of success are evident: four years in a row as number one on Fortune Magazine's list of the 100 Best Companies to Work For; buoyant stock prices; and a history of innovation. Of note, according to Bock, "the proportion of people without any college education at Google has increased over time" and is now as high as 14 percent on some teams.

Assessment Insight:

While the primary interview technique that Google uses to evaluate employees is the structured behavior interview, they use "big data" analysis to assess their overall processes and results. "Years ago, we did a study to determine whether anyone at Google is particularly good at hiring. We looked at tens of thousands of interviews, and everyone who had done the interviews and what they scored the candidate, and how that person ultimately performed in their job. We found zero relationship." It was this assessment that prompted Google to reevaluate their hiring process, shifting their focus to give candidates more opportunities to demonstrate the "soft" skills that create a solid foundation for collaboration and continued learning. *(Bryant, 2013) (Friedman, 2014)*

> *"Without humility, you are unable to learn."*
>
> *– Laszlo Bock*

Case Study

Certiport* is Making a Business out of Testing

In-person Testing and Assessment in 147 Countries and 27 Languages

Challenge:

How can organizations award a reputable credential that has authenticity and meaning, when students can prepare for that credential through any number of learning pathways, and when the authorizer has no relationship with the learner?

Solution:

Certiport,* a Pearson VUE business, manages audited processes to administer testing, grade or assess results, and verify the identification of test-takers. The firm describes itself as "the world leader in performance-based certification exams and practice test solutions for academic institutions, workforce, and corporate technology markets."

Impact:

Certiport delivers roughly 250,000 exams a month through a network of 12,000 Certiport Authorized Testing Centers in 148 countries and 27 languages.

Why is certification important? In the words of one client, "Certification is what made me stand out from the stack of résumés. When you go into a job interview and 10 other people are being interviewed, certification gives actual proof that you can do what you say you're going to do."

Assessment Insight:

Certiport combines strong process management and verification, with a global footprint and trusted relationships with partners "providing complete career-oriented certification solutions to academic institutions and IT Professionals.

"These services encompass test development, psychometrics, program management, sales and marketing for the official Microsoft® Office certification program, the Microsoft® Technology Associate certification program, the Adobe® Certified Associate certification program, the Adobe® Certified Expert program, the HP Accredited Technical Associate, the CompTIA Strata™IT Fundamentals, the Autodesk® Certified User certification program, the Intuit® QuickBooks Certified User certification program and the IC3 Digital Literacy certification." *(Certiport, 2014)*

6. Professional Learning

Key Take-Aways

- Digital technologies offer boundless opportunities to re-think and revolutionize teaching and learning.
- Instructors need opportunities to explore and master digital learning techniques.
- Effective educators are part of a broader learning community.

Digital Technologies Offer Boundless Opportunities to Re-Think and Revolutionize Teaching and Learning

In the past half-decade, educational technology has been dramatically transformed. No longer are audio and visual resources mere one-way delivery mechanisms for presenting traditional material. Today's digital learning tools offer boundless opportunities to re-think and revolutionize teaching and learning. Digital technologies for instruction and engagement enable an expert instructor to teach a top-quality course based on the absolute latest thinking in his or her field, to thousands of learners around the world. Digital learning also enables educators to access real time information and analytics to customize learning paths for each student. It also enables schools to flip learning so that students learn basic concepts independently with online resources, reserving class time to master those techniques and collaborate on their application to real-world manufacturing problems.

Spurred on by global adoption, digital technology provides educators with tools they can apply to their own teaching practice. Embracing this revolution allows educators to create a pedagogical approach that is aligned with their own style, their students' interests, and their organization's culture and values.

One source for trends in education is the NMC Horizon Report: 2014 Higher Education Edition, produced by the NMC Horizon Project in partnership with the New Media Consortium and the EDUCAUSE Learning Initiative. This report reflects the work of an international body of education and technology experts, working in concert with the NMC Horizon Project to identify:

- Six trends accelerating technology adoption in higher education,
- Six trends impeding technology adoption, and
- Six important developments that are prime for adoption in the next one to five years.

The 2014 report predicts that the flipped classroom and learning analytics will represent important adoption trends in higher education in the next year, and there has clearly been a global trend to incorporate these techniques into the mainstream of post-secondary programs. However, that same report suggests that a lack of digital fluency among educators is a "solvable challenge" which, if left unsolved, could impede the benefits these technologies bring to education.

NMC Horizon predicts that the use of technology in education will continue to advance. Within the next two to three years, the post-secondary programs will see an increased use of 3D printing and the gamification of learning. In four or five years, technologies supporting the "quantified self" and "virtual assistants" will be moving into the educational mainstream. See box on page 54 for descriptions of these educational models. *(Johnson, Adams Becker, Estrada, & Freeman, 2014)*

The NMC Horizon Report identified key trends accelerating higher education technology adoption, and significant challenges *impeding* that adoption. Providing faculty with opportunities to explore and master digital learning techniques—and participate in a broader learning community—can help meet some of these challenges. Addressing the "wicked challenges" of expanding access to post-secondary opportunities and keeping education relevant is more challenging. However, the approaches and examples in leadership, policy, ICT, digital content, assessment, professional learning, and sustainability cited in this paper may provide some guidance for addressing those challenges as well.

