United States National Educational Technology Plan

U.S. Office of Educational Technology

Editor's Note

The following are sections 1 and 2 from the National Educational Technology Plan, published by the Office of Educational Technology in the United States Department of Education. The full document is available at https://tech.ed.gov/netp/

The references follow each section, as they do in the original OET report.

Section 1: Engaging and Empowering Learning Through Technology

Goal: All learners will have engaging and empowering learning experiences in both formal and informal settings that prepare them to be active, creative, knowledgeable, and ethical participants in our globally connected society.

To be successful in our daily lives and in a global workforce, Americans need pathways to acquire expertise and form meaningful connections to peers and mentors. This journey begins with a base of knowledge and abilities that can be augmented and enhanced throughout our lives. Fortunately, advances in learning sciences have provided new insights into how people learn.1 Technology can be a powerful tool to reimagine learning experiences on the basis of those insights.

Historically, a learner's educational opportunities have been limited by the resources found within the walls of a school. Technology-enabled learning allows learners to tap resources and expertise anywhere in the world, starting with their own communities. For example:

- With high-speed Internet access, a student interested in learning computer science can take the course online in a school that lacks the budget or a faculty member with the appropriate skills to teach the course.
- Learners struggling with planning for college and careers can access high-quality online mentoring and advising programs where resources or geography present challenges to obtaining sufficient face-to-face mentoring.
- With mobile data collection tools and online collaboration platforms, students in a remote geographic area studying local phenomena can collaborate with peers doing similar work anywhere in the world.
- A school with connectivity but without robust science facilities can offer its students virtual chemistry, biology, anatomy, and physics labs—offering students learning experiences that

approach those of peers with better resources.
- Students engaged in creative writing, music, or media production can publish their work to a broad global audience regardless of where they go to school.
- Technology-enabled learning environments allow less experienced learners to access and participate in specialized communities of practice, graduating to more complex activities and deeper participation as they gain the experience needed to become expert members of the community.2

These opportunities expand growth possibilities for all students while affording historically disadvantaged students greater equity of access to high-quality learning materials, expertise, personalized learning, and tools for planning for future education.3, 4 Such opportunities also can support increased capacity for educators to create blended learning opportunities for their students, rethinking when, where, and how students complete different components of a learning experience.

Personalized Learning

Personalized learning refers to instruction in which the pace of learning and the instructional approach are optimized for the needs of each learner. Learning objectives, instructional approaches, and instructional content (and its sequencing) all may vary based on learner needs. In addition, learning activities are meaningful and relevant to learners, driven by their interests, and often self-initiated.

Blended Learning

In a blended learning environment, learning occurs online and in person, augmenting and supporting teacher practice. This approach often allows students to have some control over time, place, path, or pace of learning. In many blended learning models, students spend some of their face-to-face time with the teacher in a large group, some face-to-face time with a teacher or tutor in a small group, and some time learning with and from peers. Blended learning often benefits from a reconfiguration of the physical learning space to facilitate learning activities, providing a variety of technology-enabled learning zones optimized for collaboration, informal learning, and individual-focused study.

Agency in Learning

Learners with agency can “intentionally make things happen by [their] actions,” and “agency enables people to play a part in their self-development, adaptation, and self-renewal with changing times.”6 To build this capacity, learners should have the opportunity to make meaningful choices about their learning, and they need practice at doing so effectively. Learners who successfully develop this ability lay the foundation for lifelong, self-directed learning.

What People Need to Learn

To remain globally competitive and develop engaged citizens, our schools should weave 21st century competencies and expertise throughout the learning experience. These include the development of critical thinking, complex problem solving, collaboration, and adding multimedia communication into the teaching of traditional academic subjects.5 In addition, learners should have the opportunity to develop a sense of agency in their learning and the belief that they are capable of succeeding in school.

Beyond these essential core academic competencies, there is a growing body of research on the importance of non-cognitive competencies as they relate to academic success.7, 8, 9 Non-cognitive competencies include successful navigation through tasks such as forming relationships and solving everyday problems. They also include development of self-awareness, control of impulsivity, executive function, working cooperatively, and caring about oneself and others.

Building Non-cognitive Competencies: Providing Opportunities for Practice

Interacting with peers, handling conflicts, resolving disputes, or persisting through a challenging problem are all experiences that are important to academic success.

Digital games can allow students to try out varied responses and roles and gauge the outcomes without fear of negative consequences.28 Accumulating evidence suggests that virtual environments and games can help increase empathy, self-awareness, emotional regulation, social awareness, cooperation, and problem solving while decreasing the number of behavior referrals and in-school suspensions.29

Games such as Ripple Effects [http://rippleeffects.com/] and The Social Express [http://thesocialexpress.com/] use virtual environments, storytelling, and interactive experiences to assess a student's social skill competencies and provide opportunities to practice. Other apps help bridge the gap between the virtual environment and the real world by providing just-in-time supports for emotional regulation and conflict resolution. A number of apps are available to help students name and identify how they are feeling, express their emotions, and receive targeted suggestions or strategies for self-regulation. Examples include Breathe, Think, Do with Sesame; Smiling Mind; Stop, Breathe & Think; Touch and Learn—Emotions [https://edtechbooks.org/-taL]; and Digital Problem Solver [https://edtechbooks.org/-EqV].

Fostering Growth Mindset: Technology-based Program to Fuel Student Achievement

A key part of non-cognitive development is fostering a growth mindset about learning. Growth mindset is the understanding that abilities can be developed through effort and practice and leads to increased motivation and achievement. The U.S. Department of Education has funded several growth mindset–related projects, including a grant to develop and evaluate SchoolKit [https://edtechbooks.org/-wqL], a suite of resources developed to teach growth mindset quickly and efficiently in schools.

Jill Balzer, a middle school principal in Killeen, Texas, has seen success from using SchoolKit in her school. Balzer spoke with an eighth grader who achieved academic distinction for the first time in five years after using the using the program. "When I asked him what the difference was," recalled Balzer, "he said that now he understood that even though learning was not always going to come easy to him it didn't mean he was stupid, it just meant he needed to work harder on that subject."

