OFFICE OF
Educational Technology

Reimagining the Role of Technology in Higher Education

A Supplement to the National Education Technology Plan

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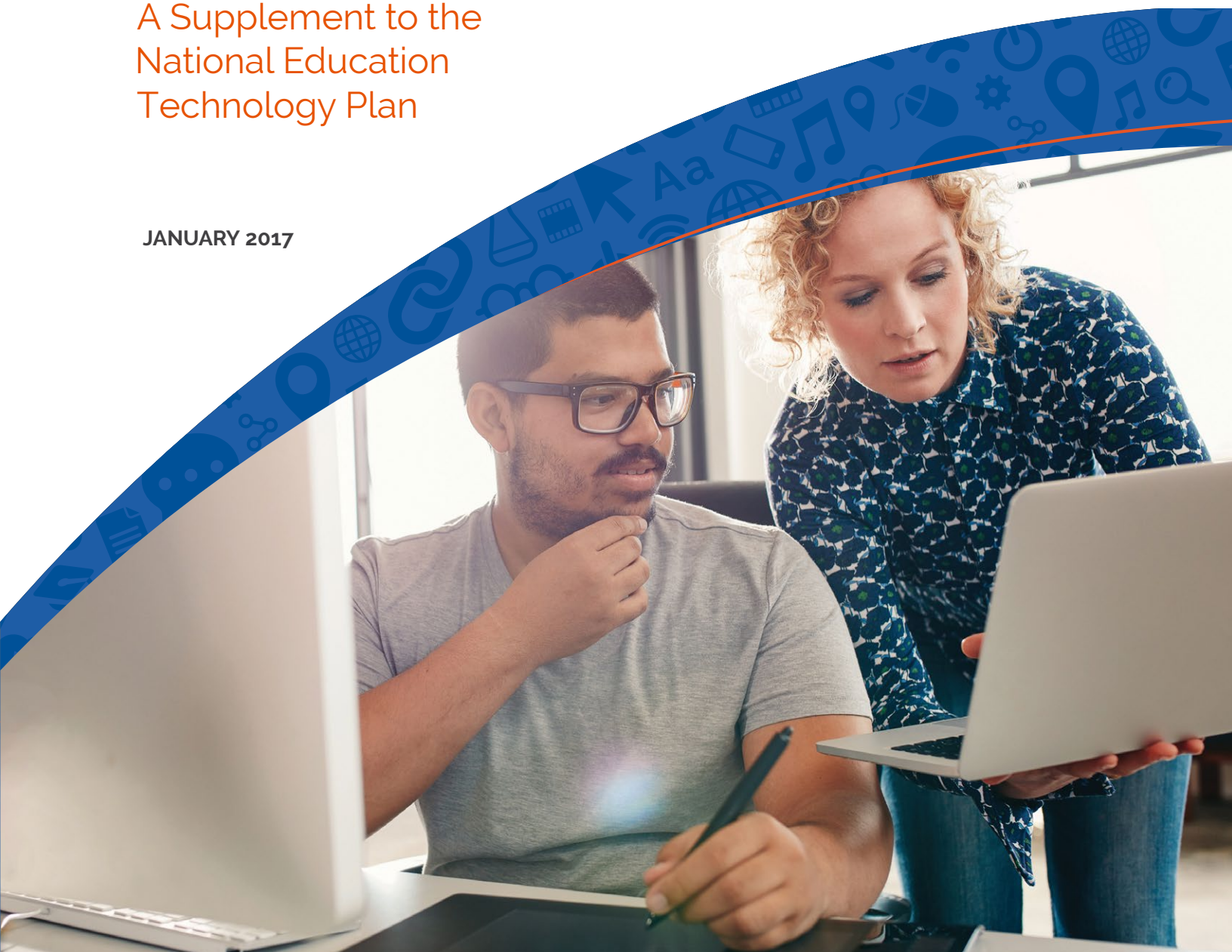

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Introduction

This document is an outgrowth of the 2016 National Education Technology Plan (NETP). The NETP presents a shared vision and call to action for transformational learning enabled by technology at all levels of our education system. Building on the work of leading education researchers; state, district, school, and higher education leaders; teachers; developers; entrepreneurs; and nonprofit organizations, the NETP recommends actions that would enable everywhere, all-the-time learning and ensure greater equity and accessibility to learning opportunities over the course of a learner's lifetime. While the concepts, recommendations, and examples in the NETP are applicable to higher education and postsecondary learning, they draw extensively from P-12 frameworks and rely heavily on its terminology and promising practices, but are not primarily applicable to the complex context of postsecondary learning or devote specific focus to its promising practices.

This Higher Education Supplement to the 2016 NETP builds on the principles described in each of the NETP's five sections—learning, teaching, leadership, assessment, and infrastructure—and examines them in the context of higher education. The supplement embraces the NETP themes of lifelong learning, equity, and accessibility and supports the NETP's assertion that technology must serve the needs of a diverse group of students seeking access to high-quality postsecondary learning experiences, especially those students from diverse socioeconomic and racial backgrounds, students with disabilities, first-generation students, and working learners at varying life stages—all with differing educational goals, but who all share the desire to obtain a postsecondary credential.

Prepared for instructors, administrators, policymakers, educational technology developers, funders, employers, and learners, the supplement articulates a vision and action plan that responds to an urgent national priority—postsecondary success for all Americans. It describes specific actions these stakeholders can take to ensure that the system of higher education continues to innovate and improve to provide all learners with opportunities for personal growth and prosperity. It examines the role of technology in serving an increasingly diverse and dispersed student body that is growing and evolving in size and composition. For example, leaders working together across sectors can use technology to enable fluid transitions between a lifetime of learning experiences and career pathways, and to underpin an infrastructure of networked institutions, education providers, community organizations, and technology developers. Academic and technology leaders can also work together to reduce achievement gaps and increase completion rates for a diverse student population. And finally, through technology-enabled everywhere, all-the-time learning, institutions, existing and new providers, workplaces, and employers can provide accessible and flexible educational experiences for all students. But this is possible only when technology is developed on an evidence-based foundation that draws from the learning sciences and is implemented using effective strategies that focus on improving the quality of learning experiences and improving the outcomes for all students.

Finally, beyond the impact of technology on students and faculty in individual classrooms and at institutions, this supplement discusses the various ways in which technology can enable system-wide and broader ecosystem applications of collaborative solutions to the core challenges of access, affordability, and completion.

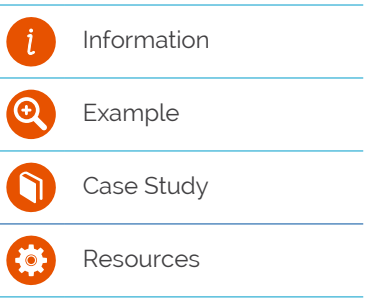
This supplement highlights many examples of innovative programs and institutions that are already engaged in this work, as well as resources for stakeholders looking for ideas and support to innovate. It also offers principles, recommendations, and examples exclusively focused on the unique challenges of the higher education ecosystem as well as innovative educational technology solutions tailored to the needs of higher education students.

How the Supplement is Organized

In Chapter One, this supplement provides context and discusses the changing nature of students in postsecondary education, including who they are and what we know about how they learn. In Chapter Two, the supplement addresses the main topics of the 2016 NETP through the lens of postsecondary learning, namely, teaching, learning, and assessment. Chapter Three examines the educational infrastructure as well as other systems necessary to support technology-enabled transformative learning experiences throughout the lifetime of learners. Chapter Four discusses collaborative postsecondary leadership structures that enable innovation and participation from all stakeholders in defining what is to be learned and how and where learning takes place. Chapter Five considers the role of technology in the future success of an emerging higher education and postsecondary ecosystem.

Throughout this supplement, examples, case studies, resources, and definitions illustrate the discussion in the text.

Icon Key



1. What is Higher Ed? A Student Prospectus

Today's average student is no longer the 18-year-old whose parents drive her up to "State U" in a minivan stuffed with boxes. Instead, the "new normal" student may be a 24-year-old returning veteran, a 36-year-old single mother, a part-time student juggling work and college, or the first-generation college student. The faces we picture as our college hopefuls can't be limited by race, age, income, zip code, disability, or any other factor.

— Ted Mitchell, Under Secretary, U.S. Department of Education

Reimagining Higher Education

Higher education has never mattered so much and to so many as a means of social mobility, an engine of economic growth, and a defender of democracy. In order for higher education to fulfill its promise as a great equalizer, we need continued innovation that can move us toward increased access, affordability and equity. This innovation will develop an ecosystem that will include a range of opportunities for a variety of high-quality educational experiences and credentials with marketplace value suited for the differing needs of students.

Historically, higher education has been viewed through the lens of its institutions[1] and our public dialogue has been framed by these categorizations. We have tended to consider students by the type of institution they attend: for example, "community college students," "Ivy League students," or "graduate school students." This may cause us to inadvertently assume that students in those institutional categories are largely similar and overlook the circumstances of many students' lives that are incompatible with the current scheduling, course sequencing, financial aid offerings, and other structural constraints imposed by this system.

This can unintentionally present higher education as easily available to everyone, located in a specific place, taking place formally over discrete periods of time, and mostly optional for workforce advancement and may also cause us to overlook and undervalue learning experiences that occur apart from discrete, formal institutional experiences. Because of this, whether a student succeeds in higher education may be determined more by the student's ability to navigate institutional structures than by their academic potential.

By placing students at the center, we can frame our understanding and design of programs, course offerings, and institutions based on their attributes and needs. In this way, our institutional policies and practices can better help students overcome barriers to successful completion. In addition, we can expand our ability to provide higher education opportunities for a greater number of students, with a broader range of needs, at a lower cost.

'New Normal' Students in Higher Education

74% of all undergraduate students have at least one nontraditional characteristic

66% transfer between institutions prior to completion

62% work either full or part time

43% attend part time

28% have at least one dependent

35% are enrolled in two-year colleges

63% are first-gen students

Source: National Center for Education Statistics. (2015).[2]

'New Normal' Students

Over the last generation, college enrollment has increased[3] due to economic recession, deindustrialization, and increasing demand for skilled workers. For example, globalization, technology, and the outsourcing of manufacturing jobs have left many adult Americans in need of new job skills to maintain their current positions or to adapt to the changing nature of industries and work.[4] In addition, where it was previously possible to have a relatively high-paying middle-class job with no postsecondary education, workers new to the workforce are finding they need more education to be considered for new job types and industries.[5,6,7] Despite this need for additional education and skills, the American workforce is also more in need than ever of even the most basic skills.[8]

In recent years, the global, economic, and societal trends have also dramatically shifted the attributes of students seeking higher education and postsecondary learning. These new normal students may already be working or have families[9] and may need access to non-academic services such as childcare and financial assistance to meet their work and family obligations as they take courses and study. They may also need flexible schedules, including courses they can complete at their own pace, faster or slower, depending on their obligations. Modularized content can enable them to engage in short bursts of study such as during lunch hours or work breaks. They may look for different ways to demonstrate their new competencies, such as with validated credentials instead of traditional academic degrees. For example, some institutions formally assess and award credit for prior learning from workforce or military experiences.[10] Most importantly, all students need support for navigating unfamiliar systems and institutional processes, including through enhanced academic, financial, and social support.

At the same time, rising costs and decreased state funding for higher education have created challenges for all students,[11] especially students pursuing more traditional forms of higher education. These challenges are particularly difficult for students who have been historically

underserved by our education system, such as students from low-income families, first-generation and English language learners, and students with disabilities. Traditional colleges and universities have begun to adapt to these students by introducing new types of instructional programs and better non-academic supports to help ensure completion, successful transfer to further education, and post-graduate employment, but rising out-of-pocket costs remain a major barrier to access and success.

Still, as change accelerates, our current education system will struggle to keep pace. Unless we become more nimble in our approach and more scalable in our solutions, we will miss out on an opportunity to embrace and serve the majority of students who will need higher education and postsecondary learning

A Student-Centered Higher Education Ecosystem

What may be needed for the new normal postsecondary student is broader ecosystem opportunities to learn within both traditional institutions and new providers, underpinned by a digital infrastructure that allows students to create, recognize, and value quality learning experiences wherever and whenever they are most convenient, and that rewards the expertise they develop within and outside of formal institutions over their lifetimes. This vision of the higher education sector would further allow students to move much more fluidly in and out of different types of institutions, depending on their needs, and transfer as they relocate or pursue increasingly demanding education and career paths.[12]

In an effort to meet the needs of these types of learners, new programs and providers of education have begun to emerge within and in partnership with institutions, offering new models of learning opportunities such as industry-aligned, job-based training programs; online learning; short-term boot camps; and competency-based education.[13,14]

In addition to traditional institutions, educational providers such as adult learning centers, workforce development and occupational training providers, libraries, community organizations, and online learning providers collaborate to meet the needs of a broader range of students. Non-institutional providers of education, including non-credit academic programs[15] and linkages to adult literacy and English language organizations,[16] youth development programs, and workforce organizations have become a more prominent option for addressing educational needs that institutions may not currently meet.

Figure A below depicts such a student-centered higher education system. Learning for students in this ecosystem is both "lifelong," happening at all stages throughout a student's life; and "lifewide," occurring not just in an educational setting, but at multiple kinds of organizations, such as community or non-traditional providers of education, in their homes, at their places of employment, and in other settings enabled by mobile and portable technology. Throughout these everywhere, all-the-time learning experiences, students may be rewarded for demonstrating their newly acquired knowledge through credit-bearing and industry-recognized credentialing.

COMPETENCY-BASED EDUCATION

Competency-based education (CBE) combines an intentional and transparent approach to curricular design with an academic model in which the time it takes to demonstrate competencies varies and the expectations about learning are held constant. Students acquire and demonstrate their knowledge and skills by engaging in learning exercises, activities, and experiences that align with clearly defined programmatic outcomes. Learners earn credentials by demonstrating mastery through multiple forms of assessment, often at a personalized pace. For more information on CBE, visit: www.cbenetwork.org.

Student-Centered Higher Ed Ecosystem

The Role of Technology in Designing a Student-Centered Approach to Higher Education

Just as rapidly changing technology has created new and constantly evolving job types and competencies requiring new skills, it has facilitated significant progress in accommodating the needs of a broader range of students. It can also revolutionize the delivery of education, allowing access to higher education for greater numbers of students at lower cost and with more flexibility.[17, 18]

However, for any technology solution to have a transformative impact on student learning and success, it must have as its foundation the specific goals, needs, and interests of the students themselves. While technology can be added to existing structures with the goal of making them marginally more efficient and flexible, technology also offers the opportunity to catalyze more significant reforms to educational structures and practices.

Design Principles for a Student-Centered Higher Education Ecosystem

Students in postsecondary education need an ecosystem that is flexible, integrated, efficient and affordable. Institutions, instructors, and administrators should consider policies and practices that anticipate and adapt to learners' needs over the course of their lives, and may include both traditional and new structures, programs, and institutional practices. The following 10 principles can guide stakeholders envisioning and creating such an expanded ecosystem.

1. **Guide students toward education that enables them to achieve their goals, is suitable to their needs, and aligns with their interests.** Students should have access to digital tools that allow them to explore their interests and that provide them resources for evaluating various education and career pathways.
2. **Helps students make wise financial decisions about postsecondary education.** Institutions and other educational providers should provide prospective students with clear information on the potential return on educational investments and/or post-completion college employment outcomes for their institutions or academic programs. This could include transparent reporting of cost, financial aid, and outcomes.
3. **Prepare students for postsecondary-level work.** Institutions should employ technology-enabled approaches to meet students where they are through redesigned diagnostic tools and adaptive, targeted remediation for students in need of additional preparation to succeed in college-level courses.
4. **Allow students to adjust the timing and format of education to fit other priorities in their lives.** Colleges, universities, and other education providers should consider how to offer programming at various times and through multiple means of delivery such as online, mobile, and blended, and through competency-based education models.
5. **Provide students with affordable access to the high-quality resources they need to be successful and to empower them to become curators of their own learning.** Institutions should ensure that students have immediate access to affordable, up-to-date learning materials that are based on current learning research and are accessible to all students. Institutions should encourage practices that support student agency to find, evaluate, and use additional learning resources that are relevant to their needs and that will persist beyond a single course.
6. **Enable advisors to help students progress through changing needs and circumstances.** Coaches, advisors, and mentors should leverage robust data to provide students with the guidance to succeed through times of transition. This support may include proactive advising and outreach by phone, text, and email. Actionable data should also be made available directly to students through analytics dashboards.
7. **Help institutions identify and provide timely and targeted assistance to students.** Instructors and advisors should have appropriate access to course-specific learning analytics data that inform early and individualized interventions to help students connect with additional academic and social support they may need to succeed.
8. **Allow students to build meaningful education pathways incrementally.** Institutions and education providers should offer stackable and transferrable credits to accommodate students who need to move seamlessly in and out of their institutions, and between systems of education, to efficiently accommodate their learning and life goals.
9. **Allow students to document their learning in ways that can be applied to further education or meaningful work.** Institutions and education providers should leverage technology to allow students to accurately demonstrate a variety of learning outcomes and should provide transparent, portable credentials that are articulated and recognized across traditional or nontraditional systems.
10. **Create a network of learning that supports students as creators and entrepreneurs, and agents of their own learning.** Empower students to drive their own continuous learning through a digital infrastructure that enables everywhere, all-the-time learning. These will support the variety of learning and credentialing pathways that students pursue throughout the stages of their lives, and need to be flexible to the learner's needs, interests, and goals, and responsive to constraints around schedule, employment, financial means, and other life circumstances.