Key Trends Accelerating Higher Education Technology Adoption	Significant Challenges Impeding Higher Education Technology Adoption
Fast Trends: Driving changes in higher education over the next one to two years • Growing ubiquity of social media • Integration of online, hybrid, and collaborative learning	**Solvable Challenges:** Those that we understand and know how to solve • Low digital fluency of faculty • Relative lack of rewards for teaching
Mid-Range Trends: Driving changes in higher education within three to five years • Rise of data-driven learning and assessment • Shift from students as consumers to students as creators	**Difficult Challenges:** Those we understand but for which solutions are elusive • Competition from new models of education • Scaling teaching innovations
Long-Range Trends: Driving changes in higher education in five or more years • Agile approaches to change • Evolution of online learning	**Wicked Challenges:** Those that are complex to even define, much less address • Expanding access to post-secondary learning • Keeping education relevant

Refer to the table on the next page for more detailed descriptions how flipped classrooms, data analytics, 3D printing, and gaming could support post-secondary learning, and for a preview of technologies to watch, including the quantified self and virtual assistant.

Important Developments in Educational Technology for Higher Education Excerpt from NMC Horizon Report: 2014 Higher Education Edition		
Time-to-Adoption Horizon: One Year or Less	Flipped Classroom	"The flipped classroom … rearranges how time is spent both in and out of class to shift the ownership of learning from the educators to the students. In the flipped classroom model, valuable class time is devoted to more active, project-based learning where students work together to solve local or global challenges—or other real-world applications—to gain a deeper understanding of the subject. Students can access this wide variety of resources any time they need them. Teachers can devote more time to interacting with each individual. After class, students manage the content they use, the pace and style of learning, and the ways in which they demonstrate their knowledge; the teacher adapts instructional and collaborative approaches to suit their learning needs and personal learning journeys. The goal is for students to learn more authentically by doing."
	Learning Analytics	"Learning analytics is an educational application of "big data," a branch of statistical analysis that was originally developed as a way for businesses to analyze commercial activities, identify spending trends, and predict consumer behavior. As web-tracking tools became more sophisticated, many companies built vast reserves of information to individualize the consumer experience. Education is embarking on a similar pursuit into new ways of applying [big data] to improve student engagement and provide a high-quality, personalized experience for learners."
Time-to-Adoption Horizon: Two to Three Years	**3D Printing**	"Known in industrial circles as *rapid prototyping*, 3D printing refers to technologies that construct physical objects from three-dimensional (3D) digital content such as 3D modeling software, computer-aided design (CAD) tools, computer-aided tomography (CAT), and X-ray crystallography. A 3D printer builds a tangible model or prototype from the electronic file, one layer at a time, through an extrusion-like process using plastics and other flexible materials, or an inkjet-like process to spray a bonding agent onto a very thin layer of fixable powder… This technology is commonly used in manufacturing to build prototypes of almost any object (scaled to fit the printer, of course) that can be conveyed in three dimensions."
	Games and Gamification	"The games culture has grown to include a substantial proportion of the world's population… While a growing number of educational institutions and programs are experimenting with game-play, there has also been increased attention surrounding gamification—the integration of gaming elements, mechanics, and frameworks into non-game situations and scenarios… Although more nascent than in military or industry settings, the gamification of education is gaining support among educators who recognize that effectively designed games can stimulate large gains in productivity and creativity among learners."
Time-to-Adoption Horizon: Four to Five Years	**Quantified Self**	"Quantified self describes the phenomenon of consumers being able to closely track data that is relevant to their daily activities through the use of technology. The emergence of wearable devices … such as watches, wristbands, and necklaces that are designed to automatically collect data are helping people manage their fitness, sleep cycles, and eating habits. Mobile apps also share a central role in this idea by providing easy-to-read dashboards for consumers to view and analyze their personal metrics… Today's apps not only track where a person goes, what they do, and how much time they spend doing it, they track their aspirations and achievements toward meeting those goals… As more people rely on their mobile devices to monitor their daily activities, personal data is becoming a larger part of everyday life"—a trend that could be applied to education in the next for years."
	Virtual Assistant	"As voice recognition and gesture-based technologies advance, and more recently, converge, we are quickly moving away from the notion of interacting with our devices via pointer and keyboard. Virtual assistants are a credible extension of work being done with natural user interfaces (NUIs), and the first examples are already in the marketplace… While crude versions of virtual assistants have been around for some time, we have yet to achieve the level of interactivity seen in Apple's classic [1987] video, Knowledge Navigator. Virtual assistants of that caliber, and their applications for learning, are clearly in the long-term horizon, but the potential of the technology to add substance to informal modes of learning is compelling." *(Johnson, Adams Becker, Estrada, & Freeman, 2014)*

Instructors Need Opportunities to Master Digital Learning Techniques

Effective digital learning requires educators to adapt techniques to fit their own personal style, the students' needs, and the institution's mission. To truly leverage digital learning as part of their teaching practice, instructors need continuing opportunities to explore and master digital tools and techniques. Phenomenal outcomes can occur when educators are armed with the skills, support, and tools that they need. Beyond redefining the role of educators and students, and finding new ways to set up a web page or get course material online, faculty need to "evolve their instructional practices for a technology-laden learning environment, whether for online or hybrid courses; as part of active learning programs; or to better exploit the benefits of technical resources..." *(Schaffhauser, 2014)*