District of Columbia Public Schools also have made the SchoolKit available to all middle schools. Principal Dawn Clemens of Stuart-Hobson Middle School saw increases in reading scores for their seventh-grade students after using the program. "With middle-schoolers, there are always excuses," Clemens said. "But this shifts the language to be about payoff from effort, rather than 'the test was too hard' or 'the teacher doesn't like me.'"

Increased connectivity also increases the importance of teaching learners how to become responsible digital citizens. We need to guide the development of competencies to use technology in ways that are meaningful, productive, respectful, and safe. For example, helping students learn to use proper online etiquette, recognize how their personal information may be collected and used online, and leverage access to a global community to improve the world around them can help prepare them for successfully navigating life in a connected world. Mastering these skills requires a basic understanding of the technology tools and the ability to make increasingly sound judgments about the use of them in learning and daily life. For the development of digital citizenship, educators can turn to resources such as Common Sense Education's digital citizenship curriculum [https://edtechbooks.org/-Qdc] or the student technology standards [https://edtechbooks.org/-snh]from the International Society for Technology in Education (ISTE).

Technology-enabled Learning in Action

Learning principles transcend specific technologies. However, when carefully designed and thoughtfully applied, technology has the potential to accelerate, amplify, and expand the impact of powerful principles of learning. Because the process of learning is not directly observable, the study of learning often produces models and conclusions that evolve across time. The recommendations in this plan are based on current assumptions and theories of how people learn even while education researchers, learning scientists, and educators continue to work toward a deeper understanding.

The NETP focuses on how technology can help learners unlock the power of some of the most potent learning principles discovered to date. For example, we know that technology can help learners think about an idea in more than one way and in more than one context, reflect on what is learned, and adjust understanding accordingly. Technology also can help capture learners' attention by tapping into their interests and passions. It can help us align *how* we learn with *what* we learn.

Following are five ways technology can improve and enhance learning, both in formal learning and in informal settings. Each is accompanied by examples of transformational learning in action.

1. **Technology can enable personalized learning or experiences that are more engaging and relevant.**Mindful of the learning objectives, educators might design learning experiences that allow students in a class to choose from a menu of learning experiences—writing essays, producing media, building websites, collaborating with experts across the globe in data collection—assessed via a common rubric to demonstrate their learning. Such technology-enabled learning experiences can be more engaging and relevant to learners.

Scaling Up Personalized Learning: Massachusetts' Innovation Schools Create Multiple Pathways to Learning

As part of Massachusetts' Achievement Gap Act of 2010, funding was set aside to give schools the opportunity to implement innovative strategies to improve learning. Through this legislation, educators can create Innovation Schools that can operate with increased flexibility in key areas such as schedule, curriculum, instruction, and professional development.

As of 2015, there were 54 approved Innovation Schools and Academies in 26 school districts across Massachusetts. Some schools implemented a science, technology, engineering, and mathematics (STEM) or STEM-plus-arts model, and others implemented a combination of one or more of the following educational models: multiple pathways, early college, dual-language immersion, or

expanded learning time.

Students in a Safety and Public Service Academy combine rigorous college-style coursework available in a variety of formats (in class, online, blended learning, off-site for internships and job shadows) in areas such as forensics, computer science, criminal law, crisis management, psychology, and video production. Students at the Arts Academy may combine their coursework with off-site learning opportunities at local universities, combining high-tech design skills and knowledge of the creative arts to prepare them for post-secondary education and a career in the arts.

Pentucket Regional School District's program has scaled their innovation approach to every elementary school in the district. Their approach is centered on student choice and the use of opportunities for learning that extend beyond the classroom walls. Through the redesign of the school day and year, students engage in hands-on experiential learning with in-class lessons; online and blended coursework; and off-campus academic opportunities, internships, and apprenticeships.

2. **Technology can help organize learning around real-world challenges and project-based learning—using a wide variety of digital learning devices and resources to show competency with complex concepts and content.**Rather than writing a research report to be read only by her biology teacher and a small group of classmates, a student might publish her findings online where she receives feedback from researchers and other members of communities of practice around the country. In an attempt to understand the construction of persuasive arguments, another student might draft, produce, and share a public service announcement via online video streaming sites, asking his audience for constructive feedback every step of the way.

Project-based Learning

Project-based learning takes place in the context of authentic problems, continues across time, and brings in knowledge from many subjects. Project-based learning, if properly implemented and supported, helps students develop 21st century skills, including creativity, collaboration, and leadership, and engages them in complex, real-world challenges that help them meet expectations for critical thinking.

Engaged Creation: Exploratorium Creates a Massive Open Online Course (mooc) for Exploring Circuits and Electricity

In the summer of 2015, the Exploratorium in San Francisco launched its first MOOC, working with Coursera, called Tinkering Fundamentals to inspire STEM-rich tinkering; introduce a set of high-quality activities that could be replicated easily in the classroom; and foster robust discussions of the learning.

The six-week course included a blend of hands-on activities, short videos of five to eight minutes each, an active discussion forum, live Web chats, social media, and other resources. Each week the videos highlighted an introduction to a new tinkering activity, the learning goals, and tips for facilitation; step-by-step instructions for how to build and support others to build the tinkering contraption; classroom video and interviews with teachers about classroom implementation and student learning; profiles of artists; and comments by learning experts. Reflective prompts generated extensive conversation in the discussion forums.

To facilitate these online activities, the Exploratorium integrated multiple platforms, including Coursera and live video streaming tools. Instructors used these online platforms and spaces to reflect on the week's activities and forum posts and to provide real-time feedback to participants. In videoconferences, the instructors positioned themselves as questioners rather than as experts, enhancing a strong sense of camaraderie and collaborative exploration.

The Exploratorium used a social media aggregator to showcase photos and videos of participants' tinkering creations, underscoring the hands-on and material nature of the work of the MOOC. The course attracted more than 7,000 participants from 150 countries, of whom approximately 4,400 were active participants, resulting in more than 66,000 video views and 6,700 forum posts. For more information, visit the Exploratorium [http://www.exploratorium.edu/] and Coursera [https://edtechbooks.org/-TQ] on the Web.