Design Principles for a Student-Centered Higher Education Ecosytem

Students in postsecondary education need an ecosystem that is flexible, integrated, efficient and affordable. The following 10 principles can guide stakeholders envisioning and creating an expanded ecosystem:

1. Guide students toward education that enables them to achieve their goals, is suitable to their needs, and aligns with their interests.
2. Helps students make wise financial decisions about postsecondary education, including through transparent information about outcomes and return on investment.
3. Prepare students for postsecondary-level work by redesigning diagnostic tools and providing adaptive, targeted learning solutions.
4. Allow students to adjust the timing and format of education to fit other priorities in their lives.
5. Provide students with affordable access to the high-quality resources they need to be successful and to empower them to become curators of their own learning.
6. Enable advisors to help students progress through times of transition and changing needs, leveraging technology such as data dashboards and texting where appropriate.
7. Collect and use real-time learning data to provide targeted assistance to students.
8. Allow students to build meaningful education pathways incrementally that allow them to move fluidly in-and-out of and between institutions to accommodate their learning and life goals.
9. Allow students to document their learning in portable ways that can be applied to further education or meaningful work.
10. Create a network of learning that supports students as creators and entrepreneurs, and agents of their own learning over their lifetimes.

"It is impossible to redesign students to fit into a system, but we can re-design a system for students. This can be the difference between success or failure for our students that need the promise of higher education the most."

—Joseph South, Director, Office of Educational Technology

These design principles are highlighted in the work that many institutions are already doing. Here are some examples.

VIRGINIA COMMUNITY COLLEGE'S ONLINE WIZARD HELPS PROSPECTIVE STUDENTS DETERMINE GOALS AND CONNECT TO THE RIGHT EDUCATION PATHWAY

Virginia Community Colleges

Design Principles: 1 2 10

The Virginia Community College System (VCCS) serves over 200,000 students in 23 campuses across the state and has unique, guaranteed transfer agreements with more than 20 colleges and universities in the commonwealth. The system serves a diverse population of just over 74,000 students attending for workforce training and community education, as well as more than 30,000 high school students attending for college credit and career counseling.[19] To address the critical life transitions that many students experience while attending, VCCS created an online coaching system called the Virginia Education Wizard (the Wizard) to help students identify their personal goals, needs, and interests and connect to VCCS offerings.

A prospective student can visit the Wizard and choose various pathways based on whether they are a current student, a veteran looking for a particular program of study, or someone looking for educational tracks that match their career aspirations. For example, selecting the veteran path allows the individual to find a civilian career based on current military experience, connect to a veteran representative to navigate benefits and financial aid programs to enroll in school, or complete a tailored career assessment specific to veterans. Beyond these exploratory tools, the Wizard provides all students with a career and course planner to link Wizard assessments with prior high school records and future degree and transfer goals. Additionally, students can participate in Imagine, a lifestyle budgeting simulation, where students determine the approximate salary needed to live in certain regions of Virginia. The simulation considers their lifestyle habits, spending requirements, and educational goals. To learn more, explore the Wizard website: https://www.vawizard.org/wizard/home.

NORTHEASTERN'S NEW DATA ANALYTICS BOOTCAMP PUSHES TRADITIONAL INSTITUTIONAL BOUNDARIES THROUGH INNOVATIVE, IN-HOUSE INCUBATOR

Northeastern University

Design Principles: 1 4 5 8 9 10

Level is a bootcamp created by New Ventures, a Northeastern University incubator whose primary goal is to develop new business ideas, revenue streams, and educational models to promote industry-aligned and experiential learning opportunities. New Ventures realized the need to provide training for data analytics programming after noting that the number of job openings including the phrase "data analytics" had increased by 372% since 2011.[20] Level is designed as a two-month, full-time program where students can learn high-tech skills in a high-demand industry from a major research university with numerous employer partnerships. Students choose from various levels including "Level Set," an introductory program on data analytics; "Level Core," which builds intermediate skills in programming languages; and a "Focused" offering in development, specializing in Marketing Analytics. Students finish the program by partnering with an employer on a capstone project to apply their skills in real-world situations.

Northeastern's Level bootcamp started in October 2015 as a non-credit, 9am–5pm, in-person program that graduated 12 students in December 2015. Less than a year later, it offered data analytics programming in a blended format in four cities across the country, including Charlotte, Seattle, and the San Francisco Bay Area, and had graduated over 100 students. Level is continuing to develop bootcamps in cloud computing, internet of things, and entrepreneurship. By spring 2017, Level graduates will be able to articulate their coursework into credits toward a Bachelor's or graduate degree at Northeastern.

Northeastern's Level bootcamp is one of the first bootcamps created by a traditional four-year institution that focus specifically on the broader field of data analytics rather than data science and is not part of a partnership with a stand-alone coding bootcamp. The rapid growth and continued expansion of their program is largely due to the deliberate decision to place New Ventures within the University's Global Network, providing the New Ventures staff with autonomy to make quick decisions, but housed close enough to the university to leverage its prestige, partnerships, and physical spaces. As the demand for specific technology-related skills increases and changes, traditional universities may consider creating similar incubators to test and build bootcamps either in-house or through partnerships.

For more information about Level and New Ventures at Northeastern, visit: http://www.northeastern.edu/newventures/.

FLEXIBLE, ACCELERATED, CUSTOMIZED & SOCIAL: HOW BAY PATH'S ONLINE PROGRAM IS HELPING ADULT WOMEN ATTAIN A COLLEGE DEGREE

Bay Path University

Design Principles: 3 4 5 6 8 10

Bay Path University launched the American Women's College Online to deploy a new online model called Social Online Universal Learning (SOUL), supported by funding from the U.S. Department of Education's First in the World grant program. The SOUL model delivers online accelerated baccalaureate degree programs designed especially to empower the diverse population of women who Bay Path serves. These include 74% first-generation college students, 54% eligible for the Federal Pell grants indicating significant financial need, one-third single parents, and 43% women of color. The goal of SOUL is to increase degree completion in a shorter amount of time and propel women toward achievement of their college degree and career aspirations.

Bay Path's SOUL model offers adult women greater flexibility and opportunity to pursue an affordable college education, even if they are employed full-time, balancing family responsibilities, struggling financially, or were unsuccessful at prior attempts to earn a degree. SOUL's accelerated degree format offers flexible 6-week sessions throughout the year allowing women who drop out of a session for any reason to pick up their programs again in a subsequent session without losing much time. SOUL is enabled by an adaptive learning platform developed as a customized solution using Realizeit™ digital courseware.

This Realizeit™ customization leverages learning analytics and predictive modeling to create a dynamic and interactive Customized Learning Environment (CLE) for course delivery. The CLE responds to a student's learning style preferences, presenting content in formats the student chooses, and gives students tools and guidance to direct their own learning. The CLE presents assignments as a series of learning activities arranged in a "learning map" that students navigate through as they achieve mastery of each activity. Content within the activities takes multiple forms, including text, videos, images, and interactive exercises. This individualizes a student's path to future activities and informs the default format in which the system will deliver future information, although all forms are available for exploration by the student.

While SOUL's design is flexible, accelerated, and customized, an integrated social aspect of the model provides a supportive community for adult women who may feel uncomfortable with technology, lack confidence in their pursuit toward a degree, or need remediation. SOUL participants have access to intensive, integrated wraparound, academic services in which they are advised by educator-coaches. The women can also access the virtual learning communities offered online for a network of peer social support and career guidance.

Through its efforts in building out the SOUL model, Bay Path University is focusing on the 67% of women aged 25 and older who lack a baccalaureate degree.[21] The SOUL model educates a large population of mothers, which positively impacts the educational attainment of their children and future generations. To date, SOUL's 6-year graduation rate of 64% for their adult student population is substantially when higher compared with national rates for adult women at private (44.4%), public (35.5%), and for-profit (28%)[22] baccalaureate institutions of higher education.

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2. Transforming Our Ecosystem

Learning, Teaching, and Assessment

Section I.
Engaging and Empowering Learning Through Technology

GOAL: All learners will have engaging and empowering learning experiences in both formal and informal settings, in multiple contexts, and at various stages throughout their lifetimes. Learners will be supported by technology that scaffolds their learning, allows them to document their competencies, and helps them form meaningful connections to instructors, mentors, and peers to ensure their success along diverse career and educational pathways.

Postsecondary education is increasingly critical to enabling productive participation in our global economy. It is also important to our democracy, which requires an informed citizenry to thrive. Beyond the two- or four-year experience on a traditional college campus, learners need access to learning pathways that provide opportunities to acquire or update knowledge and skills. This can mean expanding access to relevant formal and informal learning experiences, learning resources, instructors, peers, and mentors continuously throughout the lifetime of a learner.

With technology, we have an opportunity to make learning more directly relevant by aligning both content and learning approaches with the immediate and long-term needs and interests of learners, and the situations in which they will need to use what they have learned. For example, technology allows learners and instructors to tap resources and expertise anywhere in the world, starting with their own communities. This ability can be particularly helpful in expanding opportunities for historically disadvantaged students by providing equity of access to high-quality learning materials, expertise, personalized learning experiences, and tools for planning future education or career pathways.

Technology-Enabled Learning in Action

The following are a few ways that technology can improve and enhance learning, in both formal and informal learning settings. They are accompanied by examples of transformative learning through technology in action.

1. **Technology enables students to access learning opportunities apart from the traditional barriers of time and place.**
   This is especially important for adult learners and traditional students with conflicting priorities who need flexible learning opportunities. Instead of assuming all students will adjust priorities such as work and family obligations around course scheduling constraints, institutions can establish schedules that allow students to access courses in the evenings, provide flexible degree pathways so that students can complete a degree program outside the traditional semester-based framework, or work with alternative and online education providers to develop courses as series of shorter learning modules that can be engaged remotely or on mobile devices.

Some institutions already offer these types of programs, including the University of Wisconsin through its Flexible Online Competency-based Program;[1] the Kentucky Community and Technical College through its Learn on Demand Program;[2] and Linn-Benton Community College, located in Oregon, through its LB iLearn Online Degrees and Credentials.[3]

2. **Technology lets students access learning opportunities outside of formal higher education institutions, such as at their workplace or in community settings.** Students can also use technology to validate these experiences, demonstrate what they have learned, and receive credit that will allow them to advance in the workplace or transition to further education.

P2PU PARTNERS WITH CHICAGO PUBLIC LIBRARIES: COMMUNITY-BASED LEARNING CIRCLES

Peer 2 Peer University

Design Principles: 4 5 9 10

Through a collaborative effort between Peer 2 Peer University (P2PU), a nonprofit that facilitates learning outside the traditional classroom, and Chicago Public Libraries, up to 15 libraries around the Chicago area are now offering Learning Circles. Learning Circles are spaces where adult learners gather to take a free 6-8 week online course together, in-person, with someone from the library serving as a guide and facilitator. This partnership saw their pilot group's online course retention increase by 45% as compared to independent online study and experienced greater learner diversity with 65% of their participants coming in as first-time online learners.[4] These successes, largely attributed to the strong community of in-person learning and the access to internet, laptops, and headphones to those in need, have driven additional online course offerings ranging from Introduction to Public Speaking and the Science of Happiness to Social Entrepreneurship and Resume Writing hosted on various platform such as edX, NovoEd and Saylor Academy. To scale Learning Circles, P2PU offers a start-up toolkit and facilitator guides for other librarians interested in bringing this type of learning environment to their communities. To lead a Learning Circle, visit P2PU's online toolkit: https://www.p2pu.org/en/facilitate/.

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3. **Technology allows students to access high-quality learning resources, regardless of their institution's geographical location or funding.** Institutions with limited access to equipment, laboratory supplies, and other learning resources can help address these shortfalls by curating high-quality online resources that align with requisite learning outcomes. Some institutions also focus on curating materials that are openly licensed and/or free to use, thus significantly reducing the cost of access for students. In these cases, institutions need to also prioritize providing their students equitable access to devices and the Internet. When they do, students can also participate in discovering and sharing relevant open resources.

PUEBLO COMMUNITY COLLEGE PROVIDES BLENDED AND VIRTUAL COURSES FOR ALLIED HEALTH FIELD

Pueblo Community College

Design Principles: 4 5

With the growing need for technically skilled workers in the allied health field, Pueblo Community College, in Colorado, has created the Consortium for Healthcare Education Online (CHEO), which aims to create blended in-person and virtual courses using the North American Network of Science Labs Online (NANSLO). CHEO spans five highly rural state regions including Alaska, Colorado, Montana, South Dakota, and Wyoming that serve a diverse and high-need student population often without access to the scientific technology needed for training in various health professions on every campus. Through the NANSLO partnership, students interested in the health industry now have access to 24 remote, web-based science lab activities where they control state-of-the-art equipment including microscopes for biology and spectrometers for chemistry. Students sign up for lab time based on their own schedule and access the lab online using a URL and PIN number. Typically students work in teams of five and take turns remotely controlling the experiment while the others watch via video streaming on the control panel. For more information and to see video tutorials of lab equipment, visit the NANSLO's Remote Web-Base Science Labs: http://www.wiche.edu/nanslo/labs-RWSL. To access courses, lab activities, and other openly licensed learning resources created by CHEO, visit: https://www.skillscommons.org/handle/taaccct/43.

4. **Technology enables enhanced learning experiences through blended learning models.** For some students, technology-enabled active learning strategies and data-driven instant feedback on their progress can be coupled with high-quality, in-person instruction to improve overall course performance.[5] In addition, technology provides opportunities for students to combine online and in-person learning, accessing resources and completing some activities at their convenience and participating later in group discussions or activities.

BLENDED LEARNING ENHANCES LEARNING OUTCOMES AT SAN JOSE STATE UNIVERSITY

San Jose State University, California, in partnership with edX

Design Principles: 4 5 7

San Jose State University (SJSU), located in the heart of Silicon Valley, serves over 600 students in its Electrical Engineering program.6 One major gateway course, which involves electronics and circuits, had a typical passage rate of 59% across the department. In an effort to improve students' retention rates, and ultimately reduce the prerequisite contribution for successful passage of subsequent courses, SJSU implemented the MIT course Basic Circuit Analysis offered on the edX platform as a massive open online course (MOOC). The blended format of the course included online content with instant feedback features and embedded active learning techniques. Additionally, students were able to complete their online coursework on their own time, outside of class, and then participate in peer-to-peer teamwork and hands-on learning while on campus. Student pass rates from the blended learning model jumped to 91% from the previous year's 59% in a traditional lecture class,7 highlighting how adaptation of high quality MOOC content using a blended format in conjunction with a highly structured, in-class, team-based approach, can produce significant benefits in effectively improving student learning and success.

5. **Technology supports students in their learning based on individual academic and non-academic needs through personalization.**
   Technology can help instructors meet students where they are and advance them to mastery, accounting for their different strengths, levels of prior knowledge, and interests. It can also give learners personalized feedback and prompt instructors to initiate interventions such as additional lessons or suggestions to enable course and program success. Technology can also efficiently connect students to non-academic support to help them manage life challenges that might otherwise interfere with their learning.

DEGREE COMPASS HELPS TENNESSEE SCHOOLS CONSTRUCT SUCCESSFUL DEGREE PATHWAYS THROUGH PREDICTIVE ANALYTICS

Austin Peay State University

Design Principles: 4 6 7

College students nationwide take up to 20% more courses than are needed for graduation on average, not always motivated by a desire for creating a diverse learning experience, but because they had to rethink their plans several times. At Austin Peay State University (APSU), a regional institution in Clarksville, Tennessee with more than 40% nontraditional students and over 50% Pell grant recipients, many students were unfamiliar with the subtleties of navigating their way through a degree program. Although every APSU student meets with an advisor each semester, the institution recognized the difficulties that students face in choosing courses and constructing a successful degree pathway.

To address this need, a faculty member at APSU built Degree Compass. Degree Compass uses predictive analytics techniques based on grade and enrollment data to rank courses according to factors that measure how well each course might help the student progress through their program. Degree Compass was designed with a choice architecture to 'nudge' students toward course selections in which the data suggests they would have the most productive success, but using an interface that minimizes choice overload. The interface neither restricts nor prescribes the choices available to the student and advisor. Instead it empowers those choices by creating an information source supported by data from previous choice patterns.

A student's recommended course list is conveniently displayed in a web–based interface on the secure side of the institution's information portal. This interactive interface provides information on curriculum and requirements for each recommended course, the role that course plays toward the student's degree, and class availability in upcoming semesters. The student is able to alter the list to show only classes that are offered online, or face–to–face, or only at particular campuses to refine their decisions according to some practical constraints.

The system also gives each class a star rating. For example, a five star class is one that, among the presently available courses, best fits the student's curricular constraints, not necessarily that the course is based solely on their preferences like Netflix. In addition, the ratings show in which courses the student is predicted to earn as good a grade as they might earn in any other course that would fill their requirements, but does not guarantee an A grade. While the interface does not reveal predicted grades to the student, all of the information is available to advisors and faculty as a tool to drive more targeted student support through academic advising. Initial focus groups found that when there was a choice, faculty and students would choose courses where the star rating was higher, however, if a course was a required course, and the predicted grade was low, faculty could use the information to initiate tutoring interventions or alternative pedagogy to proactively support the student. Since the schools adopted Degree Compass, cross-institutional academic data showed students passing

more courses, earning more credits and receiving better grades with the system's recommendations. Overall retention and graduation rates increased, with significant improvement among African American students, for example, graduation rates for African American students have increased by 15.4 percent.

While APSU showed promising results with almost 11,000 students piloting the system, the institution wanted to model techniques that can scale at institutions with differing settings and student populations. Three additional Tennessee schools replicated Degree Compass with financial support from Complete College America and the Bill and Melinda Gates Foundation. These schools included two community colleges and one university, adding nearly 40,000 additional students to the pilot.