Creating an environment that is "change ready" starts at the top. The International Society for Technology in Education (ISTE) says that educational administrators play a critical role in creating a supportive and inspiring professional development environment. While ISTE is primarily focused on elementary and secondary education, their guidance for administrators and leaders applies equally well to post-secondary programs. ISTE states that leaders need to:

- Inspire and lead development and implementation of a shared vision [of] comprehensive integration of technology, which will promote excellence and support transformation throughout the organization,
- Promote a digital-age learning culture that provides rigorous, relevant, and engaging education for all students,
- Promote an environment of professional learning and innovation that empowers educators to enhance student learning,
- Build systems for systemic improvement, and
- Model digital citizenship. *(ISTE Standards for Admnstrators, 2015)*

Tactical Approach

Here are five tactics to support faculty as they adopt and apply digital technology:

1. **Create a Self-Service Library for Instructional Design**
   Offer live and web-based coaching; archive materials and curate sets of relevant resources and examples, such as templates, checklists, exercises, projects, web sites, and more; create a video archive with recordings of workshops and seminars; and provide teaching guides packed with nuggets of advice to help people learn more about relevant subjects.
2. **Provide Training in Course Redesign**
   Digital learning opens new opportunities for educators to incorporate technology in a range of ways that align with students' needs, educational goals, and pedagogy. Faculty need support and instruction to help match the technology and digital learning models to their course content, students' needs, and personal teaching style. Opportunities for digital learning vary along a number of dimensions, including the level of peer interaction, curriculum boundaries, place of learning, degree of individualization, and timing.
3. **Make Learning Collaborative and Personal**
   While educators can do a lot of work to leverage digital learning techniques in their instructional design, good programs use that base to drive more customized and personal learning experiences. Educators collaborate with students and community experts to co-design challenging learning activities that move each student toward curriculum objectives, co-creating experiences relevant to student's cognitive needs, knowledge, and interests. Educational outcomes can also be persistent and generative as faculty work with students to co-create knowledge, using modern technologies to activate 21st Century learning.
4. **Participate in a Community of Practice**
   It is amazing how helpful it is to get a tip from a peer who may have a useful approach to using technology, or has an idea or teaching technique worthy of consideration. While faculty independence—and protection of intellectual property—may be important in some aspects of research and education, educators also can thrive as connected learners, just as students do. *(Schaffhauser, 2014)*
5. **Reward Sharing**
   Ideally, our best educators will develop and share digital content, course materials and curriculum. Many are already doing so by creating online classes for their institutions, contributing their wisdom to others through communities of practice, licensing materials under Creative Commons, or making materials available as Open Education Resources. Some faculty are reticent to share their materials and insights with others, but may change their views if offered appropriate training, support, and encouragement. Digital content will not decrease the need for educators, but it will shift their focus to media-enriched, interactive, collaborative learning. It is important to recognize and reward those who take on the challenge, embrace digital technologies, and contribute new innovations to the educational digital commons.

Effective Educators are Part of a Broader Learning Community

Just as educators with expertise in a field of study such as bio-engineering or art history engage with peers in discipline-aligned learning communities, effective 21st Century educators need opportunities to learn from peers as part of a broader learning community.

Educators need time to develop their own approaches to make full use of technology that enables deeper and more meaningful learning, and this process can be accelerated by learning from others. Program administrators need to provide time for professional learning and peer interaction, and support teachers who want to explore the rapidly growing field of educational technologies.

Options include attending educational technology conferences, visiting or interning with other post-secondary programs, taking in-person and online classes, researching practices and programs on the web, and networking with peers—all provide opportunities for educators to become familiar with digital tools and find inspiration to apply new techniques to their teaching practice.

The table below lists some of the excellent resources and forums available to support educators in teaching, learning, and leading in the digital age.

Community and Professional Learning Opportunities for Educators	
NMC Horizon Project	The New Media Consortium (NMC) Horizon Project charts the landscape of emerging technologies for teaching, learning, research, and creative inquiry. Launched in 2002, The Horizon Project helps educators and thought leaders across the world build upon innovations happening at their own institutions by providing them with expert research and analysis. The NMC Academy offers a collection of online mini-courses to support educators who want to put new media techniques in practice.
International Journal of Learning and Media	IJLM is an online journal devoted to the examination of the changing relationships between learning and media across a wide range of forms and settings. IJLM also provides an international forum for scholars, researchers and practitioners to explore relationships between emerging forms of media and learning.
Connected Learning	Connected Learning revitalizes the educational process by forging links between students' academic studies, their personal passions, and opportunities to engage with peers who support and share their interests. As a result, Connected Learning can create new pathways to college, career and civic pursuits. The Connected Educators program includes research, best practices, an online community, video, and webinars on current topics in connected learning.
Microsoft Technology Enriched Instruction	This Microsoft faculty development workshop is designed to help faculty appropriately integrate technology in order to augment, enhance, extend, and, perhaps in some cases, even replace some of the traditional classroom activities. This hands-on workshop is based on two leading-edge frameworks: 21st Century Learning Design and TPACK (Technological Pedagogical Content Knowledge).
MERLOT II	MERLOT is an international community of faculty, staff, students, administrators, librarians, and others in education, interested in discovering, using and sharing Open Educational Resources (OER) for the improvement of technology-enhanced teaching and learning. The MERLOT community has developed a unique collection of more than 40,000 online learning materials, all of which have been peer- or crowd-source reviewed by members of the community.
Intel® Teach	Initially designed to help teachers integrate technology effectively into classrooms and promote student-centered approaches, engage students in learning and prepare them with critical skills for success in our digital world, the Teach curricula+ are available at no charge to global educators at all levels. Online courses are available to anyone, anywhere, anytime in 24 languages and include: Collaboration in the Digital Classroom, Designing Blended Learning, Thinking Critically with Data, Assessment in 21st Century Classrooms, Moving into Mobile Learning, Creativity in the Mobile Classroom, and Project Based Approaches. *+Case examples used in the Intel Teach online classes are generally from K-12 programs but basic course content is equally relevant to post-secondary programs.*