Building Projects for Real Audiences: National Parks Service Deepens Engagement Through Technology

Journey Through Hallowed Ground [http://www.hallowedground.org/] is a partnership project of the National Park Service that encourages students to create rich connections to history through project-based learning, specifically making videos about their visits to historical sites. The students take the roles of writers, actors, directors, producers, costume designers, music directors, editors, and filmmakers with the support of professional video editors. The videos allow the students to speak about history in their own words as well as share their knowledge with their peers. In addition to learning about history, participating in the projects also teaches students to refine their skills of leadership and teamwork. All videos become official material of the National Park Service and are licensed openly for use by other students and teachers around the world.

3. **Technology can help learning move beyond the classroom and take advantage of learning opportunities available in museums, libraries, and other out-of-school settings.**Coordinated events such as the Global Read Aloud [http://theglobalreadaloud.com/]allow classrooms from all over the world to come together through literacy. One book is chosen, and participating classrooms have six weeks in which teachers read the book aloud to students and then connect their classrooms to other participants across the world. Although the book is the same for each student, the interpretation, thoughts, and connections are different. This setting helps support learners through the shared experience of reading and builds a perception of learners as existing within a world of readers. The shared experience of connecting globally to read can lead to deeper understanding of not only the literature but also of their peers with whom students are learning.

Upskilling Adult Learners: at Peer-to-peer University (p2pu), Everyone is a Teacher and a Learner

P2PU [https://www.p2pu.org/en/] and the Chicago Public Library (CPL) have partnered to pilot Learning Circles—lightly facilitated study groups for adult learners taking online courses together at their local library. In spring 2015, the partnership ran a pilot program in two CPL branches, facilitating in-person study groups around a number of free, online courses. The pilot program has expanded to 10 CPL branches in fall 2015, with the ultimate goal of developing an open-source, off-the-shelf solution that can be deployed by other public libraries, allowing all libraries and their

communities to harness the potential of blended learning for little to no expertise or cost.

Meeting once a week in two-hour sessions, a non-content expert librarian helps facilitate a peer-learning environment, with the goal that after six weeks the Learning Circles become self-sustainable. P2PU has designed a number of software tools and guidelines to help onboard learners and facilitators, easing administrative burdens and integrating deeper learning principles into existing online learning content. Initial results suggest that students in Learning Circles have far higher retention than do students in most online courses, participants acquire non-cognitive skills often absent from pure online learning environments, and a diverse audience is participating. By working with libraries and building in additional learning support, P2PU also is able to reach first-time online learners, many of whom do not have a post-secondary degree.

P2PU measures success in terms of both the progress of individual learners and the viability of the model. In addition to the number of branches involved, cost per user, and number of learners, attributes such as retention, returning to additional Learning Circles, advancing from the role of learner to that of facilitator, and transitioning from Learning Circles into other fields (formal education, new job) are all other factors that contribute to success. Furthermore, P2PU designs for and measures academic mindsets (community, self-efficacy, growth mindsets, relevance) as a proxy for learner success.

Helping Parents Navigate a Technological World: a Resource for Making Informed Technology Decisions

Family Time With Apps: A Guide to Using Apps With Your Kids is an interactive resource for parents seeking to select and use apps in the most effective ways with their children.33 The guide informs parents of the variety of ways that apps can support children's healthy development and family learning, communication, and connection with eight strategies. These strategies are playing games together, reading together every day, creating media projects, preparing for new experiences, connecting with distant family, exploring the outside world, making travel more fun, and creating a predictable routine. Tips on how to find the best apps to meet a child's particular needs and an explanation of how and why to use apps together also are included.

The guide references specific apps, which connect parents with the resources to select appropriate apps for their children. This online community is connected with various app stores and gives parents a menu for app selection on the basis of learning topic, age, connectivity, and device capability. Information also is included that describes exactly what other elements are attached to each app—for example, privacy settings, information collection, advertisements allowed, related apps, and so on.

The Joan Ganz Cooney Center at Sesame Workshop also recommends the Parents' Choice Award Winners as a tool for selecting child-appropriate apps. These apps, reviewed by the Parents' Choice Awards Committee within the Parents' Choice Foundation, have gone through a rigorous, multi-tiered evaluation process. The committee looks for apps that help children grow socially, intellectually, emotionally, and ethically while inspiring creativity and imagination and connecting parents and children.

4. **Technology can help learners pursue passions and personal interests.**A student who learns Spanish to read the works of Gabriel García Márquez in the original language and a student who collects data and creates visualizations of wind patterns in the San Francisco Bay in anticipation of a sailing trip are learning skills that are of unique interest to them. This

ability to learn topics of personal interest teaches students to practice exploration and research that can help instill a mindset of lifelong learning.

Leveraging the Power of Networks: Cultivating Connections Between Schools and Community Institutions

Cities of LRNG [https://www.lrng.org/cities] helps close the opportunity gap by connecting young people with a wide range of learning opportunities throughout their cities. The program makes learning activities from hundreds of community organizations easily discoverable to youth and their families on a single online platform.

Each LRNG city has a website where partner organizations can make their offerings visible. Young people receive recommended activities on the basis of their personal passions. For example, in Chicago through the local Chicago Cities of Learning initiative [https://edtechbooks.org/-ru], more than 120 organizations have provided a collective 4,500 engaging learning opportunities for tens of thousands of young people in all areas of the city through the platform.

As students participate in learning activities, they earn digital badges that showcase their skills and achievements. These digital badges signify mastery of a skill—for example, coding, games, design, or fashion—giving out-of-school learning greater currency by documenting and archiving learning wherever it occurs. Each time a young person earns a badge, he or she is recommended additional learning experiences and invited to broaden or deepen skills to propel him or her along academic, civic, or career trajectories. Because digital badges contain in-depth information about each individual's learning experiences, schools and potential employers can gain a comprehensive view of each person's interests and competencies.

Hive Learning Networks [https://edtechbooks.org/-sQX], a project of the Mozilla Foundation, organize and support city-based, peer-to-peer professional development networks and champion connected learning, digital skills, and Web literacy in youth-serving organizations in urban centers around the world. Using a laboratory approach and catalytic funding model, Hive re-imagines learning as interest based and empowers learners through collaboration with peer educators, youth, technology experts, and entrepreneurs.