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6. **Technology can ensure that students with disabilities participate in and benefit from educational programs and activities.**
   Higher education students with disabilities are generally responsible for requesting auxiliary aids and services for communication and any accommodations that the student may need to ensure an equal opportunity to participate in, and benefit from, the institution's program or activity. Institutions must engage in an interactive process with the student to determine the aids, services and modifications, including the student's use of technology, needed to ensure that the student receives an equal opportunity. For example, the Center for Accessible Materials Innovation (CAMI) at Georgia Tech[8] helps institutions serving students with print-related disabilities gain access to electronic versions of textbooks with speech-to-text assistive technology. Landmark College, which serves students with learning disabilities, provides a "mix and match" approach to technology by first researching and vetting applications against a UDL rubric and then allowing students to select the tool that best accommodates their needs.[9]

Recommendations

For technology to reach its full potential to engage and empower learning, education stakeholders must focus on using it to improve learning outcomes, create new types of transformative learning experiences and delivery systems that better serve students of different circumstances, and collaborate across institutions, educational providers, and other key stakeholders to ensure that system- and ecosystem-wide goals are achieved.

Promote Excellence in Learning

Instructors should use formative and summative data available to them to systematically and continuously study how students are learning in their courses. These data can be used to diagnose the learning experience and identify both effective practices that have led to successful learning as well as identify underlying causes of failure, so they can diagnose areas where the learning experience can be improved. These data can be made available through existing course management systems, or generated real-time through student activities.

Institutions should encourage instructors and department leaders to review courses with large failure and withdrawal rates, especially large first-year required courses, and employ technology-based applications, tools, and resources to redesign these courses to support student success. Student success in these courses is especially important because they often have a significant impact on a student's retention or time to completion. Because of their large size, technology can be used to complement the instructor interaction and the available academic and non-academic support.

Educational technology developers should build tools and capabilities into educational technology solutions that can provide diagnostic insights into student learning and generate real-time, actionable data that can be used by students, instructors, and other stakeholders to improve learning outcomes. When developing software or digital content, developers will benefit by providing greater transparency about their software's accessibility features and alignment with UDL standards, because this assists institutions in educating students with various disabilities.

Policymakers, researchers, and funders should invest in research on how students learn in a technology-rich environment and incentivize researchers, postsecondary educators, and education technology developers to engage collaboratively in a cohesive research agenda. This research agenda should focus on the ways technology can impact or enhance how different types of students learn and the circumstances under which the application of technology is effective for different types of students.

BORN ACCESSIBLE

"Born accessible" is a play on the term "born digital" and is used to convey the idea that materials that are initially created in a digital format rather than being converted from print or analog equivalents ("born digital"), also can and should be created in an accessible format. Colleges and universities have a legal obligation under Federal civil rights law, including Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990, to ensure that educational technology is accessible to students with disabilities in a way that permits those students to receive all the benefits of the technology in an equally effective and equally integrated manner.

If producers adopt current industry standards for producing educational materials, those materials likely will be accessible right out of the box. The principles and research-base of Universal Design (UD), a term broadly encompassing the design of products and environments to be usable by all people, and the **Universal Design for Learning** (UDL) framework to improve and optimize teaching and learning for all people based on scientific insights into how humans learn, can serve as a common language for the field. This standard would serve as a commonly accepted framework and language around design for accessibility and offer guidance to vendors and third-party technology developers in interactions with states, districts, and institutions of higher education around design of accessible learning materials.

For more information:
http://www.benetech.org/our-programs/literacy/born-accessible/

Use Technology to Transform Learning

Instructors should use technology to transform courses into more personal and engaging learning experiences by using digital materials to increase access and create opportunities for collaborative and project-based learning. For example, instructors could use data and data systems that allow them to collect real-time feedback on student learning to quickly identify deficits of understanding so they can tailor instruction to meet these needs.

Education technology developers and other stakeholders should work to adopt a Born Accessible standard of learning resource design to help educators select and evaluate learning resources for accessibility and equity of learning experience. This sets the expectation that materials that are born digital also can and should be born accessible, and that producers and users of digital technology should adopt a standard framework and language for producing accessible educational materials using the principles and research-base of UD and UDL and offer guidance to vendors and third-party technology developers in interactions with instructors and institutions of higher education.

Develop Collaborative Solutions

Instructors, institutions, and other education stakeholders should recognize that the goals, interests, and learning needs of students are diverse and may be addressed by multiple entities. Policymakers should continue testing—with rigorous evaluations—models that support flexible pathways toward completion. These solutions could provide opportunities for students to receive credit for learning that happens outside of their institutions, such credit for prior learning or high quality learning from nontraditional education providers.

Institutions should actively engage workforce partners, nontraditional education providers, community organizations, and other stakeholders in the long-term academic and career success of learners to enhance programs of study and support services. This is especially beneficial for developing high-quality academic programs that result in credentials that demonstrate knowledge and skills aligned with the most current workforce needs, and for helping learners discover and obtain skills that are most relevant to their interests and future goals.

UNIVERSAL DESIGN FOR LEARNING[10,11,12]

Three main principles drive application of universal design for learning:

1. Provide multiple means of representation so that students can approach information in more than one way. Examples include digital books, specialized software and websites, and screen readers that include features such as text-to-speech, changeable color contrast, alterable text size, or selection of different reading levels.
2. Provide multiple means of expression so that all students can demonstrate and express what they know. Examples include providing options in how they express their learning, where appropriate, which can include options such as writing, online concept mapping, or speech-to-text programs
3. Provide multiple means of engagement to stimulate interest in and motivation for learning. Examples include providing options among several different learning activities or content for a particular competency or skill and providing opportunities for increased collaboration or scaffolding.

Technology incorporating UDL principles can enable instructors to customize of digital learning resources and curricula to the needs of all students. For more information on UDL applications, visit **http://www.udlcenter.org/aboutudl.**

Section II.
Teaching with Technology

GOAL: Higher education and postsecondary instructors will use technology to design learning experiences that better support and enable student learning, while building and using evidence to improve and evolve their instructional approach over time. Additionally, instructors will engage in ongoing professional learning experiences that prepare them to adeptly apply research-based approaches to teaching with technology; use data-driven feedback loops to provide targeted academic and non-academic support to students; and use powerful tools and resources to create collaborative learning experiences that are engaging and responsive to student needs.

Excellent instructors inspire learners to fully engage and do their best work. Those who are well trained also draw upon learning science and deep discipline knowledge to create high-quality learning experiences. However, instructors in higher education face complex challenges that are unique to their environments. While instructors at all levels are charged with responsibility for the success of students from diverse educational and socioeconomic backgrounds and with a variety of academic and non-academic needs, higher education instructors often must balance teaching responsibilities with research and service priorities. In addition, some may lack robust access to support resources. Postsecondary institutions, including public universities, community colleges, community education centers, and elite research institutions, should promote student success by supporting educators, including faculty, contingent faculty, and other instructors, in developing research-based, technology-enabled teaching practices, analyzing and interpreting formative learning data, and effectively using data-driven student support systems.

Role of Instructors in Technology-Supported Learning Environments

High-quality teaching results when instructors are intentional about pedagogy and integrating research on education and learning into their courses. In technology-supported learning environments, instructors can leverage learning systems assessment data to guide future practice by understanding how instruction and resources impact learning for students.

In addition, with technology, instructors can enhance their relationship with students and the relationship students have with their peers and their learning. For example, faculty members can leverage technology to provide opportunities for students to participate in assessing and improving the quality and applicability of learning materials available in a subject area. Instructors can also empower students to become co-creators of their learning experience by using engaging digital resources that can be accessed within and outside the classroom.

LEARNING SCIENCES AND TECHNOLOGY

The interdisciplinary research field called "learning sciences" provides insights into not only cognitive functions (how the brain encodes, stores, and retrieves the content to be learned) but also metacognitive skills (how students plan, perform, and reflect on the learning process). Learning science research shows us that distributed practice or spacing (when students take practice breaks, lasting anywhere from hours to days) leads to the information being stored in long-term memory more than massed practice (cramming) because the time between sessions allows for the formation of long-term memories, their retrieval, and their re-encoding, thereby strengthening the overall memory cue. It also teaches us that systematically varying the learning task and the concept enhances long-term retrieval of what is being learned. In addition, relating new concepts to what students already know, a process called "elaboration," is a powerful way to both help them remember and contextualize new knowledge.

Technology, when designed with these and other powerful principles of learning sciences in mind, can provide a variety of engaging environments and research-based methods from which students are better able to learn new information. These environments, which incorporate principles of spacing and elaboration, may also include tools and prompts that can support metacognitive skill development. Technology-enhanced pedagogy can improve the student learning experience by bringing powerful research-based practices into the learning environment in ways that result in a more meaningful, engaging, and impactful learning experiences.[13,14,15]

Instructors can also use technology-enabled tools to streamline and improve aspects of the classroom experience, provide actionable, real-time data on student performance, suggest academic and non-academic interventions, and create avenues for personal connections between students and instructors. The implementation of technology can serve as a catalyst for intentional planning in the practice of teaching that leads to improved learning outcomes for students.

Technology-Enabled Teaching in Action

The following are ways that technology can improve and enhance teaching. They are accompanied by examples of institutions deploying technology using these strategies.

1. **Instructors can use data gathered about student learning to provide targeted interventions and tailored feedback.**
   Student learning data can provide valuable information about where instructors can place more emphasis on concepts if students are having difficulty, prompt them to initiate interventions or suggestions such as additional lessons or supplemental content, and suggest how they can incorporate content that engages students in activities that promote the attitudes and non-cognitive skills needed for real-world application of their knowledge. Similarly, this information can allow instructors to account for the different levels of knowledge and strengths of each student and advance each toward mastery and empower students by giving them more timely feedback and greater visibility into their learning progress.

JUICE: A TECHNOLOGY PLATFORM THAT IS JUST-IN-TIME, CONTEXTUALIZED AND EMPOWERING TO HELP UNDERPREPARED STUDENTS WITH REMEDIATION

Southern New Hampshire University / College for America

Design Principles: 3 4 5

College for America, a division of Southern New Hampshire University dedicated to workforce education and offers online competency-based Associate and Bachelor's degree programs through business, government, and nonprofit partners. Since 2013, College for America has served over 6,000 students nationwide, primarily working adults who are average 37 years of age and work full time. In 2014 Complete College America reported that 42.5% of students 25 years or older needed remediation at two-year institutions and 35.5% needed remediation at four-year institutions. Graduation rates for these students were even worse with fewer than 1 in 10 students graduating from community college within three years and little more than a third completing bachelor's degrees in six years.

Conventional development education approaches tend to isolate students and have low success rates with adult learners. As an alternative, College for America created JUICE: Just-In-Time, Contextualized and Empowering, an academic assistance platform as part of the U.S. Department of Education First in the World grant program. Instead of requiring students to enroll in separate prerequisite developmental courses first, before beginning college-level work, students access JUICE concurrently, while enrolled in college-level courses, whenever they need assistance.

JUICE is an online learning platform with self-guided skill-building modules that are relevant and engaging within the context of project-based learning. The platform also uses research in the areas of cognition, literacy, game-based learning, and personalized learning, as well as proven practices for helping underprepared adults become successful college students and graduates.

College of America's philosophy flipped standard developmental education approaches:

- Instead of trying to cover everything that students might need to know, JUICE focuses on just-enough content, targeting key competencies, not an entire curriculum.
- Instead of segregating so-called "developmental" students, JUICE is available to anyone who wants or needs extra help, which removes any shame or stigma that comes with remedial support.
- Instead of making JUICE required, it is optional, but designed to be so helpful and engaging, with a wide range of interactive and relevant review and practice choices, that students want to do it.
- Instead of telling students what they should do and when, JUICE is self-directed. Students chart their own path through JUICE, which they can access anytime and anywhere.
- Instead of divorcing skills from the contexts in which people actually use them, JUICE presents all of the material in real-life settings. This makes it easier for students to see the competencies in action and understand how they're used and why they're important. This also facilitates the transfer of skills to new contexts.

Using student progress and mastery data to see where students most needed academic support, the College of America team identified the top 10 competencies that presented the greatest challenges. The initial competencies included building skills in basic mathematics, grammar, creating arguments, and analyzing data. One basic mathematics curriculum design included a module called "Develop a Budget," which allows students to self-select mini-lessons on specific skills in a section called "Conquering Decimals, Fractions and Percents;" explore a real-world situation in "Problem-Solving at Giganto-Mart;" and brush up on interdisciplinary concepts through "Facing Grammar Fearlessly."

Moving forward, JUICE is an open platform and framework and the vision is that participating programs and their students can link to shared competencies and skill-based JUICE modules, as well as contribute their own modules, mini-lessons, games, and conduct research.

PROBLEM-SOLVING IN A TECHNOLOGY-RICH ENVIRONMENT

Despite the widespread prevalence of technology and mobile devices, not all adults, even young adults, are technology proficient, particularly on tasks that require problem solving and work-related tasks. The Organization for Economic Cooperation and Development's (OECD) Program for the International Assessment of Adult Competencies (PIAAC) Survey of Adult Skills showed that U.S. adults, including the youngest cohorts, performed well below the international average on the digital problem solving (https://nces.ed.gov/pubs2016/2016039.pdf). Secondary analysis by Change the Equation revealed that the young adult respondents in the U.S. were unaware of their poor skills and did not perceive these skill gaps as a career liability, despite research on wages and advancement that shows the value of digital skills (http://changetheequation.org/blog/does-not-compute-millennials-arent-tech-savvy). The Survey of Adult Skills provides direct measures of working-age adults' cognitive skills based on their performance on literacy, numeracy, and digital problem-solving tasks set in real-life contexts. These measures are paired with a background questionnaire that asks about the use of skills at work and in daily life, work history, educational attainment, and other social, behavioral, and demographic indicators that help provide meaningful insights for research.

Many institutions have found it valuable to incorporate basic computer skills for adult learners into their program offerings. For example, the Wisconsin Technical College system has created an openly licensed Basic Computer Skills MOOC (BITS) (https://www.wisc-online.com/courses/computerskills)

This training has been adopted by other community college and workforce systems to ensure that the adults enrolling in courses are able to succeed, regardless of background in computer skills.

2. **Instructors and institutions can use student learning data to evaluate the efficacy of new teaching practices or new technologies.**
   In addition to supporting the success of students, the data generated and collected on student learning and performance on technology-enabled activities can also benefit instructors and institutions. The data can provide valuable information to instructors on which activities, classroom strategies, assessments, and technology applications have demonstrated linkages to improvements in student learning. This information can be used by faculty members to continuously improve their own teaching practice, and by academic leaders to improve consistency and efficiency of instruction across similar courses in an institution, with the goal of improving student outcomes. This data also enables researchers to conduct rigorous evaluations on the effectiveness of technology-enabled teaching practices, including the efficacy of applications and technology-enabled strategies on improving learning and outcomes for students.

ONLINE FACULTY PROFESSIONAL DEVELOPMENT AT LAGUARDIA COMMUNITY COLLEGES SUPPORTS STUDENTS IN DEVELOPMENTAL COURSES

LaGuardia Community College

Design Principles: 3

LaGuardia Community College in Queens is part of the City University of New York system. Queens is one of the most ethnically diverse boroughs in New York City, with a student population representing over 150 countries and speaking more than 100 languages. LaGuardia CC enrolls more than 4,000 new students each year and just over 3,000 of those students need at least one developmental language or mathematics course. Currently, 48% percent of those students do not pass these courses.
To support these students, LaGuardia CC focused on improving teaching through online faculty professional development. Through a software platform called Classroom Notebook and working in "pedagogy circles" of 6–8 professors, 150 faculty have engaged in carefully structured reflection on posted classroom activities and collaborative peer discussion designed to assess and improve their teaching practices. Faculty select a course for practice improvement, post a weekly reflective account of what happened in class, using validated "tags" to describe their work, and upload formative assessments and student-produced materials. The tagging system is organized around five themes of classroom experience. For example, a faculty member can tag a portion of their lesson with "evaluating" to note where he or she assessed student knowledge or "challenging" where higher order thinking skills were embedded into the lesson. The tagging system serves as the common language during peer-to-peer, coach-to-peer, and small group discussions. The technology enables asynchronous peer commenting on tagged activities and generates an evolving and easily visualized picture of pedagogical patterns. Student outcomes in classes taught by program participants have shown improved results, most notably for those courses taught by part-time faculty. For example, in the 2012-2013 project cohort, classes taught by part-time developmental Math and English faculty showed a 14% increase in pass rates and a 16% increase in retention over two semesters

3. **Technology can provide instructors with the means of creating active learning environments that connect students with content in different ways.**
   Technology-based tools can allow instructors new ways to approach content delivery in classrooms and online. For example, rather than traditional lectures, instructors using these tools can create active learning environments that encourage students to collaborate, participate in inquiry based learning, and jointly produce content that demonstrates their learning. In addition, learning can be organized around real-world challenges and scenarios so students can master skills and work together to find collaborative solutions.

BUILD COMMUNITY ONLINE AND INCREASE STUDENT ENGAGEMENT THROUGH HISTORY ROLE-PLAYING GAMES

Troy University

Design Principles: 4 10

Troy University, a public institution serving nearly 20,000 students in Alabama, transformed its primarily in-person-based Reacting to the Past (RTTP) curriculum into online coursework to increase engagement. RTTP, first implemented at Barnard College in the 1990s, is a curriculum of elaborate games set in the past and informed by classic texts and historical events. Students are assigned to various historical figures and assume their roles, such as community leaders, journalists, activists, and others. Then students lead the class through speaking, writing, critical thinking, and problem solving activities that can span one class period or an entire semester, while instructors serve as facilitators and grade oral and written work.