Example

The case example, *"Higher Engineering Education Alliance Program (HEEAP)"* describes the partnership between Intel, the Government of Vietnam, and Arizona State University, which transformed higher education in Vietnam from an essentially passive experience to an engaging program producing work-ready engineers and technical staff. See case study page 58.
(HEEAP, 2014) (Intel Higher Education Programs, 2013)

Case Study

Higher Engineering Education Alliance Program (HEEAP)

Invests in Faculty and Leadership as Part of Educational Transformation

Challenge:

To transform and modernize top engineering and technical vocational universities in Vietnam. The immediate challenge, in 2005, was an environment where the curriculum was outdated, universities were centrally managed, and student learning was primarily passive. There was little to no active, student-centered teaching, no classroom teams, no presentations, no homework, no projects, and no opportunity to learn or improve English skills.

Solution:

Intel, the Government of Vietnam, Arizona State University's Ira A. Fulton Schools of Engineering (ASU), and an industry consortium created the Higher Engineering Education Alliance Program (HEEAP) to develop local university leadership, faculty skills, curriculum innovation, and university engagement.

Impact:

HEEAP has transformed "engineering education in five universities from passive, purely theory-based instruction, to active, applied, and theory-based instruction and learning." While it was a huge undertaking, the initiative reaped rewards for Vietnam as a whole, the universities, students, Intel, and the broader business community. Vietnam is now home to one of Intel's major assembly and test facilities. Thanks to changes in Vietnam's educational programs, Intel and other industries can hire skilled local personnel to meet the majority of their business requirements. *(Intel Higher Education Programs, 2013) (HEEAP, 2014)*

Professional Learning Insight:

With support from United States Agency for International Development (USAID), Intel and Arizona State University worked with the government of Vietnam to implement a transformation program that started at the top by focusing on leading change and developing use-inspired research, increasing access to educational resources, engaging, and creating impact. While this educational overhaul included many components, at its core HEEAP created a new learning community for educators to acquire new techniques and apply them to their learning and teaching. Four tools were used to support faculty learning and transformation.

1. A six-week training program at ASU
2. Curriculum design and instructional lab
3. Faculty mentor program
4. Implementation of new instructional pedagogy in Vietnam

The HEEAP educational expansion program included six key components:

- Leadership development
- Diversity
- Faculty development
- Instructional expert development
- Distance education
- English

"If the leaders responsible for ensuring transformative change are not equipped with the skills necessary to make strategic decisions, then it will be impossible for change to occur."

– Jeffery Goss, ASU Associate Vice-Provost, Vietnam/SE Asia Programs

7. Sustainability and Growth

Key Take-Aways

- Digital technologies offer boundless opportunities to re-think and revolutionize teaching and learning.
- Instructors need opportunities to explore and master digital learning techniques.
- Effective educators are part of a broader learning community.

Investments in Technology Occur when Decision-Makers Believe and See that Technology is Mission-Critical

While there are many paths to sustainability, healthy technology programs generally require a positive feedback loop to demonstrate effectiveness and value, and gain continuing support.

Effective programs begin with vision, are codified through supportive policies, define clear goals for technology-supported learning, collect and evaluate evidence of outcomes, and identify areas for improvement in future cycles. This process creates a virtuous cycle of action, reflection, revision, and reinvestment.

Just as digital technology provides new opportunities for student assessment, digital tools create new avenues for program-level measurement, evaluation, and analysis. Evaluation goals and techniques should be determined in conjunction with developing the program vision and implementation plan. This allows administrators and faculty to create in-line measurement and reporting structures. Analyzing data in accordance with clear evaluation and program goals will create meaningful, measurable results, fuel additional support for investment, and guide improvements.

Evaluation can build the case for re-investment in programs that demonstrate measurable outcomes, or for making additional changes when new initiatives fall short of expectations. Either result moves the process forward.

Sustainability cycle: repeat regularly

While Specialized Funding may Support Pilot Programs, Long-Term Funding Needs to Become Part of the Annual Budget

While a number of specialized funding vehicles can support initial technology access and upgrades, sustainable post-secondary programs must plan to incorporate ongoing costs into institutional budgets.

Bonds, grants, levies, donations, one-time appropriations, and local partnerships can help jump-start a transformation program, but one-time funding sources essentially provide a time-limited benefit. These sources create a great way to launch a pilot, demonstrate proof-of-concept, or initiate a program, but technology must be refreshed and upgraded regularly. Securing sustainable funding and staffing should be considered at the start of any initiative.

In most cases, a thoughtful investment in appropriate student learning devices (see The Right Device for Learning, Section 3) will ensure the initial investment lasts for the duration of the educational programs, and well into the students' work life. Then the next wave of students will also need devices.