Similar to Cities of LRNG, Hive networks are made up of community-based organizations, including libraries; museums; schools; after-school programs; and individuals, such as educators, designers, and artists. Hive participants work together to create learning opportunities for youth within and beyond the confines of traditional classroom experiences, design innovative practices and tools that leverage digital literacy skills for greater impact, and advance their own professional development.

The Hive model supports three levels of engagement:

1. **Events.**Organizations with shared learning goals unite to provide fun, engaging events, such as maker parties, as a first step toward exploring longer term collaborations.
2. **Learning Communities.**Community organizers with an interest in Hive's core principles come together in regular meet-ups and events to explore how to apply connected learning tools and practices. Learning communities are in seven cities in the United States, Canada, and India.
3. **Learning Networks.**With an operational budget and staff, Hive Learning Networks commit to promoting innovative, open-source learning models in partnership with a community's civic

and cultural organizations, businesses, entrepreneurs, educators, and learners. Learning Networks are in New York, Chicago, and Pittsburgh.

For more information about Hive Learning Networks, visit Hive [https://edtechbooks.org/-sQX] on the Web.

5. **Technology access when equitable can help close the digital divide and make transformative learning opportunities available to all learners.**An adult learner with limited physical access to continuing education can upskill by taking advantage of online programs to earn new certifications and can accomplish these goals regardless of location.

Building Equal Experiences: Black Girls Code (bgc) Informs and Inspires

Introducing girls of color to technology at an early age is one key to unlocking opportunities that mostly have eluded this underserved group. BGC [http://www.blackgirlscode.com/], founded in 2001 by Kimberly Bryant, an electrical engineer, aims to "increase the number of women of color in the digital space by empowering girls of color to become innovators in STEM subjects, leaders in their communities, and builders of their own futures through exposure to computer science and technology."

Through a combination of workshops and field trips, BGC gives girls of color a chance to learn computer programming and connects them to role models in the technology space. BGC also hosts events and workshops across the country designed to help girls develop a wide range of other skills such as ideation, teamwork, and presenting while exploring social justice issues and engaging in creating solutions to those issues through technology. One example of such an event occurred at DeVry University where 100 girls between the ages of 7 and 17 learned how to build a webpage in a day. Tech industry volunteers led sessions in how to code using HTML, change the look and formatting of webpages using CCS, and design a basic Web structure. The girls developed webpages that integrated text, images, videos, and music, according to their interests and creativity. Toward the end of the day, participants presented their websites to cheering parents, volunteers, and other attendees. Between 10 and 12 similar events by BGC are held in Oakland each year.

BGC is headquartered in San Francisco, and BGC chapters are located in Chicago; Detroit; Memphis; New York; Oakland; Raleigh; and Washington, D.C., with more in development.

Creating for Accessibility: Hello Navi for the Visually Impaired

When Maggie Bolado, a teacher at Resaca Middle School in Los Fresnos, Texas, was approached about the unique challenge of helping a visually impaired student navigate the school's campus, she had not imagined the innovation that was about to happen. Bolado helped guide a group of seventh- and eighth-grade students to develop an app to navigate the school grounds called Hello Navi. Working mostly during extracurricular time, the students learned bracket coding via online tutorials that enabled them to develop the app. As they learned to program, they also were developing problem-solving skills and becoming more detail oriented.

When the app was made available for download, requests came in to tailor the app to the needs of other particular users, including one parent who wanted to know how to make it work for her two-year-old child. The students participated in a developers' forum to go through requests and questions on the app and problem-solve challenges and issues together. The students also interpreted various

data sets, tracking the number of times the app was downloaded and monitoring the number of total potential users, making possible an improved next iteration of the app.

The Future of Learning Technologies

Although these examples help provide understanding of the current state of educational technologies, it is also important to note the research being done on early stage educational technology and how this research might be applied more widely in the future to learning.

As part of their work in cyberlearning, the National Science Foundation (NSF) is researching opportunities offered by integrating emerging technologies with advances in the learning sciences. Following are examples of the projects being funded by the NSF as part of this effort:

Increased use of games and simulations to give students the experience of working together on a project without leaving their classrooms. Students are involved actively in a situation that feels urgent and must decide what to measure and how to analyze data in order to solve a challenging problem. Examples include RoomQuake, in which an entire classroom becomes a scaled-down simulation of an earthquake. As speakers play the sounds of an earthquake, the students can take readings on simulated seismographs at different locations in the room, inspect an emerging fault line, and stretch twine to identify the epicenter. Another example is Robot-Assisted Language Learning in Education (RALL-E), in which students learning Mandarin converse with a robot that exhibits a range of facial expressions and gestures, coupled with language dialogue software. Such robots will allow students to engage in a social role-playing experience with a new language without the usual anxieties of speaking a new language. The RALL-E also encourages cultural awareness while encouraging good use of language skills and building student confidence through practice.

New ways to connect physical and virtual interaction with learning technologies that bridge the tangible and the abstract. For example, the In Touch With Molecules project has students manipulate a physical ball-and-stick model of a molecule such as hemoglobin, while a camera senses the model and visualizes it with related scientific phenomena, such as the energy field around the molecule. Students' tangible engagement with a physical model is connected to more abstract, conceptual models, supporting students' growth of understanding. Toward a similar goal, elementary school students sketch pictures of mathematical situations by using a pen on a tablet surface with representational tools and freehand sketching, much as they would on paper. Unlike with paper, they easily copy, move, group, and transform their pictures and representations in ways that help them to express what they are learning about mathematics. These can be shared with the teacher, and, via artificial intelligence, the computer can help the teacher see patterns in the sketches and support the teacher's using student expression as a powerful instructional resource.

Interactive three-dimensional imaging software, such as zSpace, is creating potentially transformational learning experiences. With three-dimensional glasses and a stylus, students are able to work with a wide range of images from the layers of the earth to the human heart. The zSpace program's noble failure feature allows students constructing a motor or building a battery to make mistakes and retry, learning throughout the process. Although the content and curriculum are supplied, teachers can customize and tailor lesson plans to fit the needs of their classes. This type of versatile technology allows students to work with objects schools typically would not be able to afford, providing a richer, more engaging learning experience.