Student feedback that online classes often felt isolated and were difficult environments for community building, a member of the history faculty at Troy, built the first fully digital versions of the RTTP curriculum, with a focus on peer interaction and feedback. This online RTTP game, set during the civil rights movement, includes a pretest and pre-reading accessible online through Blackboard, Troy University's learning management system. Once complete, students are assigned roles and log into Slack, a communication platform, as their characters work through the rest of the game. Students record and upload their speeches in audio or video format to Slack, they vote, have debates and sometimes even riot, virtually, while playing the game online. Students use Slack through their phones and the platform sends them notifications that prompt them to interact more throughout the day.

Using the RTTP curriculum as part of the online course has improved engagement in other online lessons. BlackBoard discussion board posts tripled during the RTTP portion of the curriculum, and online students' end-of-course evaluations have more similar comments to in-person courses given the community building and collaborative environments fostered by the program. The traditional RTTP curriculum is now in use at over 300 colleges and universities in the U.S. and abroad. Dr. Elizabeth Blum, the creator of this online RTTP game encourages other history faculty interested in creating online versions of the games to join the Facebook RTTP Faculty Lounge for an innovative and supportive community. There are currently 10 games published in the RTTP series, and more in development. For more instructor resources, visit: https://reacting.barnard.edu/instructor-resources

ARIZONA STATE UNIVERSITY IMPLEMENTS AND SHARES HABITABLE WORLDS: A PERSONALIZED, INTERACTIVE AND SIMULATED INTRODUCTION TO SCIENCE

Arizona State University

Design Principles: 3 5 7

Arizona State University (ASU), in collaboration with SmartSparrow, an adaptive software platform, built an online course called Habitable Worlds as an introduction to science for non-science majors. Habitable Worlds is a simulated exploratory experience and an alternative to traditionally taught, lecture-based, general education science courses. The online course, comprised of simulations and interactive environments called Virtual Field Trips, guide students through inquiry-based lessons that include foundational concepts in physics, biology, and chemistry to determine whether other planets in the universe are habitable. While Habitable Worlds is an online course, its inquiry-based model includes personalized quests that are media-rich and adaptive to meet students' learning needs as they progress through the simulation. Additionally, instructors get access to learning-authoring tools that allow for real-time lesson adjustments based on student performance data collected throughout the course. More than 1,500 students have taken Habitable Worlds, and the course, plus additional related courses, can now be used and modified by instructors outside of ASU via Inspark, a digital and science-focused teaching network. To learn more about Habitable Worlds, visit: https://www.habworlds.org/ and to learn how to use Habitable Worlds at your own institution visit: https://inspark.education/

4. **Instructors can use technology-enabled tools to provide personalized and connected experiences to all students.**
   While technology can be used to replicate face-to-face interactions, its real power may come from more transformative uses. With clearly defined learning goals in mind, instructors can employ technology to explore new pedagogical strategies enabled by technology, such as online collaborative problem-solving environments. These strategies can be incorporated into classroom, online, and blended (combinations of in-person and online learning activities) courses to provide students with engaging learning experiences.

   Technology can also assist instructors in designing high-fidelity, real-world challenges and scenarios, such as simulations and virtual laboratories, so students can collaborate to master skills in virtual settings. Technology solutions that meet a born accessible standard can ensure that all students will be able to participate in these active learning experiences, regardless of their diverse learning needs.

   In large introductory courses, personalized experiences can rebalance the expectation that students will succeed, rather than fail, by building instructor capacity for ensuring the success of all students, no matter the class size. Technology can also enable instructors to become a more immediate and accessible part of a student's support system. For example, at the University of Michigan, students in introductory STEM courses use ECoach, a digital tool that tailors communications and support to students based on individual backgrounds, goals, and current standings of students in the course. ECoach data analytics also provide a platform for faculty to give individualized advice and coaching and for students to interact with peers.[16]

COLLABORATING ACROSS INSTITUTIONS: FACULTY PILOT NEW ADAPTIVE DELIVERY MODELS

Multiple

Design Principles: 3 4 5

The Personalized Learning Consortium (PLC) at the Association of Public and Land-grant Universities (APLU) offers its member institutions opportunities to understand, implement, and scale the use of technologies designed to personalize and improve the education experience. PLC members jointly fund the consortium and determine the program's focus. One current initiative includes a grant-funded project called Accelerating the Adoption of Adaptive Courseware, which supports eight public universities in implementing adaptive courseware in high-enrollment, introductory-level courses at scale. The PLC also recently completed a successful project to develop adaptive courseware for English Composition in which four universities selected an adaptive learning platform provider, collaborated in content development for teaching introductory writing, and piloted the adaptive courseware at each institution. The use of adaptive courseware offers faculty insight into individual student needs while supporting a more student-centered instructional model. Early use of adaptive courseware at public research universities suggests that student learning outcomes can improve when instructors adopt personalized learning technologies which provide ongoing assessment of a learner's knowledge and skills and then adapts the complexity and presentation of content in blended learning environments. For more information, visit the PLC's current project's webpage: http://www.aplu.org/projects-and-initiatives/personalized-learning-consortium/plc-projects/Accelerating-Adoption-of-Adaptive-Courseware.html.

5. **Instructors can use technology tools to provide high-quality resources to students at a lower cost.**
   The price of college textbooks has increased substantially over past decades. In the case of public community colleges, this cost can represent a significant portion of the overall costs of attendance. Some students avoid or postpone expensive textbook and access code purchases, putting them at risk of missing valuable course content and assessment activities. Technology can enable instructors to transform teaching by using high-quality, low-cost digital resources for their students. Not only do these resources reduce the cost of education for students, but many community colleges have found that overall course retention and success increases when all students access course materials at the same time, at the start of a course.[17]

OPENLY LICENSED TEXTBOOKS

Data from the Bureau of Labor Statistics (BLS) suggest that between 2001 and 2015, new textbook prices rose at an average of 5.9 percent per year, a rate almost three times greater than the average growth per year of overall consumer prices.[18]

Open textbooks are textbooks that have been funded, published, and licensed to be freely used, adapted, and distributed. Typically these books have been created or reviewed by faculty from a variety of colleges and universities to assess their quality. These books can be downloaded for no cost, or printed at low cost. Many colleges and universities have adopted open textbooks and other openly licensed resources as a way to utilize available technologies to make the costs of higher education more affordable for students. Below, we have outlined a number of resources available to institutions looking to adopt open textbooks and resources.

- OpenStax—from Rice University: https://openstax.org/higher-ed. Supported by various philanthropic organizations, OpenStax provides instructors with more than 25 free, openly-licensed, and high-quality college and Advanced Placement textbooks
- Multimedia Educational Resource for Learning and Online Teaching (MERLOT)—from California State University System: https://www.merlot.org. MERLOT is one of the largest collections of open resources and textbooks in the world, and has partnered to create user communities, with institutions, consortia of institutions, and states to provide access to these resources to students.
- Open Textbook Network—from University of Minnesota: http://research.cehd.umn.edu/otn/. The Open Textbook Network at the University of Minnesota works with over 200 campuses to provide faculty professional learning and training on adoption of open resources in classes.

A number of institutions of higher education have committed to their own initiatives to broaden adoption of open textbooks and other resources, in an effort to make college more affordable for students. Some examples include:

- Achieving the Dream OER Initiative. Achieving the Dream awarded 38 community colleges in 13 states competitive grants to help faculty to redesign courses around OER in place of traditional textbooks. This partnership with the Community College Consortium, along with Lumen Learning, and SRI International will generate data on the effect of resource cost on retention and degree completion, as well as quality of resources. http://achievingthedream.org/resources/initiatives/open-educational-resources-oer-degree-initiative.

MAKING THE SHIFT TO OPEN EDUCATIONAL RESOURCES: OPENSTAX OUTLINES FOUR STEPS TO INCREASE FACULTY ADOPTION

Rice University

Design Principles: 4 5

OpenStax is Rice University's non-profit education technology initiative. Founded in 1999 and formerly known as Connexions (CNX), the nonprofit is one of the largest and most used Open Educational Resource (OER) platforms. Millions of users have accessed thousands of educational "building blocks" and e-textbooks through the platform each month. This user generated content approach was widely hailed throughout the OER community, together with other groups such as MERLOT, OER Commons, and Orange Grove.

By 2008, it became clear that simply providing a delivery platform for course materials was not enough to increase access for the majority of students. Many faculty do not have time to develop or piece together resources to fully meet their curricular needs, prompting OpenStax to shift its focus to achieve scale and sustainable access. Rather than expect faculty to create open resources from the scratch, the OpenStax team instead provided ready-made, high-quality resources that faculty could adopt immediately and then adapt as they saw fit.

OpenStax developed a better understanding of faculty needs and built a new model to encourage faculty to adopt and adapt free, peer-reviewed, professionally developed textbooks. The new model included their findings around four themes for successful adoption:

1. **Free and open is not enough.** Materials must meet the quality thresholds set by the community. Producing high quality content that can be used by a wide range of institutions is not easy. OpenStax leverages teams of professional authors, reviewers, development editors, graphic designers, and assessment experts to ensure the content meets quality thresholds set by educators.
2. **Meet standard scope and sequence requirements.** Faculty have ever-increasing responsibilities and less time to restructure their courses around new materials, combine materials to create their course, or write their own materials. Creating resources that meet standard scope and sequence requirements removes barriers to OER adoption because it takes faculty less time to adopt. Moreover, faculty may readily adapt the materials or add their own content when they have professionally produced materials to build upon. This practice also enhances academic freedom and frees faculty to drive pedagogical reform such as inquiry-based approaches and flipped models.
3. **Improve discoverability.** A major barrier for OER adoption is simply spreading awareness that high-quality, immediately adoptable OER content exists. To improve discoverability, the team positioned their peer-reviewed, professionally developed textbooks and OpenStax branded textbooks separately from OpenStax CNX (the textbook library), while still making these professionally developed textbooks available through the OpenStax CNX platform. Peer-reviewed textbooks are made available at openstax.org, where users can download a PDF, follow a link to the OpenStax CNX web view, or order a low-cost print option from Amazon or campus bookstores. This positioning has proved immensely successful. In fact, one week in September 2015 saw over one million unique visitors to the precursor openstax.org site, openstaxcollege.org.
4. **Provide additional resources.** Faculty are accustomed to using additional learning resources such as presentation slides, solution manuals, online homework, and courseware to improve course management. This is especially true for adjunct faculty who have limited time to prepare for a last-minute course assignment, or when they have to teach introductory courses that cover topics beyond their expertise. To address this challenge, OpenStax partnered with a wide variety of supplemental services providers, allowing faculty to choose what is best for their students.

By designing their platform around these four themes, OpenStax intervened earlier in the OER adoption and implementation process to make OER more useful and accessible for the more than 6,300 faculty users to date, saving 1.7 million students $168 million. OpenStax gives faculty the academic freedom to utilize the materials however they see fit. Many instructors are now adopting the resources as the primary text for their course and driving pedagogical reform by incorporating OER into flipped and inquiry-based models. Today, 32% of colleges and universities in the United States are using at least one OpenStax textbook and recent survey data indicates a re-adoption rate of 96%.[19]

Technology Can Elevate the Practice of Teaching in Higher Education

With technology, instructors can design new and engaging ways for students to learn. However, developing high-quality, pedagogically sound courses requires a significant investment of time and effort. Within institutions and across systems, faculty and instructors can be empowered to invest this time as an important component of their core responsibilities and given instructional design resources to enable them to develop and modify courses. Following are some descriptions of promising practices that can help elevate teaching in postsecondary institutions.

1. **Institutions can foster ongoing professional learning for instructors that supports them in developing their skills as users of technology for teaching in online and blended environments and enhances their knowledge of research-supported teaching practices.** Some institutions have invested in teaching by providing resources and opportunities through institutional centers for teaching and learning. These centers can provide ongoing support to faculty to enable a range of assistance, from the availability of instructional designers and technologists to advise for faculty on how to build their courses to providing production support for modules or full online courses. Other institutions have provided opportunities for faculty to spend time outside of the semester to focus on developing engaging online and technology-enabled courses. In addition, institutions can invest in research on their own instructional practices and apply promising practices to course design.

UNIVERSITY OF NORTH CAROLINA FACULTY LEARN INNOVATIVE TECHNIQUES AT ONLINE COURSE DEVELOPMENT INCUBATOR

University of North Carolina

Design Principles: 5

The University of North Carolina (UNC) System's strategic plan aims to increase the portion of North Carolinians with Bachelor's degrees by 11% by 2025.[20] Currently, the system has 324 online courses; however, it is looking to expand its online offering through enhanced teaching and learning environments to meet its strategic goal. Faculty with little prior experience redesigning their traditional courses will now have to adjust their practices to create the new learning environments.

To support faculty with in-the-moment professional development to define and use best practices around online teaching and learning, the UNC system introduced the Instructional Innovation Incubator (i3@UNC). Faculty participants are designated i3@UNC Fellows. Fellows work under the guidance of state and national experts in instructional technology and design to develop innovative new courses. Faculty for this exclusive fellowship were chosen by a selection committee composed of i3@UNC alumni, program directors, and the vice president for the Office of the Learning Technology and Innovation at the UNC system.

About 115,000 students in the UNC system took at least one online course last year, while 22% of the UNC system faculty taught at least one online course. In 2015, nearly a quarter of UNC system faculty taught at least one online course and 5% taught exclusively online. i3@UNC supports the digital transformation of the university by empowering faculty to use the best instructional techniques and technologies to serve the needs of today's 'post-traditional' learners: working adults, military affiliates, and first-generation students.

The incubator covers design strategies for online content; using assessments to personalize instruction; employing social media for student engagement and discussion; tailoring online instruction to different disciplines; and using specialized technological tools in online and blended teaching and learning.

2. **Institutions can create new career ladders for faculty and instructors who master technology in teaching.**
   Lower price points of apps and the proliferation or low-cost devices have led to proliferation of technology options for instructors at all levels. However, instructors often do not have the time to investigate or develop expertise in using technology. Some institutions have provided incentives to instructors by rewarding excellent technology-based instruction with employment stability and promotion opportunities, such as tenure track opportunities for teaching faculty, adjuncts, and other instructors. Others have provided professional recognition programs for instructors who lead in implementing and evaluating new technology for both quality and cost-effectiveness.[21]

EXAMPLES OF EVALUATING TECHNOLOGY IN TEACHING

With the proliferation of technology-enabled tools and applications, there is an increased need to evaluate the growing body of research, programs, and projects that support instructors.

Online content created at the University of Colorado, Boulder as part of its Physics Education Technology (PhET) project highlights multiple research papers on the use of PhET simulations during lectures and labs as in-class activities in conjunction with solid pedagogical practices. Studies can be found on the Science Education Resource Center webpage: http://serc.carleton.edu/sp/library/phet/why.html, as well as PhET's research on in-class use page: https://phet.colorado.edu/en/research.

- The University of North Carolina System developed the UNC Learning Technology Commons, a system-wide platform of curated digital learning products available for accelerated purchase by faculty members of the UNC system. The vendor products on the platform have been selected based on evidence of efficacy and effectiveness in a variety of contexts. Information is available at: http://unc.learntrials.com/.
- The Guided Pathways to Success (GPS) Seal of approval is a program designed by Complete College America to recognize software tools that most effectively promote college completion through adherence to the essential, evidence-based completion interventions. The initiative evaluates vendors and their software solutions for functionality that supports pathways, including the ability to default students onto their chosen academic map, easy integration of the registration process and software, and the mechanisms for ongoing monitoring and reporting for when students get off track http://completecollege.org/complete-college-america-unveils-technology-seal-of-approval/.
- Tyton Partners and the Online Learning Consortium have developed the Courseware in Context (CWiC) framework for evaluating functionality or efficacy of digital courseware products or courses. Information is available at: http://www.coursewareincontext.org.
- Similarly, with the widespread availability of Massive Open Online Courses (MOOCs) comes the need to evaluate the effectiveness of this model. This community college pilot study shows the development, implementation, and evaluation results of integrating a MOOC into a traditional, credit-bearing college course, https://peer.asee.org/developing-and-implementing-effective-instructional-strategems-in-stem.

Recommendations

The availability of technology for teaching online or in person with technology presents an opportunity to improve teaching practice and not merely to broaden the reach of existing courses.

Promote Excellence in Teaching

Institutions should incent mastery of teaching with technology by making resources on evidence-based technology practices available to instructors. This includes dissemination of information and best practices for use of applications in various subject areas and teaching contexts, professional learning opportunities that include training on technology, and technical support for effective implementation of technology in classrooms. Institutions should implement policies that reward excellent technology-based teaching and invest in the development of quality teaching faculty and instructors by providing them with stable career pathways and advancement opportunities.

Use Technology to Transform Teaching

Instructors should use technology to reimagine courses in ways that more actively engage students, are more inclusive of different learning needs, and enable a collaborative and flexible learning environment. This can include creation and use of data that provide immediate feedback on the effectiveness of course components and the relevance of learning resources, and can help instructors adjust the pace and content of their courses accordingly. Instructors should also use data and other feedback to study the effectiveness of their teaching practices, adjust pedagogical strategies as needed, and design engaging activities that lead to better learning outcomes for their students.

Develop Collaborative Practice of Teaching

Within institutions, **instructional designers, learning engineers, researchers, institutional data analysts, technologists, and learners** should collaborate with instructors to design active learning experiences that are engaging and based on research on how students learn. In addition to learning experiences, this collaboration could extend to include academic and non-academic support provided by other education stakeholders or high quality resources or content provided by nontraditional education providers. Policymakers and other education stakeholders should convene partners and other institutions, including non-traditional and informal education providers, to share resources and effective approaches to providing flexible and relevant learning experiences to students.