Technology does not stand still. Broadband and wireless networks will need upgrades, and IT staff must be available and trained to support the increasingly integrated areas where technology and education intersect.

Funding technology from the regular operating budget parallels the integration of technology into program curriculum. Incorporating sustainable technology reinvestment in program-specific operating budgets provides stable financing for essential purchases and continuing support.

Since stakeholders in post-secondary education include businesses, governments, and society as a whole, all sectors have the opportunity—and vested interest—to develop and support strategies that defray technology costs.

- Some countries provide nearly unlimited high-capacity broadband connections to schools at free or reduced rates.
- Tax policies can support computer purchases or provide tuition reimbursement, in addition to directly funding educational programs.

Making technology a priority, with evidenced-based communication and a strategic plan will help motivate and sustain stakeholder investments and partnerships in education.

Demonstrated Impact Drives the Case for Sustaining and Expanding Programs

Ongoing measurement and evaluation are essential to building a sustainable program, because they demonstrate results, and quantify program value. Effective evaluation is more than counting devices distributed, training hours logged, skills developed, grades attained, graduations, certificates issued, or even jobs and joy. By identifying what works and what doesn't, and how to improve performance over time, regular evaluation of digital learning programs advances knowledge among stakeholders, catalyzes innovation, and strengthens the case for sustaining investments.

In addition to developing a detailed evaluation plan, leaders need to foster a culture of measurement, regular reflection, and improvement. By exploring successes and failures, educators increase the capacity of all stakeholders to see patterns and insights that can lead to ever-improving results.

Four Steps to Strategic Evaluation

Grantmakers for Effective Organizations (GEO), a coalition of grantmakers committed to building strong and effective nonprofit organizations, has developed a guide for organizations looking to develop comprehensive evaluation programs. The Four Essentials for Evaluation outlines a process based on leadership and planning, organizing data and processes, sharing, and learning from others. *(Grantmakers for Effective Organizations, 2012)*

1. **Lead:** Create a culture where evaluation is an everyday priority that supports and advances continuous learning.
2. **Plan:** Develop a framework to ensure you are evaluating with a clear purpose. Evaluation results should feed into program adjustments that improve outcomes.
3. **Organize:** Ensure the necessary infrastructure and systems to support your plan. Collect the data needed to measure results.
4. **Share:** Collaborate with partners, colleagues and others to ensure that evaluation (and informed revisions) produce meaningful results.

Luckily, most post-secondary institutions have in-depth research capabilities and a strong community focus. These learning institutions are poised to build effective evaluation programs, learn from both successes and failures, and use knowledge gained to grow and improve digital learning in each subsequent cycle.

Examples

The case example, *"Ensuring Each Student has the Connections, Computational Power, and Content to Thrive at College,"* shows how Southern Illinois University reshaped their technology plans to drive increased student engagement and improve student retention. They built a business case for one-to-one computing by using digital content to dramatically decrease the cost for student textbooks. See case study page 62. *(Dell, 2014)*

The case example, *"Can Benchmarks Give Public Libraries the Edge for Technology Reinvestment?"* shows how a nonprofit foundation worked with the library field to develop a set of technology benchmarks to support ongoing investment in public access technology. See case study page 63. *(About Edge, 2014)*

Case Study

Ensuring Each Student has the Connections, Computational Power, and Content to Thrive at College

Southern Illinois University Rolls Tablets into Tuition

Challenge:

Southern Illinois University (SIU) is an intensive research university with a public access policy that encourages a very diverse student body. According to Chancellor Rita Cheng, "almost half of SIU's undergraduate students are the first in their families to go to college;" 30 percent are minorities. For all students, and especially for these students, Cheng sees community building and educational engagement as key motivators for students to stay in college. SIU sought to boost student engagement and strengthen community by implementing a common technology platform for all academic and student services. Cheng says, "We know that when students feel part of SIU's community, they stay here [and complete their degree.]"

Solution:

The University launched *Mobile Dawg*—an integrated application that combines the university's student information and learning management systems with a core freshman curriculum, on-board electronic textbooks, dormitory information, and the campus calendar. The program started in 2013, providing 2,600 incoming freshmen with Dell touch tablets with Intel® processors and Windows 8.* By building the equipment costs into the tuition, and distributing devices as part of orientation, *Mobile Dawg* levels the playing field for students—ensuring that every student has full access to the connections, computational power, and content needed to thrive at college.

Impact:

Although the *Mobile Dawg* rollout at SIU is still in its early stages, the positive response from students and their parents has been extraordinary. Cheng says, "Our provost for academic affairs got a standing ovation at the freshman orientation sessions when he held up a *Mobile Dawg* tablet. No one's ever gotten a standing ovation for anything at orientation." Even as SIU rolls more applications onto *Mobile Dawg* they are collecting data on use, engagement, educational outcomes, costs, and student retention. So far the numbers look good. Retention rates for freshmen entering the sophomore class were up 8.3 percent for the first class of *Mobile Dawg* students.