Augmented reality (AR) as a new way of investigating our context and history In the

Cyberlearning: Transforming Education EXP project, researchers are addressing how and for what purposes AR technologies can be used to support the learning of critical inquiry strategies and processes. The question is being explored in the context of history education and the Summarizing, Contextualizing, Inferring, Monitoring, and Corroborating (SCIM-C) framework developed for historical inquiry education. A combined hardware and software platform is being built to support SCIM-C pedagogy. Students use a mobile device with AR to augment their "field" experience at a local historical site. In addition to experiencing the site as it exists, AR technology allows students to view and experience the site from several social perspectives and to view its structure and uses across several time periods. Research focuses on the potential of AR technology in inquiry-based fieldwork for disciplines in which analysis of change across time is important to promote understanding of how very small changes across long periods of time may add up to very large changes.

E-rate: Source of Funding for Connectivity

The Schools and Libraries Universal Service Support Program, commonly known as E-rate, is a source of federal funding for Internet connectivity for U.S. schools and libraries. Created by Congress in 1996, E-rate provides schools and libraries with discounted Internet service based on need. The program was modernized in 2014 to allow schools to prioritize funding high-speed wireless connectivity in schools. For more information about E-rate, visit the website of the Federal Communications Commission (FCC) [https://edtechbooks.org/-nk].

Across these examples, we see that learning is not contained within screens or classrooms and that technology can enrich how students engage in the world around them.

To see additional examples of cyberlearning, visit The Center for Innovative Research in CyberLearning [https://edtechbooks.org/-tz].

Bringing Equity to Learning Through Technology

Closing the Digital Use Divide

Traditionally, the digital divide in education referred to schools and communities in which access to devices and Internet connectivity were either unavailable or unaffordable. Although there is still much work to be done, great progress has been made providing connectivity and device access. The modernization of the federal E-rate program has made billions of dollars available to provide high-speed wireless access in schools across the country.

However, we have to be cognizant of a new digital divide—the disparity between students who use technology to create, design, build, explore, and collaborate and those who simply use technology to consume media passively.

On its own, access to connectivity and devices does not guarantee access to engaging educational experiences or a quality education. Without thoughtful intervention and attention to the way technology is used for learning, the digital use divide could grow even as access to technology in schools increases.

Providing Technology Accessibility for All Learners

Learning experiences enabled by technology should be accessible for all learners, including those with special needs. Supports to make learning accessible 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 *universal design*, 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.

Three main principles drive application of universal design for learning (UDL):

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.

Digital learning tools can offer more flexibility and learning supports than can traditional formats. Using mobile devices, laptops, and networked systems, educators are better able to personalize and customize learning experiences to align with the needs of each student. They also can expand communication with mentors, peers, and colleagues through social media tools. Digital tools also can make it possible to modify content, such as raising or lowering the complexity level of a text or changing the presentation rate.

At a higher level of engagement, digital tools such as games, websites, and digital books can be designed to meet the needs of a range of learners, from novices to experts. Learners with little understanding might approach the experience first as a novice and then move up to an intermediate level as they gain more knowledge and skills. One example is McGill University's The Brain from Top to Bottom [http://thebrain.mcgill.ca/]. The site includes options to engage with the content as a beginner, intermediate, or advanced learner and adjusts the learning activities accordingly.

To help in the selection of appropriate universally designed products and tools, the National Center on Universal Design [http://www.udlcenter.org/] for Learning has developed a resource linking each guideline to information about digital supports that can help a teacher put UDL into practice.

Reaching All Learners: Tools for Udl

Developed with support from the U.S. Department of Education, the tools listed here were designed to help educators implement UDL principles into classroom practice and make learning activities more accessible:

- Nimble Assessment Systems developed Nimble Tools [https://edtechbooks.org/-HGp], to deliver standard versions of assessment instruments that are tailored with embedded accommodation tools to meet the specific needs of students with disabilities. Some examples of the accommodation tools include a keyboard with custom keyboard overlays, the capacity of the system to read text aloud for students, an on-screen avatar presenting questions in American Sign Language (ASL) or Signed English, and the magnification of text and images for students with visual impairments.
- The Information Research Corporation developed eTouchSciences [https://edtechbooks.org/-ote], an integrated software and hardware assistive technology platform to support STEM learning among middle school students with (or without) visual impairments. The product includes a haptic sensing controller device to provide real-time tactile, visual, and audio feedback. See video [https://edtechbooks.org/-crm].
- Filament Games developed the Game-enhanced Interactive Life Science [https://edtechbooks.org/-ipa]suite of learning games to introduce middle school students to key scientific concepts and practices in the life sciences. These games, aligned to UDL, provide students with multiple means of representation, expression, and engagement and provide assistive features such as in-game glossaries and optional voice-over for all in-game text. See video [https://edtechbooks.org/-oRw].
- Institute for Disabilities Research and Training developed the myASL Quizmaker [https://edtechbooks.org/-LA]to provide Web-based assessments for deaf or hard of hearing students who use ASL. This product provides automatic ASL graphic and video translations for students; enables teachers to create customized tests, exams, and quizzes that are scored automatically; and provides teacher reports with grades and corrected quizzes. See video [https://edtechbooks.org/-LwX].

Design in Practice: Indiana School District Adopts Udl for All Instruction for All Students

Bartholomew Consolidated School Corporation is a public school district in Columbus, Indiana, serving approximately 12,000 students. The student population consists of 13 percent in special education, 50 percent receive free or reduced-price lunch, and more than 54 languages are spoken. UDL has been helpful as a decision-making tool in the deployment of technologies such as computers and other networked devices. The UDL guidelines help educators determine what strategies, accessible technologies, and teaching methods will enable all students to achieve lesson goals.

In one instance, a social studies teacher held an online discussion during a presidential debate. Realizing that some students were not taking part in class discussions, the teacher used technology to provide multiple means of representation, expression, and engagement. Some students who were reluctant to speak up in a face-to-face setting felt safe to do so online, becoming engaged participants in the class discussion.

Since they adopted a universal design approach, graduation rates increased by 8 percent for general education students and 22 percent for special education students. Also, the number of students taking and passing Advanced Placement tests has increased.