Section III.
Assessments Enabled by Technology

GOAL: The higher education community will collaborate to develop authentic assessments that enable measurement of student learning and competency attainment. These assessments will improve student learning by providing frequent feedback and enabling personalization, helping faculty understand student learning and improve teaching, and assisting institutions in tracking student attainment of competencies and progress. Education providers will leverage technology to allow for the precise and comprehensive assessment of student learning at greater scale, aligning, where appropriate, with externally validated standards developed by faculty, employers, and others.

While postsecondary learners do not experience the cycles of annual, standardized testing used in P12 education, they will see many forms of assessment approaches throughout their lifetime of learning. These include individual course-level assessments largely designed by instructors; standardized program-level assessments that follow completion of some programs of study such as certification exams; and assessments of workforce readiness skills. The various types of assessments learners will encounter should enable them to learn and practice the skills they need to apply their knowledge in the real world and should provide institutions with data and tools for improving teaching and tracking progress.

However, higher education has typically relied on traditional paper-based assessments, often developed by instructors on their own with little or no input or training from knowledgeable peers, psychometricians, or others with specialized expertise, and without the support of advanced statistical analysis tools. Even instructors offering the same course within one institution often use different assessments to measure learning. This uncoordinated approach to creating, evaluating, and integrating assessment tools makes it difficult, if not impossible, to create a broad enough base of evidence to build knowledge about instructional approaches that are most effective. In short, the science of assessment is underutilized in our institutions.

In contrast, technology-enabled assessments can provide a more immediate, complete, and nuanced picture of student needs, interests, and abilities, and do so at a scale far beyond paper-based assessments. Moreover, technology-enabled assessments that are based upon sophisticated data analytics and cognitive models of learning can provide instructors with real-time insights into student learning. With these insights, instructors can provide immediate, targeted feedback to students in the moment and, over time, personalize learning content and approaches for many more students. Technology-based assessments can also ensure knowledge sharing and consistency across an individual instructor's learning approaches and across multiple instructors' approaches in the same institution.[22]

Technology can provide instructors the ability to easily adapt content or delivery of assessments to allow participation by students with a greater variety of learning needs and enable instructors to personalize and improve learning for each individual student.

Technology-Enabled Assessments in Action

Technology has enabled various types of authentic assessments across a broad range of subject areas, applications, and students at scale. Here are some of the ways that diverse assessment types provide opportunities for instructors to learn more about how students learn and improve the practice of teaching. Examples of institutions using these strategies are included.

1. **Technology-enabled assessments can allow more precise measurement of student learning against clearly mapped competencies.**
   In addition to providing students with transparent documentation of their learning progress and skills attainment, technology-enabled assessments can be documented, verified, and made portable across the various stages of a student's education and career.

ENHANCING THE TRADITIONAL TRANSCRIPT: ELON UNIVERSITY'S PATH TO VISUAL EXPERIENTIAL TRANSCRIPTS

Elon University

Design Principles: 8 9 10

Elon University, a small liberal arts college in North Carolina, wanted a better way for students to discuss their entire learning experiences and fully describe accomplishments above and beyond the information captured on a traditional academic record. While traditional academic records capture assessment in the form of grades, the university recognized a growing demand from the job market to have verified records of more than just end-of-term assessments across students' courses culminating in the form of grade point averages. Additionally, they couldn't necessarily make the time-consuming and extensive shift to new assessment models, such as ePortfolios. Instead, Elon partnered with Parchment, a digital credentialing service, to try a different approach that would enhance students' current academic records by adding a visual component to capture the university's five experiential learning tracks: Global Education, Research, Leadership, Internships, and Service. Parchment's data collection process requires a simple spreadsheet and then, depending on what the student has accomplished, the five experiential learning tracks are translated into graphical representations. The visual transcript includes a map of the world indicating where a student has studied abroad, the number of presentations delivered or links to research papers, the name and logo of internship organizations, and a circular graph of hours donated to various service areas.

Since launching these visual transcripts in May 2016, over 500 students have requested the new version, often coupling it with a traditional academic record and resume in one PDF document to share with employers. Students no longer have to go to multiple places to get a comprehensive look at their college experience, and employers feel like they are taking less of a risk on applicants with an enhanced student record certified by the university. All entering freshmen enroll in Elon 101 and are provided information on how to build their experiential record at the beginning of their university career. Elon has expanded the transcript to its Elon Academy, which offers continuing education programming for high-risk high school students each summer. Students who complete Elon Academy receive a "lifelong learning record" that is a comprehensive picture of student achievements prior to matriculation in college used to empower students to be more confident self-advocates.

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2. **Technology enables assessment to be done through formative learning activities.** Data-rich formative assessments can provide feedback on student progress to students, peers, and instructors. In addition, these data can provide students with feedback on how to proceed toward mastery, including through portfolio creation, participation in challenges, projects-based learning activities, games, simulations, and advanced analytics. In some cases, assessments provide opportunities for peer learning through feedback. For example, Eli Review, developed by faculty at Michigan State University, is a pedagogical tool and technology environment that fosters peer learning through revision cycles to improve writing.[23] The Wharton Online Ordinal Peer Performance Evaluation Engine (WHOOPPEE) peer-learning environment, developed by faculty at the University of Pennsylvania, encourages greater participation and peer support in evaluating progress in large courses.[24]

The Future of Technology-Enabled Assessment

As we continue to increase our knowledge of learning science to better understand how students learn and transition to technology-based assessment, there are numerous ways in which we can improve assessments over time. For example, real-time assessments can allow for personalized and improved learning, while enabling instructors to engage with students individually to provide valuable feedback. Program-level technology-based assessments can also make credit transfers between institutions more seamless, enable credit transparency, and provide better quality assurance.

An example of reducing the need for instructors to provide all the feedback students need is the Carnegie Mellon Open Learning Initiative (OLI) courses, which are complete, self-contained online courses that do not require an instructor for students to learn effectively.[25] Studies have shown that with the pedagogical scaffolding and cognitive tutoring in an OLI course, students learning with the courseware perform as well as those taking a traditional face-to-face version of the same course. When the OLI courseware is used in a blended instructional model, students can reach the same level of learning as those in traditional face-to-face courses in half the time.[26] While these results are not typical of other systems, they do demonstrate the potential of some tools to allow instructors to compress the instruction of lower level content so they can focus more attention on higher level, richer aspects of the material.

The ability to transfer credits from institution to institution easily is important to today's postsecondary students, who are increasingly mobile and more likely to pursue learning opportunities across different locations and institutions. Traditionally, transfer and articulation agreements between institutions, and standardized assessments of prior learning at the time of enrollment have allowed students to move between certain institutions. However, even when course information is aligned between these institutions, students may not always receive credit due to institutional policies. These individually negotiated agreements also do not anticipate all the institutions that a student may attend. Some institutions have begun to implement a variety of strategies that enable students to learn continuously across institutions and systems and receive credit for their learning at other institutions, without the additional time and cost of taking duplicative courses. Some institutions have even extended this into the secondary education system, allowing students to move fluidly between secondary and postsecondary education systems, such as by developing partnership agreements for co-enrollment or dual enrollment programs.

CALIFORNIA COMMUNITY COLLEGES CREATE THE ONLINE COURSE EXCHANGE TO ENHANCE THE STUDENT COURSE TRANSFER EXPERIENCE

California Community College System

Design Principles: 1 3 4 8

The California Community Colleges (CCC), one of the largest systems of higher education in the United States with 113 colleges across 72 independently governed districts, created a high-quality online experience for course transfer to accelerate completion for its 2.1 million students. After the system eliminated many courses due to a declining budget in the late 2000s, students experienced limited access to key content at their home colleges. During this period, close to 12% of CCC students shuttled between their home college and at least one other college to find the courses they needed to graduate. In response, CCC created the Online Education Initiative (OEI), which includes a component called the Course Exchange, to support the course transfer experience across the community college system.

OEI initiated the Course Exchange and identified high-demand transfer courses for students pursuing Associate's degrees as a project starting point. Selected volunteer faculty within these high demand courses received support through a collaborative process where they used resources such as the OEI Course Design Rubric and had their courses peer-reviewed by a fellow CCC faculty specifically trained in online instructional design and delivery. Training also included an online course for faculty to learn how to make their courses more accessible for students with disabilities.

Key technical aspects were simultaneously developed, including a common course management platform for students, an identifier for each CCC student, and Student Information System (SIS) application programming interfaces (APIs) to share student enrollments and data across college information systems. OEI recognized the challenges with course articulation and leveraged the course identification-numbering framework (C-ID) that was already in place for course transfers to the California State University system as a starting point and opportunity to scale.

With more students needing credential transparency, open assessment frameworks and clearly defined standards help students to demonstrate real-world knowledge and skills they have acquired. Technology can provide these students with the opportunities to immediately verify that their learning is relevant to workforce skills. An open framework provides transparency for employers and institutions that can allow students to receive credit for workplace learning.

For more information, visit: http://ccconlineed.org/.

REAL-WORLD SCENARIOS CREATED WITH INDUSTRY PARTNERS FOSTERS AUTHENTIC ASSESSMENT FOR ONLINE LEARNERS

New England College of Business

Design Principles: 5

The New England College of Business (NECB), originally a banking and finance institution started in 1909 as a training management program for bank tellers, now is a fully accredited online college offering Bachelor's degrees in business, international business, marketing, and a Master's degree in business, business ethics, and finance. The college's student population, on average, is 34 years old and 98% are fully employed. NECB is a place where working adults can go to upskill, and currently 76% of students report being promoted within their company within a year after graduating.

While NECB provides interactive learning opportunities through simulations in their online coursework, the college wanted to improve student engagement and ownership through more authentic assessment. In 2015, NECB partnered with Authess, a company using machine-learning technology to assess competency-based learning and workplace readiness, to create a real-world lending assessment for their Principles of Banking course. The assessment, which Authess created in partnership with industry-experts, includes a scenario about whether to foreclose on a home. Students read the scenario, conduct research, analyze critical information, and then submit their plans of action. Course instructors have access to multiple data points as students work through the problem and can use the data to inform what content to focus on during interactive lectures. Upon completion, students walk away with a report outlining how close their performance was to an expert's performance in the field. The two Principles of Banking courses that used the new form of assessment showed an average overall performance increase of 9% on end-of-term assessments compared to students in the same class without access to the authentic assessment platform. To learn more about NECB's comprehensive online approach, visit: https://www.necb.edu/.

Recommendations

Technology-enabled, open, transparent, auditable assessment systems can greatly reduce fraud and waste in the higher education system. More open assessment systems allow others to review both the premise and the execution of the assessments as well as the results so that they can be compared against discipline or industry standards.

Promote Excellence in Assessment Practice

Institutions and instructors should collaborate to transform assessments by creating high-quality, technology-enabled authentic assessment activities that allow students to simulate real-world experiences in high-fidelity settings. These assessments should have open frameworks with outcomes that are transparent and easily accessed by external validators, employers, and students.

Transform Assessment through Data

Institutions should invest in data systems that will gather data from high-quality assessments of student learning across course implementations along with information concerning student and instructor characteristics and course design. Institutions and instructors should work together with researchers to evaluate course and program assessments to determine whether they accurately measure student learning against the defined objectives and to determine the effectiveness of implementation of assessments within different learning contexts and for variety of students.

Develop Collaborative Assessment Solutions

Researchers and funders should develop collaborative networks that evaluate and improve the effectiveness of assessments by drawing from the relevant professional associations, interdisciplinary research expertise across related disciplines, and engaging in public discourse on their findings to continually shape the academic approach to assessment. Within these networks, **instructors and other education stakeholders** should form communities of practice around discipline areas and skill areas. These communities should provide support around new technology-based assessment tools, disseminate evidence from research on new assessment tools and models, and promote integration of high-quality formative and summative assessments into course and program design.

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3. Systems That Support Student Success

GOAL: All students and educators will be supported by a robust infrastructure that bridges formal, informal, workplace, and mobile learning environments to connect a diversity of learning experiences and document and share learning outcomes across the ecosystem.

For most students, higher education will consist of many diverse learning experiences, including institution-based learning, online coursework, continuing education, workforce training, and personal pursuits. Learners will be most successful as they progress through these experiences if they are supported by a robust educational infrastructure that connects these experiences and translates these experiences into verified competencies, skills, and expertise that they own and that can help them along future academic or career pathways.

To accomplish this, our educational infrastructure should progress toward integration of multiple academic and non-academic support systems; be more flexible to accommodate a diversity of needs and the constraints of learners who move fluidly in and out of formal learning settings; and be interoperable across institutions and external systems to create a coherent whole that supports a student throughout a lifetime of learning.

An integrated infrastructure that supports information-driven student success

Institutions currently collect data through various course and learning management systems as well as through financial aid, career planning, and student information systems. Integrated data infrastructures can provide institutions and instructors with a complete picture of a student's learning experience, measure student progress, identify evidence-based interventions that can increase student performance, and initiate the interventions to optimize a student's pathways for success. For example, Ivy Tech Community College combined cloud-based and open-source platforms with predictive analytics and sustainable data practices to create a cost-effective and secure system to provide administrators, staff, and faculty with the data they need to identify students at risk and intervene. This integrated data platform predicts with over 80 percent accuracy which students are likely to struggle in specific courses within the first two weeks of class. This information generates alerts to staff members and triggers individual, targeted support by staff members, who contact each student individually to discuss their needs.

USING DATA TO CLOSE ACHIEVEMENT GAPS: HOW GEORGIA STATE USED A GPS ADVISING-SYSTEM TO IMPROVE ITS GRADUATION RATES FOR THEIR UNDERSERVED STUDENT POPULATIONS

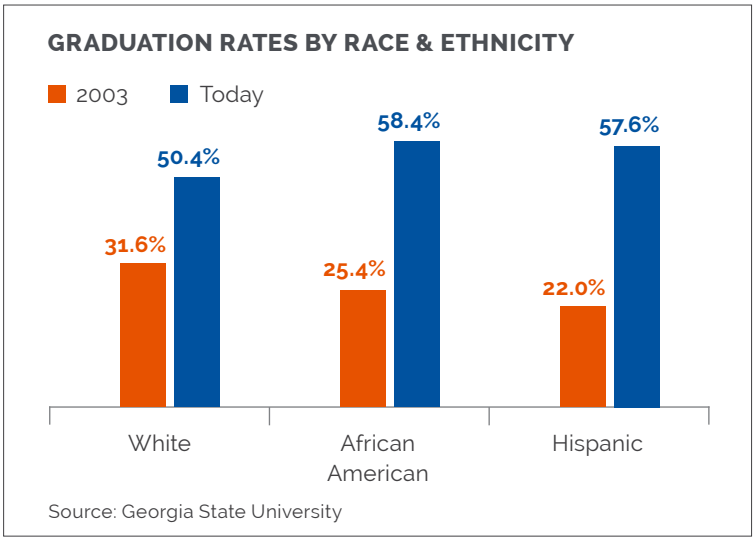
Georgia State University

Design Principles: 6 7

Georgia State University (GSU), located in downtown Atlanta, is the largest public university in Georgia. It serves over 32,000 students and has become both more diverse with a study body moving from 46% to 64% non-white, and more economically disadvantaged with Pell grant recipients climbing from 31% to 59%. The institution has also suffered from significant achievement gaps. As recently as 2003, the university's institutional graduation rates stood at just 32%. Graduation rates were 22% for Latinos, 29% for African Americans, and 18% for African American males. Students who received Pell grants graduated at rates up to 10 percentage points below those students who did not receive Pell grants.

By analyzing institutional data, university leaders began to identify specific causes for the low success rates. With over 90 undergraduate majors and 3,000 courses to choose from, students were often overwhelmed by the choices they faced. Low-income and first-generation students lacked both familiarity with the options and a support system to help them choose. Even students who successfully attained a degree changed majors on average two and half times before they graduated, racking up wasted credit hours and adding costs and time to degree in the process. Thousands of students were registering for courses that did not match their degree requirements, and too many students were dropping out before they could find a way to navigate the complex series of choices in front of them.

In 2012 GSU launched its GPS Advising system to better address the issues they uncovered around student success. The platform uses ten years of GSU student data, including more than 2.5 million grades and 140,000 GSU student records, to create predictive analytics for how each current student will likely fare in any major and in most courses the university offers. Each day, the system tracks more than 30,000 students for over 800 different risk factors and alerts a student's advisor, allowing him or her to intervene while there is still a chance to get the student back on track. Over the 2015-2016 school year alone, alerts coming out of the GPS system prompted more than 50,000 in-person meetings between advisors and students to focus on their overall success.



To manage the tens of thousands of alerts generated from the system, GSU hired 42 additional academic advisors. While the costs associated with the reorganization of the academic advising model are significant, GSU has been able to increase its overall retention rates, leading to a revenue growth that covers the investment in the student-success initiative each year.

Since the implementation of GPS Advising four years ago, GSU's achievement gaps have been eliminated. The institutional graduation rate has improved 22% since 2003. Rates are up 28% for African American students (to 58%), 40% for African-American males (to 58%), and 36% for Latinos (to 58%). Overall, African Americans, Hispanics, first-generation, and Pell students all graduated at or above the rate of the student body overall. The total number of degrees conferred annually by GSU has increased from 5,800 to 7,500 over the past five years. Students also complete their degrees in less time. The class of 2016 on average took half a semester less time to complete all of their degree requirements than the class of 2013, saving this year's graduates approximately $12 million in tuition and fees.

To learn more about student advisement at Georgia State, visit: http://advisement.gsu.edu.