Sustainability Insight:

From its inception, the SIU one-to-one computing approach was designed to further educational outcomes for students. SIU chose a one-to-one program to create a standard computing platform to ensure equitable access for all students and to encourage easy communications across the school community. David Crain, SIU's assistant provost and CIO, placed a priority on durability, centralized administration, interoperability, and costs. As part of the *Mobile Dawg* initiative, SIU adopted electronic course materials for freshmen-level foundation courses, paid for by a course fee. "This not only saves hundreds of dollars for the student," explained Crain, "but the course fees are included in their financial aid, so they don't have to pay for the materials out of pocket." For the 2014 academic year, the digital resources for four foundational freshmen courses saved USD 272 per student. "Now," he said, "on Day 1, students have electronic access, on their tablets, to their course materials for our foundation courses." *(Dell, 2014)*

Case Study

Can Benchmarks Give Public Libraries the Edge for Technology Reinvestment?

Challenge:

The Bill & Melinda Gates Foundation Global Libraries program invested in technology programs in public libraries as a way to ensure that all people had free and open access to computer technology and the associated information services. While many of the 9,000 public libraries in the United States sustained those initial investments, many did not. After more than a dozen years of grantmaking in this area, the Foundation was looking for a vehicle to help public libraries and their communities sustain and grow the technology infrastructure needed to provide contemporary library information services. Based on research and evaluation on program outcomes, the foundation identified three pre-conditions for technology reinvestment:

- Organizations must believe that technology is central to their mission.
- Leaders need to have a plan to reinvest.
- Leaders need an evidence-based plan for investments.

Solution:

Developed by a national coalition of leading library and local government organizations, the Edge Initiative was designed to help libraries create a path for the continuous growth and development of public technology services: "The Edge Toolkit gives libraries a look into their local data, from operations to partnerships and programming, to assess how their community is using the technology and how best practices can be put into place to align future growth and services with community priorities. It also provides useful resources to package and showcase the data to other community leaders." *(About Edge, 2014)*

Impact:

Initial uptake in the field has been extremely positive, with more than 1,700 libraries completing the assessment and 900 more in the pipeline. Anecdotal feedback confirms librarians feel the assessment tool does give them an edge in technology planning and communication. Karen Danczak Lyons, Director, Evanston Public Library (IL), says "Edge helps us convince the leaders on our Board and in our community that we need additional financial resources. It adds another nationally recognized, thoughtful assessment, and Edge is proving what we've been saying all along but didn't have the evidence to back up: public libraries play an important role in access to technology."

In collaboration with the Edge Initiative, an external firm collected baseline data in 2014. A follow up two-year longitudinal study has been launched to continue evaluating the tool's effectiveness in supporting sustained technology investments.

Sustainability Insight:

The Edge Initiative brings together a number of key sustainability principles:

- **Edge is evidence based.** National benchmarks, planning tools, impact assessment tools, and training materials help leaders use the Edge to develop an evidence-based technology plan.
- **Edge goes from need to plan.** By providing planning tools that capture community needs, develop detailed gap assessments, and articulate implementation priorities, Edge provides leaders with a roadmap to improve their technology infrastructure.
- **Edge is local.** While The Edge is based on national benchmarks, those benchmarks are applied in a local context based on the services that are most important in the local community.

Conclusion: Now an Educational Revolution has Begun

A report titled *Future Work Skills 2020*, produced by the Institute for the Future (IFTF), analyzes "the key drivers that will reshape the landscape of work and identifies key work skills needed in the next ten years." The report does not predict the specific jobs categories or labor requirements of the future, noting that dramatic shifts in jobs have rendered most studies and predictions in this area useless. Instead, IFTF identifies six big disruptive shifts that are likely to reshape the landscape of work and then predicts ten new skills needed for the 2020 workforce. Although the IFTF report focuses on the work environment, the trends and skills described will likely impact all areas of our lives, including health, entertainment, socialization, and civic engagement.

The lists to the right summarize the findings from that report, listing the six drivers for change and the ten skills needed in the future workforce. *(Davies, Fidler, & Gorbis, 2011)*

Of note, many of these skills have been discussed throughout this paper and demonstrated in case summaries. These are the changes that demand a revolution in post-secondary education and drive leaders to incorporate ICT and digital learning more thoroughly in curricula. These are the shifts that motivate more people to pursue post-secondary learning and to invest in continuing or further education throughout their lives. These are the skills our institutions need to consider to help people learn, adapt and thrive in tomorrow's society.

> Now [an educational] revolution has begun, thanks to three forces: rising costs, changing demand and disruptive technology. The result will be the reinvention of the university.
>
> *– Clayton Christiansen, Creative Destruction, The Economist, 2014.*

> Educational institutions at the primary, secondary and post-secondary levels are largely the products of technology infrastructures and social circumstances of the past. The landscape has changed and educational institutions should consider how to adapt quickly in response.
>
> *(Davies, Fidler, & Gorbis, 2011)*

Future Work Skills 2020 *(See full chart on page 66)*

Six Drivers of Change

1. Extreme longevity
2. Rise of smart machines and systems
3. Computational world
4. New media ecology
5. Super-structured organizations
6. Globally connected world

Ten Skills for the Future Workforce

1. Sense-making
2. Social intelligence
3. Novel and adaptive thinking
4. Cross-cultural competency
5. Computational thinking
6. New-media literacy
7. Transdisciplinarity
8. Design mindset
9. Cognitive load management
10. Virtual collaboration

This white paper gathered examples and ideas from global leaders that are reinventing post-secondary education and poses new approaches for those who are ready to rise to the challenge of re-inventing teaching and learning. Digital technology is disrupting all economic sectors and revamping the educational landscape. More change is on the horizon. Technology is moving fast, with an expanding Internet of Things, wearable technology, an explosion in mobile applications, and even more powerful data analytics. The nature of work and the structures for collaborating and communicating continue to evolve.