Physical Spaces and Technology-enabled Learning

Blended learning and other models of learning enabled by technology require educators to rethink

how they organize physical spaces to facilitate best collaborative learning using digital tools. Considerations include the following:

- Are the design and layout of the physical space dynamic and flexible enough to facilitate the technology-enabled learning models and practices selected? Can a space in which an educator delivers whole-class instruction also be shifted to facilitate individual online practice and research?
- Do the physical spaces align in their ability to facilitate individual and collaborative work? When practices such as project-based learning require students to be working together with multiple devices for research and presentation building, is the space as useful as when individual learners need time and space to connect with information and experts online for personalized learning?
- Can the physical spaces and tools be shaped to provide multiple contexts and learning experiences such as Wi-Fi access for outdoor classrooms? Are library spaces able to become laboratories? Can a space used as a history lecture hall for one class become a maker space for engineering the next period?

For more information and tools for aligning physical spaces, visit the Centre for Effective Learning Environments [https://edtechbooks.org/-VS] and the Clayton Christensen Institute's Blended Learning Universe [https://edtechbooks.org/-NTP].

Innovation From the Ground Up: Denver School for Science and Technology (dsst) Uses Space to Promote Student Achievement

The DSST is an innovative high school located in Stapleton, Colorado, a redeveloped neighborhood near downtown Denver. Behind the bright colors and unique geometry of spaces at DSST lies a relationship to the way academic subjects are taught and community is formed at the high school. The school is designed to be flexible and aims to support student achievement through the design of its physical spaces.

The school features a series of gathering spaces that can be used for various academic and social purposes throughout the day. The largest of the gathering areas, near the school's entrance, is where the school's daily morning meeting for both students and faculty is held. Student and faculty announcements, skits, and other community functions are all encouraged in this communal setting.

Each of the three academic pods also includes informal spaces for gathering, studying, and socializing. These academic clusters are linked by a galleria, or large open hallway, that is lined with skylights and also serves as a gathering place for students and faculty members.

DSST has demonstrated results in the academic achievement of its students and in its attendance record. In 2005, the school's founding Grade 9 class was the highest scoring Grade 9 class in Denver in mathematics and the second highest scoring class in reading and writing. DSST was also the only Denver high school to earn a significant growth rating on the Colorado Student Assessment Program test scores from one year to the next. Student attendance at the school is typically about 96 percent.

Recommendations

States, districts, and post-secondary institutions should develop and implement learning

resources that embody the flexibility and power of technology to create equitable and accessible learning ecosystems that make learning possible everywhere and all the time for all students. Whether creating learning resources internally, drawing on collaborative networks, or using traditional procurement procedures, institutions should insist on the use of resources and the design of learning experiences that use UD practices to ensure accessibility and increased equity of learning opportunities.

States, districts, and post-secondary institutions should develop and implement learning resources that use technology to embody design principles from the learning sciences. Educational systems have access to cutting-edge learning sciences research. To make better use of the existing body of research literature, however, educators and researchers will need to work together to determine the most useful dissemination methods for easy incorporation and synthesis of research findings into teachers' instructional practices.

States, districts, and post-secondary institutions should take inventory of and align all learning technology resources to intended educational outcomes. Using this inventory, they should document all possible learner pathways to expertise, such as combinations of formal and informal learning, blended learning, and distance learning. Without thoughtful accounting of the available tools and resources within formal and informal learning spaces within a community, matching learners to high-quality pathways to expertise is left to chance. Such an undertaking will require increased capacity within organizations that have never considered such a mapping of educational pathways. To aid in these efforts, networks such as LRNG, the Hive Learning Networks, and education innovation clusters can serve as models for cross-stakeholder collaboration in the interest of best using existing resources to present learners with pathways to learning and expertise.

Education stakeholders should develop a born accessible standard of learning resource design to help educators select and evaluate learning resources for accessibility and equity of learning experience. Born accessible is a play on the term born digital and is used to convey the idea that materials that are born digital also can and should be born accessible. If producers adopt current industry standards for producing educational materials, materials will be accessible out of the box. Using the principles and research-base of UD and UDL, 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.

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Section 2: Teaching With Technology

Goal: Educators will be supported by technology that connects them to people, data, content, resources, expertise, and learning experiences that can empower and inspire them to provide more effective teaching for all learners.

Technology offers the opportunity for teachers to become more collaborative and extend learning beyond the classroom. Educators can create learning communities composed of students; fellow educators in schools, museums, libraries, and after-school programs; experts in various disciplines around the world; members of community organizations; and families. This enhanced collaboration, enabled by technology offers access to instructional materials as well as the resources and tools to create, manage, and assess their quality and usefulness.

To enact this vision, schools need to support teachers in accessing needed technology and in learning how to use it effectively. Although research indicates that teachers have the biggest impact on student learning out of all other school-level factors, we cannot expect individual educators to assume full responsibility for bringing technology-based learning experiences into schools. They need continuous, just-in-time support that includes professional development, mentors, and informal collaborations. In fact, more than two thirds of teachers say they would like more technology in their classrooms, and roughly half say that lack of training is one of the biggest barriers to incorporating technology into their teaching.

Institutions responsible for pre-service and in-service professional development for educators should focus explicitly on ensuring all educators are capable of selecting, evaluating, and using appropriate technologies and resources to create experiences that advance student engagement and learning. They also should pay special care to make certain that educators understand the privacy and security concerns associated with technology. This goal cannot be achieved without incorporating technology-based learning into the programs themselves.

For many teacher preparation institutions, state offices of education, and school districts, the transition to technology-enabled preparation and professional development will entail rethinking instructional approaches and techniques, tools, and the skills and expertise of educators who teach in these programs. This rethinking should be based on a deep understanding of the roles and practices of educators in environments in which learning is supported by technology.

Roles and Practices of Educators in Technology-supported Learning

Technology can empower educators to become co-learners with their students by building new experiences for deeper exploration of content. This enhanced learning experience embodies John Dewey’s notion of creating “more mature learners.” Side-by-side, students and teachers can become engineers of collaboration, designers of learning experiences, leaders, guides, and catalysts of change. Following are some descriptions of these educator roles and examples of how technology can play an integral part.

Authentic Learning

Authentic learning experiences are those that place learners in the context of real-world experiences

and challenges.