However, integrating data across systems and from various applications and tools can provide a number of interoperability and data security challenges. Some institutions have begun to consider a modularized approach to systems interoperability, which can improve overall data flow.

A COLLABORATIVE APPROACH TO DATA INTEGRATION: IMPLEMENTING A FRAMEWORK FOR THE REAL-TIME DIGITAL EXCHANGE OF DATA ACROSS MULTIPLE SYSTEMS AND ORGANIZATIONS

Multiple

Design Principles: 10

Many institutions grapple with technology challenges to access data across systems. Managing the efficient, multidirectional flow of data from internal systems like student information and learning managements systems, to external educational applications and workforce systems can be difficult when ultimately trying to coordinate the best experience for students and staff to enable success and completion.

To address this common challenge, a group of numerous institutions and partners around the country convened and created a common data integration framework. The framework was first tested by two community colleges in Massachusetts and the Massachusetts' State Division of Career Services (DCS) with funding from the Department of Labor's Trade Adjustment Assistance Community College and Career Training (TAACCCT) grant program. This framework integrated education and workforce data from multiple data systems through a real-time digital exchange to allow individuals at America's Job Centers to view academic programs that matched their career-related search criteria across multiple colleges. The framework allowed for seamless data flow between the two institutions' academic programming records hosted on their school information system, Banner, to integrate with career codes from the DCS database so that students could access information, quickly and efficiently, in one place. The data integration framework uses open-sourced Application Programming Interfaces (APIs), which facilitate the secure and scalable exchange of information between systems and into the America's Job Center platform, and openly licensed educational business models and software service contracts to describe the common services provided by educational enterprise systems. Implementations of these contracts plug into the framework to integrate and configure access to existing or new infrastructure. Third party application developments are then able to securely consume data through multiple protocol technologies to meet the evolving needs of next generation student success applications.

Building on the success in Massachusetts, this initiative has evolved into an educational consortium known as the DXtera Institute, which was incorporated in October 2016 with the support of USA Funds, a non-profit college and career success organization. DXtera Institute helps scale the development, utilization, education and training of this innovative technology to enable digital exchange for the purpose of increasing college completions. Original partners include the American Association of Collegiate Registrars and Admissions Officers (AACRAO), Complete College America, FutureWorks, Georgia State University, Massachusetts Institute of Technology, Tennessee Board of Regents, University of Hawaii, Western Interstate Commission for Higher Education, and many other two- and four-year institutions. For more information, visit: www.dxtera.org.

Institutions should create learning environments that support instructors in delivering high-quality digital learning and provide value for students and institutions. These systems provide flexibility for instructors and students by allowing them to draw from a broad base of national and international expertise; and allow them to access relevant, high-quality content from a variety of sources. Some have transitioned to use of fully digital or openly licensed materials. For students with limited resources, these digital learning systems allow them to engage in high-quality, low cost educational experiences, without needing to relocate.

UNIVERSITY OF MARYLAND UNIVERSITY COLLEGE'S SWITCH TO 100% OPEN EDUCATIONAL RESOURCES FOSTERS ACCESS, AFFORDABILITY AND A COLLABORATIVE LEARNING MODEL

University of Maryland University College

Design Principles: 4 5

Controlling the cost of course materials is increasingly critical for providing an affordable, relevant education. Increasing costs in course materials have a detrimental impact on students, especially for students at the University of Maryland University College (UMUC), who have multiple and divergent demands on their financial resources. UMUC is an open university designed to meet the educational needs of adult students balancing education, work, family, and military service, and therefore their success is additionally affected by the logistical, financial, and practical difficulties of obtaining textbooks and other materials. To address these problems, UMUC has made a commitment to move to an Open Educational Resource (OER) solution.

While reducing student costs is important, the university's goals are also to understand OER's impact on learning outcomes and their pedagogical implications for students and faculty. When selecting OERs, learning designers hold facilitated team sessions to break down the course outcomes into competencies, after which librarians, directors, and subject matter experts search for materials that cover the topics addressed by those outcomes and competencies. Sources that can be freely accessed, remixed, and redistributed and are accessible to all populations, allow for a collaborative learning model that empowers students to not only demonstrate their mastery of a concept, but to apply it in different contexts, and perhaps even to teach their peers. Faculty using OER acquire new skills that emphasize mentoring over judging and encourage students to substantively revise their own resources in a cycle of continuous improvement.

The impacts of UMUC's move to 100% OER have been substantial:

- **Reduced out-of-pocket textbook costs by more than $17 million in 2015.** Conservative estimates from the university's first year of implementation of the undergraduate programs alone indicated and average savings of $365 per student. Projections for 2016, when both undergraduate and graduate programs will be fully converted, exceed $19 million.
- **Greatly improved access and flexibility for students.** In over 700 undergraduate courses and 200 graduate courses at UMUC, students now have access, at no additional cost, to all required learning materials. Every student starts class with the same access to materials. There is no delay for a textbook to be purchased and delivered, so all students can start learning from day one.
- **No degradation in learning outcomes.** UMUC is finding that using OER contributes to student learning and holds enormous potential for advancing online pedagogy. Students are more effectively learning how to research, evaluate, and analyze research materials and sources, rather than relying on information from a textbook. This becomes especially important as students move through the upper-level

courses where the analysis, synthesis, and creation of original materials is paramount. OER typically presents a variety of opinions, requiring student analysis, synthesis, and determination of facts. Also of note is the fact that online documents are more likely to spotlight real world, practitioner-focused issues. This helps enable the analysis and synthesis of materials so students can make the leap from academics to professional practice.

- **Making better use of learning materials.** The move to OER has supported a faculty focus on learning outcomes by breaking free from the practice of structuring a course around textbook sequence and scope. Instead, multiple resources can be used, with the selection process emphasizing the importance of learning outcomes. As a result, all materials can be tightly integrated into class assignments and activities, eliminating the frustration of purchasing textbooks that are underused or never used in a course.
- **Materials can be updated much more easily than a textbook.** Flexibility is especially important in rapidly changing or evolving fields such as computing or in courses where current topics are used extensively as teaching tools, such as government and politics. Turnaround time for textbooks from creation to publication and distribution can take years. Online peer-reviewed articles can be published in under a year. Access to up-to-date materials at no cost is a benefit for students and faculty who want to stay current.
- **Students appreciate that the resources are free and enjoy the portability of digital resources.** Feedback from students indicates that they are very pleased that UMUC is putting their financial needs and considerations at the forefront and appreciate UMUC's commitment to affordable, quality education. Additionally, since most students are never without a mobile phone or tablet, the portability of the resources makes students more likely to refer to them more frequently.

Moving forward, UMUC will partner with the University System of Maryland's Kirwan Center to build awareness and support for OER adoption across the rest of the 12 public 4-year institutions in the System. This partnership will also set a research agenda aimed at calculating cost savings to students; describing faculty willingness to use and improve open resources with colleagues throughout the world; students' interaction and use of free resources; and analyzing the impact of the new culture needed to focus on lowering costs and improving quality while maintaining open access.

REIMAGINING COMPLETION: DATA DASHBOARDS PUSHING THE BOUNDARIES OF DATA COLLECTED TO INFORM INSTITUTIONAL SUCCESS

Multiple

Design Principles: 8

WASC Senior College and University Commission (WSCUC) is a regional accrediting agency serving a diverse membership of public and private higher education institutions throughout California, Hawaii, and the Pacific Islands.

In an effort to rethink what data can be collected and analyzed to determine "completion" at institutions, WSCUC developed the Graduation Rate Dashboard (GRD). The GRD uses a "redemption rate," the proportion of the number of credits granted and then redeemed toward a degree, to track students regardless of whether they are full-time or part-time, first-time or transfer, or how many years have passed since their matriculation. In addition to the "redemption rate," if institutions collect just one more data point, the ratio of the average dropout's total units to the average graduate's total units, the result is an estimate of overall graduation over time. By 2012, WSCUC had a dozen institutions piloting the GRD, and, currently, the team is rolling out the process more broadly across their entire membership.

Data from the GRD are not meant to replace data coming from other systems to inform accreditation, but is one of multiple measures used by WSCUC to understand student success. In fact, other dashboards are similarly pushing the boundaries of what data can be collected to inform institutional performance. The Integrated Postsecondary Education Data System (IPEDS), for example, is broadening the coverage of student graduation data to reflect the diverse student populations at 2-year institutions and improve the collection of student progression and completion data. IPEDS will now look to collect outcome measures for non-first-time students, part-time students, and Pell grant recipients. For more information about the GRD, frequently asked questions, and archived webinars demonstrating the platform, visit WSCUC's GRD webpage: https://www.wascsenior.org/resources/about-the-graduation-rate-dashboard. For more information about the IPEDS changes in the 2016-2017 data collection, visit: https://surveys.nces.ed.gov/ipeds/ViewContent.aspx?contentId=17.

1. **Institutions can ensure that their digital infrastructure provides students with a mechanism for mapping learning and skills mastery to stackable and portable credentials.**
   Regardless of where they are along their learning pathway, students need a reliable means of demonstrating their learning and tracking the variety of credentials and skills they earn. In some cases, these credentials may be competency-based and attest to the mastery of specific skills and knowledge. In other cases, credentials could be aligned to specific workforce skills earned on the job or credits earned through prior learning assessments or regular coursework. Recording and recognizing these credentials in a consistent and reliable way will enable students to access learning more fluidly across institutional and non-institutional settings without having to duplicate work or losing credit. It will also be important to develop new ways of assuring quality for various types of credentials.

WESTERN INTERSTATE COMMISSION FOR HIGHER EDUCATION STREAMLINES COURSE TRANSFERS ACROSS STATES

Multiple

Design Principles: 8

The Western Interstate Commission for Higher Education (WICHE) is a regional organization comprised of 16 member states and territories across the United States. In 2010, WICHE, in collaboration with five member states—California, Hawaii, Oregon, Utah and Wyoming—launched the Interstate PassportSM Initiative ("the Passport") with funding from the Carnegie Corporation of New York, the Bill & Melinda Gates Foundation, the Lumina Foundation, and a U.S. Department of Education First in the World grant. The Passport project brought together 22 institutions to develop Passport Learning Outcomes, quality assurance mechanisms, and processes. The goal of the Passport is to ensure the acceptance of course work completed in lower-division general education blocks for students who transfer from one Passport institution to another.

Project directors at WICHE realized the need for the Passport based on research showing that students in the U.S. are increasingly mobile[1] and their achieved credits rarely transfer. Up to 40% of those who transfer lose more than 10% of their community college credits in the process; 14% lose more than 90% of their credits.[2] Those transfer students take 1.2 years longer, on average to earn a baccalaureate degree,[3] adding approximately $9,000 in tuition and fees[4] to the cost of their attendance.

Participating institutions used Passport Learning Outcomes (PLOs), rather than credits, and Proficiency Criteria (PC) rather than traditional assessments, as they built requirements for general education blocks. PLOs define the knowledge and skills needed to attain mastery in a particular course, and PC state how a student demonstrates proficiency in the learning outcomes. The PLOs and PC span nine focus areas modeled after the Liberal Education and America's Promise (LEAP) Essential Learning Outcomes developed by the Association of American Colleges and Universities. These areas include:

- **Foundational Skill Areas:** (1) Oral Communication; (2) Written Communication; (3) Quantitative Literacy
- **Knowledge Areas:** (1) Natural Sciences; (2) Human Cultures; (3) Human Society and the Individual; (4) Creative Expression
- **Crosscutting Skill Areas:** (1) Critical Thinking; (2) Teamwork; (3) Value Systems

The success of these PLOs and PC is based on the concepts of faculty agreement and tracking students' academic progress after transfer. Faculty teams, comprised of two-year and four-year faculty members from participating institutions, negotiated to arrive at an agreed-upon set of PLOs and PC. Each member institution constructs a Passport Block, a list of the courses and/or learning experiences by which students can achieve the learning outcomes. Faculty members then award the Passport to students who have earned it and network-member institutions agree to recognize incoming transfer students with a Passport as having completed their lower-division general education requirements in the Passport's nine areas.

In fall of 2016, with the completed "framework" of PLOs and PC in the nine knowledge and skill areas, member institutions began to award Passports to students. While data will be collected and analyzed on an ongoing basis to determine the degree to which the Passport facilitates the transfer process and leads to successful degree completion, WICHE has already noted multiple, immediate benefits. For example, institutions spend less time and effort re-negotiating equivalencies as courses and disciplines evolve, allowing for greater curricular flexibility. There are fewer unnecessary or duplicated courses for students will mean greater student motivation and faster time to degree, ultimately improving an institution's overall performance metrics. Finally, with the rise in students transferring to four-year institutions, these transfer students can increasingly become a key segment of an institution's recruitment strategy.[5]

Those interested in streamlining the transfer process can find more information about this framework and the agreements between states and institutions at: http://www.wiche.edu/passport/home.

EMPLOYER'S MILITARY SKILL LOCATOR

The Health eWorkforce Consortium, led by Bellevue College in Washington State, aims to create a procedure for providing prior learning assessments to meet the needs of veterans transitioning to civilian careers through postsecondary education. The consortium of Community Colleges in the State of Washington developed the Employer's Military Skill Locator to streamline the veteran hiring process and recommend the type and amount of prior learning credits that an individual of a certain military experience level should receive in the health information technology field. Through prior learning assessments (PLA), veterans can earn postsecondary credits for training received and merits attained while serving in the military. In partnership with the American Health Information Management Association (AHIMA) this tool establishes a foundation for standardized PLA to enable more fluid transitions for service members into the field. To access the tool and additional information about earning PLA in health IT, visit: http://hiteducation.org/hew-member-college-resources/prior-learning-assessment-pla-resources/and http://emsl.hiteducation.org/pla.

BLOCKCHAIN FOR EDUCATION

Originally created as the underlying database for bitcoin, the blockchain technology is now being seen as valuable and purposeful beyond the financial sector. Blockchain can provide the ability to store information on a secure, permanent, historical ledger that can be both public and private, allowing students to transport verified records of learning and skills throughout their lifetimes. The technology has the potential to change how technology applications approach student education data.

In the context of postsecondary education, blockchain technology provides another means of sharing student data securely across many institutions that also includes data from online learning tools, co-curricular activities, employment history, and other learning experiences. This would also allow the data to be exchanged, understood, and validated amongst many parties beyond postsecondary institutions.

Early examples include work by the ACT Foundation (in partnership with the Institute for the Future)[6] and Open Badges,[7, 8] who have set a vision for a credentialing system based on digital records of learning earned from a variety of institutions and organizations that are stored and shared from a central "ledger." Holberton School of Software Engineering in San Francisco, CA[9] and the University of Texas (UT) at Austin[10] have been proponents of such a vision by using the technology to underpin the credits or credentials they offer.

To encourage an ecosystem of academic, industry and military education providers, the UT System's Institute for Transformational Learning (ITL) has developed an "open" ChainScript platform. Based on the emerging BlockCert standard, ChainScript is capable of housing a wide range of accomplishments (e.g. credit, badges, digital certificates) issued by partnering institutions. Students and alumni will own and will be empowered to share their accomplishments with whomever they please. The platform will provide easy validation capabilities to ensure integrity.

For more information on blockchain for education, visit: https://blockchainedu.org/learn/.

2. **Institutions should ensure controlled access and protection when using student data.** Administrators, faculty, and software companies should be mindful of how data privacy, confidentiality, and security practices affect students. As they plan, they should ensure that policies are in place regarding who has access to student data and that students understand their rights and responsibilities concerning data collection. These policies should include establishing a clear guidance on what it means to enter into an agreement with providers. a provider and a process for evaluating technology for alignment with privacy and security requirements prior to use with students. This is true not only for formal contracts, but also for consumer-oriented "Click-Wrap" software that is acquired simply by clicking "accept" to the provider's "Terms of Service."[11]

STUDENT DATA AND PRIVACY

PTAC Recommendations

The U.S. Department of Education established the Privacy Technical Assistance Center (PTAC) as a one-stop resource to learn about privacy related to student data. PTAC provides information and updated guidance on privacy, confidentiality, and security practices through a variety of means, including training materials and direct assistance. PTAC also provides guidance on relevant Federal privacy laws that protect student data. PTAC recently provided additional recommendations on protecting student privacy while using online educational services and transparency best practices for schools and districts, available at http://ptac.ed.gov/document/protecting-student-privacy-while-using-online-educational-services and http://ptac.ed.gov/document/Transparency-Guidance.

FERPA Recommendations

The Family Educational Rights and Privacy Act is a Federal law that protects the privacy of student education records and the personally identifiable information (PII) contained therein. FERPA gives parents and eligible students (i.e., students who have reached 18 years of age or attend an institution of postsecondary education) certain rights with respect to student education records including, but not limited to, under certain circumstances the right to access and seek to amend said records. 20 USC §§ 1232g(a)(1) and 1232g(a)(2); 34 CFR §§ 99.10(a) and 99.20(a). Further, FERPA generally requires that educational agencies and institutions, to which funds have been made available under any program administered by the U.S. Department of Education, obtain the prior written consent of parents or eligible students before disclosing PII from a student's education records, unless such disclosure satisfies an exception to this written consent requirement. 20 USC § 1232g(b)(1); 34 CFR §§ 99.30 and 99.31.

Educational institutions should review PTAC's *Protecting Student Privacy While Using Online Educational Services: Requirements and Best Practices* for guidance on legal requirements and best practices for educational institutions to consider when evaluating the use of online educational services in collaboration with, among others, third party vendors and software companies.