As the global economy shifts toward enterprises driven by knowledge and information, post-secondary education and ICT skills become foundational for workers who want to advance in their profession and participate fully in society. Most people will continue to invest in and learn new skills throughout their lives, as part of formal or informal, structured or "unbundled" education. Post-secondary programs can drive this revolution in new learning or be crushed by it.

Harnessing ICT and leveraging digital learning can expand both the reach and impact of post-secondary education, helping to close the global skills gap and expand national economies. While there is no guide for reinventing individual institutions, there are proven approaches based on the seven-element post-secondary digital learning model:

1. Leadership
2. Policy
3. Information and Communications Technology
4. Digital Content
5. Assessment and Credentials
6. Professional Learning
7. Sustainability and Growth

Strong leadership and effective policies set the foundation for educational changes. A robust and growing ICT infrastructure and an abundance of digital content open new opportunities for educators to reach students in different ways, facilitating rather than directing learning paths. Educators need a supportive environment for professional learning and the flexibility to rethink assessment and credentials. Mission-aligned measurement and evaluation will drive continuous improvement and program sustainability.

For all of the challenges implicit in reinventing post-secondary education, these are challenges that educators, leaders, governments, and businesses are meeting head-on. There are strong proof points drawing us forward, a whole world of people committed to continuing to learn, and wondrous opportunities for learners to contribute fully to society.

Future Work Skills 2020: Six Drivers of Change *(Davies, Fidler, & Gorbis, 2011)*	
1. Extreme longevity	Increasing global lifespans change the nature of careers and learning.
2. Rise in smart machines and systems	Workplace automation nudges human workers out of rote repetitive tasks.
3. Computational world	Massive increases in sensors (e.g., Internet of Things) and processing power make the world a programmable system.
4. New-media ecology	New communication tools (e.g., video, animation, and augmented reality) will require new media literacies beyond text.
5. Super-structured organizations	Social technologies (e.g., game design, neuroscience, and happiness psychology) will drive new forms of production and value creation.
6. Globally connected world	Increased global interconnectivity puts diversity and adaptability at the center of organizational operations.

Future Work Skills 2020: Ten Skills for the Future Workforce *(Davies, Fidler, & Gorbis, 2011)*	
1. Sense-making	The ability to determine the deeper meaning and significance of what is being expressed.
2. Social intelligence	The ability to connect to others in a deep and direct way, to sense and stimulate reactions and desired interactions.
3. Novel and adaptive thinking	Proficiency at thinking and coming up with solutions and responses beyond that which is rote and rule-based.
4. Cross-cultural competency	The ability to operate in different cultural settings.
5. Computational thinking	The ability to translate vast amounts of data into abstract concepts and to understand data-based reasoning.
6. New-media literacy	The ability to critically assess and develop content that uses new media forms, and to leverage these media for persuasive communication.
7. Transdisciplinarity	Literacy in and ability to understand concepts across multiple disciplines.
8. Design mindset	The ability to represent and develop tasks and work processes for desired outcomes.
9. Cognitive load management	The ability to discriminate and filter information for importance, and to understand how to maximize cognitive functioning using a variety of tools and techniques.
10. Virtual collaboration	The ability to work productively, drive engagement, and demonstrate presence as a member of a virtual team.

About the Authors

Frank Martinez works with the Intel Education team and meets regularly with national and institutional leaders around the world—understanding their needs and helping to design technology-based programs and solutions to improve post-secondary education and meet national and regional goals. Frank has engaged in business, market, and education development opportunities in more than 50 countries working closely with public sector and technology industry leaders to create programs, exchange ideas, and share best practices on ICT policy, solutions, skills development, and affordability. Frank received his Master's degree in Electrical Engineering from Cornell University (Ithaca, NY).

Karen Archer Perry is the founder of Clarion Collaborative, a research-based consultancy that focuses on creating and supporting digital programs to drive large-scale systemic changes in educational and civic institutions. Information and connection are at the root of meaningful change. Clarion Collaborative works with partners to develop and implement informed change strategies that transform organizations, revitalize client relationships, and build community capacity.

An electrical engineer, Karen has deep experience in the telecommunications industry. She contributed to the National Broadband Plan as an expert advisor to the Federal Communications Commission. Karen has developed broadband and digital inclusion projects around the country and managed research, advocacy, and broadband grants in the public library field as a senior program officer at the Bill & Melinda Gates Foundation.

Key collaborators on this project included Marsha Iverson, who provided editorial input and market insight. Stacey Wedlake conducted the initial literature review; Lisa Fernow provided research on digital content.