Educators can collaborate far beyond the walls of their schools. Through technology, educators are no longer restricted to collaborating only with other educators in their schools. They now can connect with other educators and experts across their communities or around the world to expand their perspectives and create opportunities for student learning. They can connect with community organizations specializing in real-world concerns to design learning experiences that allow students to explore local needs and priorities. All of these elements make classroom learning more relevant and authentic.

In addition, by using tools such as videoconferencing, online chats, and social media sites, educators, from large urban to small rural districts, can connect and collaborate with experts and peers from around the world to form online professional learning communities.

Building Communities for Educators: International Education and Resource Network (iearn) Fosters Global Collaborative Teaching and Learning

Through technology, educators can create global communities of practice that enable their students to collaborate with students around the world. Technology enables collaborative teaching regardless of geographic location, as demonstrated by the global nature of the Solar Cooking Project organized by earth and environmental science teacher Kathy Bosiak.

Bosiak teaches at Lincolnton High School in Lincolnton, North Carolina, and is a contributing educator for iEARN [http://www.iearn.org/], a nonprofit organization made up of more than 30,000 schools and youth organizations in more than 140 countries. iEARN offers technology-enabled resources that enable teachers and students around the world to collaborate on educational projects, all designed and facilitated by teachers and students to fit their curriculum, classroom needs, and schedules.

In addition to its student programs, iEARN offers professional face-to-face workshops for teachers that combine technology and continued engagement through virtual networks and online professional learning opportunities. The workshops focus on the skills needed to engage in Internet-based collaborative learning projects, including peer review, team building, joining regional and international learning communities, and developing project-based curricula that integrate national education standards.

Educators can design highly engaging and relevant learning experiences through technology. Educators have nearly limitless opportunities to select and apply technology in ways that connect with the interests of their students and achieve their learning goals. For example, a classroom teacher beginning a new unit on fractions might choose to have his students play a learning game such as Factor Samurai, Wuzzit Trouble, or Sushi Monster as a way to introduce the concept. Later, the teacher might direct students to practice the concept by using manipulatives so they can start to develop some grounded ideas about equivalence.

To create an engaging and relevant lesson that requires students to use content knowledge and critical thinking skills, an educator might ask students to solve a community problem by using technology. Students may create an online community forum, public presentation, or call to action related to their proposed solution. They can use social networking platforms to gather information and suggestions of resources from their contacts. Students can draft and present their work by using

animated presentation software or through multimedia formats such as videos and blogs. This work can be shared in virtual discussions with content experts and stored in online learning portfolios.

A school without access to science labs or equipment can use virtual simulations to offer learners those experiences that are currently unavailable because of limited resources. In addition, these simulations are safe places for students to learn and practice effective processes before they conduct research in the field. Just as technology can enhance science learning for schools lacking equipment, it can enable deep learning once students are in the field as well. Students can collect data for their own use via mobile devices and probes and sync their findings with those of collaborators and researchers anywhere in the world to create large, authentic data sets for study.

Educators can lead the evaluation and implementations of new technologies for learning. Lower price points for learning technologies make it easier for educators to pilot new technologies and approaches before attempting a school-wide adoption. These educators also can lead and model practices around evaluating new tools for privacy and security risks, as well as compliance with federal privacy regulations. (For more on these regulations, see Section 5: Infrastructure [https://edtechbooks.org/-vMe]). Teacher-leaders with a broad understanding of their own educational technology needs, as well as those of students and colleagues, can design short pilot studies that impact a small number of students to ensure the chosen technology and the implementation approach have the desired outcomes. This allows schools to gain experience with and confidence in these technologies before committing entire schools or districts to purchases and use.

Teacher-leaders and those with experience supporting learning with technology can work with administrators to determine how to share their learning with other teachers. They also can provide support to their peers by answering questions and modeling practical uses of technology to support learning.

Evaluating Technology Through Rapid-cycle Technology Evaluations

As schools continue to invest heavily in education technology, there is a pressing need to generate evidence about the effectiveness of these investments and also to develop evaluation tools that developers and practitioners can use to conduct their own evaluations that take less time and incur lower costs than do traditional evaluations. The U.S. Department of Education is funding a rapid cycle technology evaluation project that will design research approaches for evaluating apps, platforms, and tools; conduct pilots and disseminate the resulting short reports; and create an interactive guide and implementation support tools for conducting rapid cycle technology evaluations to be used by schools, districts, developers, and researchers.

Rapid cycle technology evaluations will help provide results in a timely manner so that evidence of effectiveness is available to school and district leaders when they need to make purchasing decisions.

Teach to Lead: Developing Teachers as Leaders

Teach to Lead [http://teachtolead.org/], a joint program of the National Board for Professional Teaching Standards, ASCD, and the U.S. Department of Education, aims to advance student outcomes by expanding opportunities for teacher leadership, particularly opportunities that allow teachers to stay in the classroom. With the help of supporting organizations, Teach to Lead provides a platform for teacher-leaders and allies across the country (and around the world) to create and expand on their ideas.

Teach to Lead participants are invested personally in the development of their teacher leadership action plans because the ideas are their own. Participants identify a current problem within their school, district, or community and develop a theory of action to solve that problem. Since its inception in March 2014, Teach to Lead has engaged more than 3,000 educators, in person and virtually through its online platform, with more than 850 teacher leadership ideas spanning 38 states. Teach to Lead regional Teacher Leadership Summits brought together teams of teacher-leaders and supporting organizations to strengthen their teacher leadership ideas, share resources, and develop the skills necessary to make their projects a reality.

Marcia Hudson and Serena Stock, teacher-leaders at Avondale Elementary School in Michigan, identified a need for teacher-led professional development at their school and created a module for teachers to collect and analyze student outcome data to drive new professional development opportunities. The teachers now are holding engagement meetings with teacher-leaders to develop and fund professional development and data collection further.

Chris Todd teaches at Windsor High School in Connecticut and is a Teacher-Leader-in-Residence for the Connecticut State Department of Education. Chris's team is developing the Connecticut Educator Network, a database of teacher-leaders who are readily available to advise on policy development. The group intends to provide training and policy briefings to continue to hone the teachers' leadership skills.