Educational institutions that disclose PII from education records to third party vendors must comply with FERPA. More specifically, before disclosing such PII to third party vendors, educational institutions must either obtain the prior written consent of parents or eligible students, or non-consensually disclose such PII in accordance with an exception to FERPA's consent requirement. One such exception to consent permits educational institutions to non-consensually disclose PII from student education records to "school officials." 20 USC § 1232g(b)(1)(A); 34 CFR § 99.31(a)(1). An organization, such as a third party vendor, may be considered a "school official" only if it meets all of the following criteria: the organization (i) performs an institutional service or function

for which the educational institution would otherwise use employees; (ii) is under the "direct control" of the educational institution regarding the use and maintenance of the education records; (iii) is subject to 34 CFR § 99.33(a) of the FERPA regulations governing PII use and redisclosure; and, (iv) meets the criteria listed in the educational institution's Annual Notification of FERPA Rights for being a "school official" with a "legitimate educational interest." 34 CFR § 99.31(a)(1). With respect to a "school official's" use and redisclosure of PII and education records, among other requirements, the "school official" may not redisclose such PII or education records to another party without the prior written consent of the parent or eligible student, and may only use the PII or education records for the purpose for which it was disclosed to the "school official" by the educational institution. 34 CFR §§ 99.31(a)(1)(i)(B)(3) and 99.33(a). Further, although FERPA's "school official" exception to consent does not require written agreements/contracts between educational institutions and third party vendors, the U.S. Department of Education recommends them as a best practice.

Educational institutions should explore whether the use of de-identified data by software companies for research and product development is a possibility, as properly de-identified data is not covered by FERPA. However, it can be challenging to truly de-identify student data, and de-identification may require removing the name, date of birth, and other more obvious identifiers. Properly de-identified data use for research or product development should be defined under the terms of the contract between the educational institution and the vendor. More details can be found at the U.S. Department of Education at: http://www2.ed.gov/policy/gen/guid/fpco/ferpa/index.html and http://www2.ed.gov/policy/gen/guid/fpco/ferpa/index.html.

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3. **Learning experiences enabled by technology should be accessible for all learners, including those with special needs.**

   Supports to make learning accessible to all students, including students with disabilities, should be built into learning software and hardware by default. The approach of including accessibility features from the beginning of the development process, also known as born accessible universal design,[12] is a concept well established in the field of architecture. Modern public buildings include features such as ramps, automatic doors, or braille on signs to make them accessible by everyone. In the same way, features such as text-to-speech, speech-to-text, enlarged font sizes, color contrast, dictionaries, and glossaries should be built into educational hardware and software to make learning accessible to everyone.

   For example, the California State University's Accessibility Technology Initiative (ATI) is an institution-wide commitment to ensure technology access for individuals with disabilities provide comparable functionality, affordability, and timeliness, delivered in as seamless a manner as possible.[13] The implementation of UDL principles can reduce the need for, and costs associated with, individual accommodations for inaccessible technology products. As part of the institution's procurement process, they can also drive vendor improvements to product accessibility.

UDL ON CAMPUS

UDL on Campus is a collection of resources developed by CAST, a nonprofit education research and development organization, geared toward multiple stakeholders within postsecondary institutions, including instructional designers, faculty, policy makers, and administrators. The purpose of the site is to offer an understanding of Universal Design for Learning (UDL) in higher education and contains materials for course design through the lens of learner variability and digital media tools to create flexible learning environments. For more information about UDL, visit the National Center on Universal Design for Learning. Visit http://udloncampus.cast.org/ to explore these and other resources.

4. **Institutions can ensure ubiquitous access to connectivity and devices.** Although connectivity itself does not ensure engagement, students and instructors cannot take advantage of the opportunities to connect and engage globally or leverage high-quality learning resources without consistent and reliable access to the Internet, including in their homes. This is a challenge, especially for many low-income students. Communities and entities around the country have been working to provide low-cost Internet and personal devices to support learners and their families, such as Comcast's Internet Essentials,[14] EveryoneOn.org,[15] AT&T's Access program,[16] and newly configured Lifeline program.[17] For example, EveryoneOn has partnered with Miami-Dade College in Florida to integrate digital inclusion into their intake and orientation processes so that every student can be aware of their low-cost Internet options. The Broadband Toolkit[18] and Buy-in Toolkit[19] showcase lessons from the Broadband Technology Opportunities Program, a large grant-funded initiative that worked in communities around the country.

BRINGING BROADBAND TO NEW COMMUNITIES: OKLAHOMA CHOCTAW NATION TRIBAL AREA CREATES PUBLIC-PRIVATE COLLABORATION

Choctaw Nation

Design Principles: 5

Due to the high cost of installing and maintaining the infrastructure required for high-speed connectivity, many sparsely populated areas of the country lack access to the internet, widening the digital divide for people living in rural areas. The Choctaw National Tribal Area has demonstrated how, through a combination of grants, loans, and donations, private industries can bring critical access to these underserved communities.

In 2009–10, Pine Telephone, the service provider offering voice, video, cell, long-distance, and high-speed broadband in southeastern Oklahoma, applied for and received four American Recovery and Reinvestment awards totaling $56 million to build the infrastructure to provide Internet access to the 10 unserved counties encompassed by the Choctaw Nation.[20]

Prior to this investment, the Choctaw National Tribal Area lacked access to reliable broadband service. The low population density (8.3 to 19.7 people per square mile), the high poverty rate (25% of the population below the poverty line), and the rugged terrain made the economics of broadband infrastructure very challenging. Initial capital costs to deploy broadband meant that broadband service was limited to commercially viable areas.[21]

Today, more than 1,700 customers have access to high-speed connectivity over both fiber and wireless networks, as does every educational institution in the Pine Telephone service area. The benefits for the community have been significant as the connectivity allows the Choctaw Nation to multicast educational videos and share messages from tribal leadership from a central location. For example, the Choctaw School of Language, created to promote and preserve the language, history, and culture of the Choctaw people, now offers a distance-learning Choctaw language curriculum to five colleges for foreign language credit.[22]

5. **Institutions can have clear Responsible Use Policies (RUP) in place to promote responsible use and protect student privacy.**
   An RUP is a written agreement among institutions, instructors, and students that outlines the terms of responsible use and consequences for misuse. Effective RUPs create an opportunity to teach students to become responsible digital citizens, which will help them thrive in a connected world.[23]

TOOLS FOR RESPONSIBLE USE OF DATA

Stanford University, in partnership with Ithaka S+R, has launched a project to investigate the responsible use and the ethical collection of student data and its subsequent sharing with a wider audience. Resources available include research, applications and tools, and sample policies that all institutions can use as a starting point for drafting their own policies regarding student data.

http://ru.stanford.edu/

Recommendations

Technology systems should be designed to act in tandem with academic policies to provide a more integrated experience for students. Decisions at institutions on technology platforms, systems, tools, and applications should be made in collaboration with academic leadership. When appropriate, student feedback should be incorporated, such as in testing systems and learning applications. Similarly, decisions on academic policy at institutions should include technology leadership. Institutions should deploy technology systems that provide a seamless student learning experience to support student needs. When investing in new platforms and systems, institutions must consider interoperability elements that allow for secure exchange of student data.

Data on student learning, service needs, and outcomes should be integrated within institutions and across the higher education ecosystem, while ensuring the privacy and security of student information. This can be accomplished with data-sharing agreements and programmatic partnerships with non-credit and non-institutional educational providers, K-12 education, and employers. Policymakers should encourage institutions to consider the responsible use and ethical collection of data, as well as ensure access and equity remain as key policy drivers at the federal, state and local level.

Data on student learning, service needs, and outcomes should be integrated within institutions and across the higher education ecosystem, while ensuring the privacy and security of student information, to the extent permissible under applicable state and federal law. Educational institutions should explore data sharing agreements and programmatic partnerships with non-credit and non-institutional educational providers, K-12 education, and employers in order to effectively evaluate the outcomes of their students in compliance applicable privacy laws. Policymakers should encourage institutions to consider the responsible use and ethical collection of data, as well as ensure access and equity remain as key policy drivers at the federal, state and local level.

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4. Leadership that Enables Innovation and Change

GOAL: Leaders across the higher education ecosystem will be empowered to implement technology-enabled practices that optimize student success for all of today's students and create a culture that promotes collaboration, innovation, and change.

Taking full advantage of technology to transform learning requires strong leaders capable of creating a shared vision, a plan for achieving it, and the ability to build capacity for innovation and change. As a starting point, leaders across our higher education ecosystem need to prioritize the success of all students and engage technology to expand appropriate support for all students, especially for those who lack traditional support networks.

To be successful in addressing the needs of the increasing number of new normal students, leaders need to provide collaborative leadership within their own institutions and also develop collaborative networks across the full range of partners in the ecosystem. One key factor in the success is a shared commitment by leaders to fostering a culture in individual institutions and across the ecosystem around student-centered design strategies. The strategies can clarify and support the institutional structures, student policies, and teaching practices that need to be developed and regularly evaluated to enable greater access, affordability, and success. Across the network of partners, these strategies can be scaled to provide support experiences that allow students to create successful learning experiences throughout their lives.

For example, within an institution, leadership responsible for academic, technology, and student support can work in concert to develop promising practices for providing comprehensive system that helps improve student completion rates. Across institutions and ecosystem partners, these institutional leaders can share and scale these promising practices and also enable students to fluidly transition across educational and career pathways and receive support and credit along the way. For these collaborations to be successful, leaders must create and tap into data systems that provide insight into student progress, starting before they arrive at an institution, extending long after they leave, and incorporating both formal and informal learning throughout the course of their lives and careers. Working with technology teams across sectors, these data systems could be designed to permit linking individual student records, in compliance with applicable privacy law, across institutions for longitudinal analysis.

At institutions, leadership at all levels should work together to develop a strategy and action plan for use of technology to support the institution's strategic plan in providing for the needs of the students at their institution.

Because technology is fast becoming an essential tool for enabling and measuring key strategies for academic success, collaborative leadership teams should include the administrative officers who typically handle technology infrastructure as part of institutional strategic and budget planning. Rather than regarding these Chief Information Officers (CIO) or Chief Technology Officers (CTO) as service providers, academic leadership should instead partner with technology leadership to create a digital learning infrastructure and technology plan that leverages technology to achieve the institution's strategic academic goals and that support the core aims of the institution.

This plan could include strategies for adapting courses and programs to changes in workforce demand and for adjusting teaching practices and course delivery approaches to deal effectively with learner variability, and increasing the availability of technology and technology-enabled tools. Senior institutional leaders, such as presidents, chancellors, and chief academic officers can ensure that technology-enabled innovation is a core component of the institution's strategic vision.

DESIGNING FOR STUDENTS FIRST: HOW THE UNIVERSITY OF TEXAS SYSTEM CREATED A PERSONALIZED PLATFORM THAT CAPTURES A STUDENT'S LIFELONG EDUCATIONAL JOURNEY

University of Texas System

Design Principles: 3 4 5 8 9 10

The Institute for Transformational Learning (ITL) was created as an innovation center for the University of Texas (UT) System and was charged with developing new educational models and credentials designed to better meet workforce needs critical to Texas and the nation. The UT System is made up of 14 academic and health science campuses and serves over 220,000 students, including traditional learners blended with continuing, professional, and military students.

ITL began its work by investing in the development of a personalized digital infrastructure capable of supporting strategic programming directions. Taking a design-thinking approach to better understand the needs of participating learners and academic and support staff, a team of faculty, student service, and learning experience designers mapped the requirements for lifelong educational journeys absent the traditional constraints of time, pace, and a standard set of support services. This process resulted in TEx, the Total Educational Experience, a platform of platforms that puts the learner at the center of the educational experience and supports scale delivery of unbundled, stackable professional and academic credentials.

Driven by data, TEx overlays incumbent learning management systems (LMS) and school information systems (SIS) across multiple institutions to create a persistent and progressive learner profile, and a blockchain powered ChainScript™ of learner-owned experience and achievement offered by a broadening ecosystem of providers.

TEx also break down curricula into core competencies that are defined with industry experts and aligned back to accredited curricula. The end deliverable is a knowledge graph that defines the skills and know-how required for success in a professional field as defined by faculty, industry subject matter experts, accreditors, and practitioners. Based on this design, the TEx platform allows for meaningful personalization of pace, content and services aimed at optimizing success for every learner.

An initial prototype of TEx was implemented in Fall 2015 with 129 students enrolled in an open access Bachelors of Science degree in Biomedical Sciences at UT Rio Grande Valley. Across the first two semesters, the ITL team analyzed over 3.5 million data points collected by the TEx system to investigate the impacts of technology and curricular transformation on engagement and persistence rates. Initial data seem to indicate substantial positive effects on learning outcomes and first year retention. Prototype findings also highlight the importance of TEx's mobile-first strategy, commitment to offline content, and a gamified, learner-centered experience.

Based on critical learning from this prototype, the ITL team is rapidly expanding the TEx platform and portfolio of programming to focus on the ever-growing demand for knowledge workers in the fields of health and technology. In partnership with the UT academic campuses and health science centers, ITL is applying its approach to include degrees and targeted certificates and alternative credentials in cybersecurity, public health, engineering, and business.

Multiple institutions should collaborate to accelerate system-wide change across regions, states, and the nation.

By creating a network of partners, individual institutions can share successful approaches and drive policy changes that will lead to improved efficiency of resources, ensure consistent delivery of quality education, and provide smooth transfer pathways to students across multiple institutions, state systems, or networks of institutions.

These partnerships provide an opportunity to galvanize a wide range of stakeholders, including employers, regional or national industry organizations or licensing boards, workforce boards, non-institutional education providers, and economic development entities to build responsive and effective career pathways and training programs that align with current industry needs. Partnerships with State agencies that administer Unemployment Compensation, State Longitudinal Data Systems[1] and Workforce Data Quality Initiative grant programs[2] can enable sharing of outcomes data to provide increased transparency on institutional quality for students. These data sources would also facilitate identification of linkages between postsecondary education, training, and employment that provide students with the services they need as they flow between the systems. Institutions developing partnerships with national industry or employer associations have the additional opportunity to scale nationally recognized credentials, ensuring their transferability.

DATA THAT BRIDGES EDUCATION AND WORKFORCE

Although providing job training is not the sole purpose of the higher education system, many students, especially nontraditional students pursue postsecondary education in order to enhance their employability.[3] State education and workforce longitudinal administrative databases can allow institutions and researchers to analyze and report on outcomes of educational programs. These provide policymakers and institutions with information on which programs are relevant to employment demands and allow students to make more informed decisions about education based on their post-completion needs.

The Department of Education's Statewide Longitudinal Data Systems (SLDS) Grant Program propels the successful design, development, implementation, and expansion of K12 and P-20W (early learning through the workforce) longitudinal data systems. These systems have been enhancing the ability of states to efficiently and accurately manage, analyze, and use education data, including individual student records and make data-informed decisions to improve student learning and outcomes; as well as to facilitate research to increase student achievement and close achievement gaps. http://nces.ed.gov/programs/slds/about_SLDS.asp

In parallel, the Workforce Data Quality Initiative (WDQI) Grant Information grants administered by the U.S. Department of Labor support the creation and linking of workforce databases to education data at the individual-level. Collecting these and other data sources longitudinally will provide a comprehensive picture of workers' earnings throughout their careers and allow analysis to demonstrate the relationship between education and training programs, as well as the additional contribution of the provision of other employment services to employment outcomes. https://www.doleta.gov/performance/workforcedatagrant09.cfm

Organizations such as the Workforce Data Quality Campaign have developed toolkits to help states develop policies that will build robust, longitudinal data infrastructures and create tools to facilitate the public use of data. http://www.workforcedqc.org/resources-events/resources/data-policy-toolkit

CROSS-INSTITUTIONAL COLLABORATION: HOW THE UNIVERSITY SYSTEM OF MARYLAND IS REFORMING REMEDIAL MATH ACROSS THE STATE

University System of Maryland

Design Principles: 3 4 5

The University System of Maryland (USM) is the Maryland State public higher education system and includes 12 institutions, 2 regional centers, and a system office. In 2015, USM was received a First in the World Grant from the U.S. Department of Education to form a partnership with Maryland Community Colleges to address the issue of mathematics remediation across the state. This collaboration prompted policy work that allowed for new rigorous mathematics courses specific to non-Science Technology Engineering Math (STEM) students to fulfill the state general education requirements. The long-term goal of this project is to allow this approach to be adopted at all of Maryland's 29 public higher education institutions. Nationally, only 20% of community college students and 28% of four-year students enroll in programs that require calculus, making the new mathematics pathways potentially relevant for as many as 70–80% of students in public institutions.

For other states looking to implement and scale developmental math for students interested in liberal arts and social science majors, USM learned a few promising practices for replication. The success of the project resided in its multiple groups working simultaneously: groups of faculty developing, reviewing, and sharing curriculum and assessments; groups of institutional leaders determining transfer and articulation protocol; and groups of national leaders serving in advisory capacity to make sure the details and intricacies of the project do not keep those involved from missing the overarching project goals.

The project, called the Maryland Mathematics Reform Initiative (MMRI), consists of two alternative pathways to the traditional algebra-intensive, calculus-driven mathematics course sequence appropriate for STEM students: a statistics pathway for health and social science majors and a quantitative reasoning pathway for liberal arts and fine arts majors. The new pathways accelerate the progress of students through developmental math, replacing what may be a two- or three- semester developmental sequence with a single-semester course that is more applicable to students interested in liberal arts and social sciences.

In Maryland, 21.3% of students enrolled in Maryland's 4-year public institutions and 70.7% of students enrolled in Maryland's community colleges require remediation in math or English, or both.[4] These non-credit courses are a major barrier to degree completion. The new developmental course in Maryland will allow students to be better prepared to succeed in a rigorous college-level statistics course by introducing concepts such as algebraic and numerical skills through applied problem solving and the consistent integration of technology and statistical literacy.