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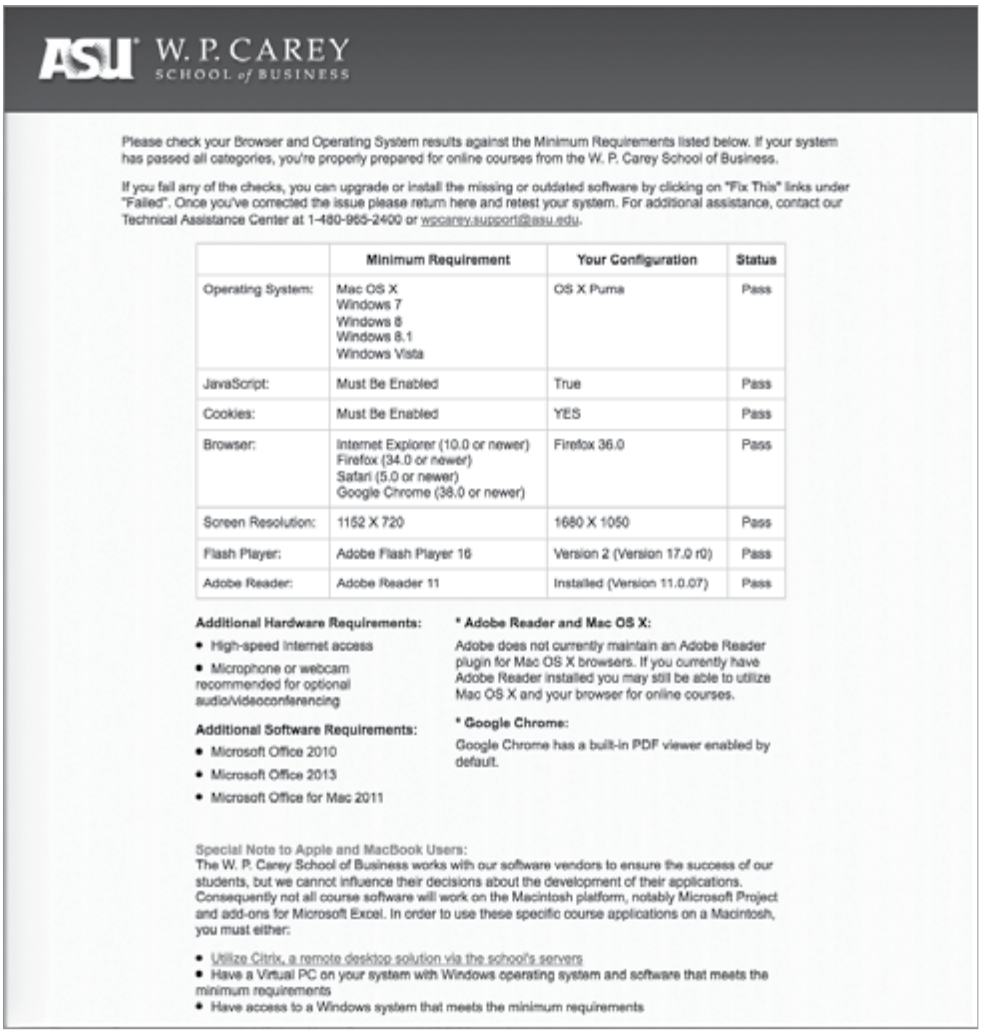
Appendix

W.P. Carey School of Business, Arizona State University, provides this link to test students' devices against the minimum requirements for the school.



ASU W. P. CAREY SCHOOL of BUSINESS

Please check your Browser and Operating System results against the Minimum Requirements listed below. If your system has passed all categories, you're properly prepared for online courses from the W. P. Carey School of Business.

If you fail any of the checks, you can upgrade or install the missing or outdated software by clicking on "Fix This" links under "Failed". Once you've corrected the issue please return here and retest your system. For additional assistance, contact our Technical Assistance Center at 1-480-965-2400 or wpcarey.support@asu.edu.

	Minimum Requirement	Your Configuration	Status
Operating System:	Mac OS X Windows 7 Windows 8 Windows 8.1 Windows Vista	OS X Puma	Pass
JavaScript:	Must Be Enabled	True	Pass
Cookies:	Must Be Enabled	YES	Pass
Browser:	Internet Explorer (10.0 or newer) Firefox (34.0 or newer) Safari (5.0 or newer) Google Chrome (36.0 or newer)	Firefox 36.0	Pass
Screen Resolution:	1152 X 720	1680 X 1050	Pass
Flash Player:	Adobe Flash Player 16	Version 2 (Version 17.0 r0)	Pass
Adobe Reader:	Adobe Reader 11	Installed (Version 11.0.07)	Pass

Additional Hardware Requirements:

- High-speed Internet access
- Microphone or webcam recommended for optional audio/videoconferencing

Additional Software Requirements:

- Microsoft Office 2010
- Microsoft Office 2013
- Microsoft Office for Mac 2011

*** Adobe Reader and Mac OS X:**

Adobe does not currently maintain an Adobe Reader plugin for Mac OS X browsers. If you currently have Adobe Reader installed you may still be able to utilize Mac OS X and your browser for online courses.

*** Google Chrome:**

Google Chrome has a built-in PDF viewer enabled by default.

Special Note to Apple and MacBook Users:

The W. P. Carey School of Business works with our software vendors to ensure the success of our students, but we cannot influence their decisions about the development of their applications. Consequently not all course software will work on the Macintosh platform, notably Microsoft Project and add-ons for Microsoft Excel. In order to use these specific course applications on a Macintosh, you must either:

- Utilize Citrix, a remote desktop solution via the school's servers
- Have a Virtual PC on your system with Windows operating system and software that meets the minimum requirements
- Have access to a Windows system that meets the minimum requirements

intel Education