This fall, the 12 partnering institutions, including five USM institutions and seven community colleges serving approximately 158,000 new students each year, will be the "early adopters" of the new mathematics pathways and developmental course. This initial phase of the project focused on faculty and staff creating the new developmental course and preparing the evaluation plans. Support has included the development of an online portal for networking and communication; two whole-project face-to-face meetings; several small workshops both in person and by webinar for faculty, advisors, and data liaisons; monthly "office hours" with experts in the new math pathways from the Charles A. Dana Center at the University of Texas at Austin; and the development of a resource library to support the teams with tools, templates, and exemplars from other institutions. In addition, the team has an advisory board with wide-spanning partnerships including mathematics associations, policy makers, institutional leaders, developmental education centers, and researchers.

MMRI also plans to research the potential impact of positive change across the state through a framework that assures the findings and strategies will be replicable in a variety of settings within the state of Maryland and nationally. The project benefits from a highly diverse group of institutional participants, including research universities (University of Maryland, Baltimore County), comprehensive universities with large transfer enrollments (University of Baltimore, Towson University), an historically Black college or university (HBCU) (Coppin State University), and institutions serving non-traditional students (University of Maryland University College) as well as small (Cecil College), large (Montgomery College), urban (Harford Community College, Howard Community College), and rural (Garrett College) community colleges. As a microcosm of higher education in Maryland, the MMRI institutions are representative of the entire population and, therefore, the findings should offer multiple opportunities for implementation in a variety of settings.

To learn more about MMRI, visit: https://dcmathpathways.org/where-we-work/maryland.

EDUCATIONAL TECHNOLOGY IN TEACHER PREPARATION

The NETP recommends that teacher preparation programs better prepare their students to use technology to effectively support P-12 student learning throughout their careers. Since the release of the NETP, teacher preparation innovators have collaborated with the Office of Educational Technology (OET) to develop and adopt four guiding principles for the use of technology in pre-service teacher preparation programs. The four principles are:

1. Focus on the **active use of technology** to enable learning and teaching through creation, production, and problem-solving.
2. Build **sustainable, program-wide systems of professional learning** for higher education instructors to strengthen and continually refresh their capacity to use technological tools to enable transformative learning and teaching.
3. Ensure pre-service teachers' experiences with educational technology are **program-deep and program-wide,** rather than one-off courses separate from their methods courses.
4. Align efforts with **research-based standards, frameworks, and credentials** recognized across the field.

Teacher preparation programs across the nation have publicly committed to working toward the four principles and better preparing its students by giving them the skills needed to meaningfully use technology in their future classrooms. The Advancing Educational Technology in Teacher Preparation Policy Brief further details the recommendations for teacher preparation programs. Read the brief at: https://tech.ed.gov/teacherprep/.

Recommendations

Institutions should develop a clear vision and strategic plan for the use of technology to enable learning that encourages participation by instructors, students, technology providers and external stakeholders such as community organizations, economic development boards, and workforce system entities. Presidents and senior academic and technology decision-makers should work together to set a clear vision and goals that views technology as an opportunity to augment learning, evaluate and enhance current systems and processes, and establish funding models for sustainable technology acquisition. This could include ensuring interoperability of systems, transparency of outcomes, frameworks for verifying learning outcomes, and providing opportunity for use of openly licensed resources. Institutions should take a systematic approach to technology-enabled innovations, by supporting opportunities for pilot programs with investment in rigorous evaluation of both the technology and the effectiveness of the innovation.

Institutions should create strategic networks with leaders at other institutions. Institutions should recognize that learning occurs beyond the walls of a single institution and create partnerships of shared expertise, content, and resources, so that students can take advantage of all the opportunities that are relevant and available. These partnerships will allow institutions to share and scale promising practices and evidence-based strategies for use of technology that improves student learning and outcomes.

Institutions should create strategic networks with external systems to develop systems that support lifelong and lifewide learning for students. In a truly all-the-time, everywhere learning ecosystem, learning occurs across multiple institutions and institution types, throughout a student's life occurring not just in an educational setting, at multiple kinds of organizations, such as non-traditional providers of education, at their places of employment, and in other settings enabled by mobile and portable technology. Leaders at institutions should reach out to a network of local and national stakeholders in the education ecosystem, such as the secondary education system, economic development boards, workforce system entities, community organizations, and nontraditional education providers. These collaborations, including appropriate data and service sharing, will ensure that students can transition fluidly between education systems and from education to workforce, throughout a lifetime of learning.

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5. The Future of Higher Education

This supplement begins with a discussion of the potential for a student-centered, technology-enabled higher education ecosystem designed to meet the needs of all students, including students with "nontraditional" characteristics, who represent the majority of today's postsecondary learners. Many colleges and universities and providers of non-institutional learning experiences are using technology to increase flexibility, reduce costs, and validate student learning. Technology is allowing them to provide personalized learning experiences accessible to a broader diversity of students and enhances the services that address their broader range of needs.

Significant progress has already been made. As evidenced by the numerous examples in this supplement, we are using technology to serve students better. For example:

- The national conversation around Federal, State, and institutional policies have better aligned to promote access, affordability, and completion for students in postsecondary education and in best practices for technology-enabled training for working learners that promote skill gains.
- There has been greater availability of data on student learning and outcomes. These data have increasingly become available and used as part of the decision-making at institutions.
- Technology-enabled models of learning have allowed educators to rethink the design and delivery of high-quality education that expands learning and supports interactions among students, faculty, instructors, peers, and mentors for a learning experience that is more engaging and effective than earlier efforts that sought to apply technology to learning.
- Use of online and interactive digital tools such as simulations, adaptive platforms, and cognitive tutors have become more pervasive and have expanded learning opportunities for many students.
- Non-institutional providers of education, including non-credit academic programs and non-institutional education providers, are developing more high-quality learning programs designed to address changing student needs. Technology has enabled more seamless alignment, articulation, and collaboration between these formal and informal educational providers.

But there is much more to be done. Below are some considerations that must guide us as we continue in our work.

Equity: We must focus innovation on what matters. It is imperative that the key goal remains ensuring all students have affordable and equitable access to learning experiences, particularly those who stand to gain the most from higher education. Technology opens the potential and provides opportunity to improve student outcomes and lower costs. We should work to ensure that students who have been historically underserved and are currently not well-served benefit from all of these opportunities. This will require continued, intentional, and concerted focus by organizational leaders and policymakers to identify and understand these students and from researchers and technology developers to target evidence-based innovations toward addressing their needs.

Access: We must continue to leverage technology to deliver high-quality learning opportunities to those who need it most. High-quality, technology-enabled resources and education delivery can become a major driver of decreased costs and increased access to higher education for students who stand to gain the greatest benefit. For example, online delivery of educational content has already begun to revolutionize the broad availability of learning, making it possible for institutions to provide high-quality educational content to learners in all corners of the globe. New modularized course delivery strategies, adaptive learning platforms, and competency based models can help students demonstrate mastery of new skills and allow them to advance toward completion of academic degrees, certifications and other credentials in a cost effective and time efficient manner. Still, research has shown mixed results on whether online education has improved learning outcomes or increased equity of opportunity. We need more investment in rigorous research and development to make online learning and other technology-enabled learning more effective in closing opportunity gaps,[1] rather than widening them. We also need to continue to leverage tools that guide students through application and financial aid processes, and help them to select the institutions or programs based on their interests and career goals while providing accurate data on outcomes so that the true cost and value of their investment is transparent.

EDUCATIONAL QUALITY THROUGH INNOVATIVE PARTNERSHIPS

In 2015, the US Department of Education announced the Educational Quality through Innovative Partnerships (EQUIP) experiment, which will test the implications of allowing students—particularly low-income students—to access Federal student aid to enroll in programs offered by non-traditional training providers, in partnership with colleges and universities, including coding bootcamps, online program providers, and employer organizations.

Each partnership between institutions and non-traditional providers must be reviewed and monitored by an independent, third-party quality assurance entity (QAE). QAEs will hold the non-traditional providers and postsecondary institutions accountable by assessing the student outcomes, including learning and employment and the management of the program.

The experiment will: (1) test new ways of allowing Americans from all backgrounds to access innovative learning and training opportunities that may lead to good jobs, but that fall outside the current financial aid system; and (2) evaluate approaches for outcomes-based quality assurance processes that focus on student learning and other outcomes.

For more information on the EQUIP program, visit: http://tech.ed.gov/equip/

Affordability: We must consider ways to ensure technology-enabled learning is affordable for students. In some cases, institutions are able to make educational opportunities more widely available at a low cost through digital or open educational resources; yet those savings are not always passed directly to students themselves. Institutions and faculty should continue to explore engaging learning experiences that leverage technology to reduce instructional costs for the institution and cost of tuition and fees for students. Institutions and researchers should work together to provide technology-enabled interventions that lower costs for students and apply evidence-based strategies to improve learning outcomes.

Completion and Outcomes: We must shift our focus to outcomes through data within institutions and across the ecosystem. Both the traditional and emerging higher education sector must focus on outcomes, for both student learning and post-program student success. Rather than relying on proxies of learning, technology gives us the opportunity to more accurately measure whether students have met learning objectives or mastered particular competencies or skills. As we continue to refine existing assessment tools and develop new instruments to measure learning, these will provide us insight into the pedagogy and practices that support a diversity of students learning needs and the support structures that will enable them to learn.

While not all program impacts can be measured, institutions already collect many outcomes-based data points. In addition, the digital infrastructure and technology applications used at institutions increasingly make more data available. All of these can be used to improve programs and demonstrate their effectiveness. However, many of these data are currently siloed in individual, disconnected data systems within an institution. In addition, much data is available across the ecosystem that describes student outcomes in different learning contexts.[3] Collaboration across the postsecondary ecosystem to protect student privacy while making data more broadly available will create transparency and accountability for both institutions and non-traditional providers to provide students with high-quality learning experiences.[4]

Ecosystem: Learning occurs in an expanded higher education ecosystem that is emerging and needs to grow. Increasingly the postsecondary learning ecosystem consists of not only traditional institutions, but also a wider array of organizations where learning occurs. This includes workforce training opportunities such as apprenticeships, employer training, and on-the-job learning; new and traditional providers of education offering short-term training opportunities, such as bootcamps; and informal learning spaces such as libraries and community centers. Learning can—and does—happen in all of these spaces, and students should be empowered to take advantage of all opportunities to learn and recognize their increased knowledge and skills when they do.

Re-Bundling: Assembling high-quality learning experiences and resources from various sources can increase quality and access. Technology enables institutions and education providers to disaggregate many of the component parts of education. For example, individual course modules, internships or work-based learning opportunities, student supports, assessments, and resources can be made available to learners apart from a co-located experience. This provides institutions and learners with a greater opportunity to create a personalized postsecondary learning experience by re-bundling these components in ways that are more accessible and more affordable for students.

Institutions can support and facilitate this by providing a framework for these experiences within the context of their formal academic programs. In some specific industry and skill areas, groups of employers have begun to articulate the in-demand competencies and skills[2] and have partnered with employers and education providers to offer training. Institutions and various learning organizations may incorporate some or all of these into the design of accredited degree or certificate programs. Institutions could develop authentic assessments that can reliably measure student mastery of competencies and that could be validated with industry partners, giving confidence to the validity of these student's skills.

In addition, institutions can support and empower students to select high quality learning resources to supplement their academic programs. Technology enables learners to access courses or learning resources from a variety of institutions or nontraditional education providers, and also engage with peers or experts across the world through social networks. Learning resources, including textbooks, online modules, or even full courses could be developed across multiple organizations and shared, possibly at greatly reduced costs if open licenses are used.

Research: We must conduct more research that tests effectiveness and informs practice. It is vital that the ongoing innovation that contributes to the higher education ecosystem is supported by research and builds a strong evidence base for technology-enabled learning. Research on learning through technology can lead to changes to pedagogy and program design to best facilitate different kinds of learning for different kinds of students in varying contexts. Existing research of this type covers only a small portion of our information needs. We also need an increased and specific focus on effectiveness of technology-enabled strategies and support services that improve learning outcomes for working learners, transitioning servicemen and veterans, and traditionally disadvantaged populations. In order for this to happen, institutions, researchers, and technology developers need to develop a shared framework for understanding the importance of testing the efficacy of technology-enabled programs.

FIRST IN THE WORLD

The Department's First in the World (FITW) grant program awarded approximately $135 million to institutions of higher education to support the development, replication, and dissemination of innovative solutions and evidence for what works in addressing persistent and widespread challenges in postsecondary education. These solutions will specifically be targeted for students who are at risk for not persisting in and completing postsecondary programs, including adult learners, working students, part-time students, students from low-income backgrounds, students of color, students with disabilities, and first-generation students. Many of the projects and early outcomes of the FITW grantees have been highlighted in this supplement. For more information, visit: http://www2.ed.gov/programs/fitw/index.html.

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Conclusion

A dynamic higher education ecosystem is essential to providing opportunities for learning and advancement in our society. The background, circumstances, and needs of those it serves grow more diverse and expansive year by year, providing opportunity for reimagining by colleges and universities and new entrants. As demonstrated in the many examples in this document, visionary leaders and individual instructors are already engaged in the hard work of redesigning their approach to be more responsive to these needs and are using technology to accelerate and expand their efforts in powerful ways.

In individual classrooms, well-prepared and properly trained instructors can apply technology to positively impact the teaching and learning experience for each student and greatly increase the flexibility and ease with which they can pursue their education. As leaders of our system of higher education become more aware of what technology can offer, they are instigating the design of technology-enabled solutions that serve the core mission of their institutions and expand its reach. They are also leveraging technology to collaborate with new providers, increasing the fluidity with which students move between formal and informal learning environments, and documenting their abilities and accomplishments.

In this time of incredible transformation, higher education has never mattered so much to those who seek it. It drives social mobility, energizes our economy, and underpins our democracy. When applied systematically and collaboratively across programs and institutions, technology can help leaders address long-standing issues of access, affordability, and completion, and can result in profoundly improved outcomes for the students they serve. In doing so, we extend the promise of higher education to millions more who are counting on it to enrich their personal lives, transform their professional prospects, and realize their dreams.

Appendix A

Resources

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Appendix B

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Public Events

Reimagining Higher Education Convening Washington, DC, June 30, 2016
New York Regional Outreach Event, August 10, 2016
Boston Regional Outreach Event, August 23–24, 2016
San Francisco Regional Outreach Event, August 31–September 1, 2016

Appendix C

The Development of the Higher Education Supplement

The 2017 Higher Education Supplement to the National Education Technology Plan builds on the 2016 National Education Technology Plan that discusses how technology can be leveraged to serve the needs of a diverse group of students seeking access to high-quality postsecondary learning experiences, especially those students from diverse socioeconomic and racial backgrounds, students with disabilities, first-generation students, and working learners at varying life stages—all with differing educational goals, but who all share the desire to obtain a postsecondary credential.

The development of the supplement began as a part of a convening in Washington, DC (Reimagining Higher Education, June 30, 2016) attended by over a hundred thought leaders, institutional administrators, providers of non-traditional education, education technology developers, and policymakers. Following this convening the Technical Working Group (TWG) was engaged through a number of virtual and in-person meetings.

The first meeting engaged the group of recognized experts to develop the vision, overarching themes and outline of the document. On the basis of expertise and interest, each of the TWG members was assigned to a sub-group to focus on one of the five key topic areas: Learning, Teaching, Leadership, Assessment, and Infrastructure. Over subsequent virtual and in-person meetings, the TWG members drafted language and provided feedback that informed the development of the supplement working drafts, including the identification of relevant research and exemplary programs. The TWG reviewed three drafts and offered their comments and recommendations, which were incorporated into the final document. In addition, a group of national content experts and members of key stakeholder groups reviewed and provided feedback on the draft document, which was also incorporated into the final version.

The supplement was also informed by a series interviews with leaders from the U.S. Department of Education, academic leaders, technology innovators, and nonprofit organizations. These interviews provided valuable insight into the priorities and practices being implemented to further the goals of ensuring equity and accessibility to high-quality instruction enabled by technology for all students.

In addition to the interviews, the development of the supplement also brought together eight focus groups, including a student focus group, and others around the topics of assessment, education technology, new models of education, and change management and leadership. The participants represented a broad cross section of key stakeholders, including practitioners, state and local administrators, education technology developers, and experts from across the field. The focus groups provided the opportunity for participants to give insights and recommendations around their area of expertise and to identify exemplars of the innovative use of

technology in formal and informal educational settings. The OET team also participated in regional outreach events and traveled to innovation hubs around the country interviewing groups from research centers, traditional institutions, non-traditional providers and nonprofit organizations to gather best practices in the field and highlight examples of technology in action within higher education.

Throughout the development process for the supplement, attention was focused on the compilation and review of proposed examples to illustrate the innovative use of technology across the five areas of Learning, Teaching, Assessment, Infrastructure and Leadership. Suggestions were collected from the TWG members, interviews, focus group participants, and U.S. Department of Education staff. In an effort to identify those examples that best aligned with the supplement, the OET teams used the following criteria to make the final selection: quality of the user experience, evidence of success, and clear use of technology, where appropriate. The 25 examples included in the supplement represent today deepen an understanding of the innovative use of technology to enhance teaching and learning in various segments of the postsecondary education ecosystem and the learning opportunities available to students in a diverse set of institutions and learning organizations. While all the examples are meant to inspire action, they vary in the availability of data on effectiveness, including many promising innovations and emerging practices. The examples range in length to provide both quick contextual highlights to the work currently being implemented in the field, as well as longer case studies that outline the detailed problems facing specific institutions or organizations and the steps taken and outcomes of innovations in practice.

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