Educators can be guides, facilitators, and motivators of learners. The information available to educators through high-speed Internet means teachers do not have to be content experts across all possible subjects. By understanding how to help students access online information, engage in simulations of real-world events, and use technology to document their world, educators can help their students examine problems and think deeply about their learning. Using digital tools, they can help students create spaces to experiment, iterate, and take intellectual risks with all of the information they need at their fingertips. Teachers also can take advantage of these spaces for themselves as they navigate new understandings of teaching that move beyond a focus on what they teach to a much broader menu of how students can learn and show what they know.

Educators can help students make connections across subject areas and decide on the best tools for collecting and showcasing learning through activities such as contributing to online forums, producing webinars, or publishing their findings to relevant websites. These teachers can advise students on how to build an online learning portfolio to demonstrate their learning progression. Within these portfolios, students can catalog resources that they can review and share as they move into deeper and more complex thinking about a particular issue. With such portfolios, learners will be able to transition through their education careers with robust examples of their learning histories as well as evidence of what they know and are able to do. These become compelling records of achievement as they apply for entrance into career and technical education institutions, community colleges, and four-year colleges and universities or for employment.

Deepening Student Understanding: Using Interactive Video to Improve Learning

Reflective teachers can search for new ways for their students to engage with technology effectively, especially when students are not optimizing their learning experiences. Every year at Crocker Middle School, Ryan Carroll would ask his sixth-grade world history students to watch a variety of online videos for homework. He found that no matter how entertaining or interesting the videos were, his

students were not retaining much of the information being presented, and often they were confused about key concepts. After learning about Zaption [https://edtechbooks.org/-Vk], a teaching tool funded by the U.S. Department of Education, Carroll realized his students could get more out of the videos he assigned. Using Zaption's interactive video platform, he added images, text, drawings, and questions to clarify tricky concepts and check for understanding as students watched the video.

Zaption's analytics allow educators to review individual student responses and class-wide engagement data quickly, giving greater insight on how students are mastering key concepts as they watch and enabling teachers to address misconceptions quickly.

Educators can be co-learners with students and peers. The availability of technology-based learning tools gives educators a chance be co-learners alongside their students and peers. Although educators should not be expected to know everything there is to know in their disciplines, they should be expected to model how to leverage available tools to engage content with curiosity and a mindset bent on problem solving and how to be co-creators of knowledge. In short, teachers should be the students they hope to inspire in their classrooms.

Co-learning in the Classroom: Teacher User Groups Provide Peer Learning for Adult Education Educators

Recognizing the power of virtual peer learning, the U.S. Department of Education's Office of Career, Technical, and Adult Education has funded projects that have established teacher user groups to explore the introduction of openly licensed educational resources into adult education. This model of professional development recognizes that virtual peer learning can support teachers to change their practice and provide leadership and growth opportunities. The small groups of far-flung teachers work with a group moderator to identify, use, and review openly licensed resources in mathematics, science, and English language arts.

Reviews referenced the embedded evaluation criteria in OER Commons [https://www.oercommons.org/], a repository of open educational resources (OER) that can be used or reused freely at no cost and that align to the College- and Career-Readiness mathematics and language arts and Next Generation Science Standards. They also included practice tips for teaching the content to adult learners. The reviews are posted on OER Commons and tagged as *Adult Basic Education* or *Adult English for Speakers of Other Languages* to facilitate the discovery by other teachers of these high-quality, standards-aligned teaching and learning materials.

Learning Out Loud Online: Jennie Magiera, District Chief Technology Officer and Classroom Teacher

Planning a lesson on how elevation and other environmental influences affect the boiling point of water, Jennie Magiera realized that many of the students in her fourth-grade class in Cook County, Illinois, had never seen a mountain. So Magiera reached out to her network of fellow educators through social media to find a teacher in a mountainous area of the country interested in working with her on the lesson.

Soon, Magiera and a teacher in Denver were collaborating on a lesson plan. Using tablets and online videoconferencing, the students in Denver showed Magiera's students the mountains that they could see outside of their classrooms every day. After a discussion of elevation, the two teachers engaged their students in a competition to see which class could boil water faster. By interacting with students

in the other class, Magiera's students became engaged more deeply in the project, which led them to develop a richer understanding of ecosystems and environments than they might have otherwise.

Educators can become catalysts to serve the underserved. Technology provides a new opportunity for traditionally underserved populations to have equitable access to high-quality educational experiences. When connectivity and access are uneven, the digital divide in education is widened, undermining the positive aspects of learning with technology.

All students deserve equal access to (1) the Internet, high-quality content, and devices when they need them and (2) educators skilled at teaching in a technology-enabled learning environment. When this occurs, it increases the likelihood that learners have personalized learning experiences, choice in tools and activities, and access to adaptive assessments that identify their individual abilities, needs, and interests.

Connected Educators: Exemplars

Technology can transform learning when used by teachers who know how to create engaging and effective learning experiences for their students. In 2014, a group of educators collaborated on a report entitled, Teaching in the Connected Learning Classroom [https://edtechbooks.org/-Xt]. Not a how-to guide or a set of discrete tools, it draws together narratives from a group of educators within the National Writing Project who are working to implement and refine practices around technology-enabled learning. The goal was to rethink, iterate on, and assess how education can be made more relevant to today's youth.

Producing Student Films With Online Audiences: Katie Mckay: Lights, Camera, Social Action!

In Katie McKay's diverse, fourth-grade transitional bilingual class, encouraging her students to work together on a project helped them build literacy skills while simultaneously giving them the opportunity to pursue culturally relevant questions related to equity.

McKay recognized that her students were searching for the language to talk about complicated issues of race, gender, power, and equity. To address the competing priorities of preparing her students for the state test and providing them with authentic opportunities to develop as readers and writers, McKay started a project-based unit on the history of discrimination in the United States.

Students worked in heterogeneously mixed groups to develop comic strips that eventually were turned into two videos, one showing micro-aggressions students commonly see today and one about the history of discrimination in the United States. The movie on micro-aggressions portrayed current scenarios that included characters who acted as agents of change, bravely and respectfully defending the rights of others.

According to McKay, students who previously were disengaged found themselves drawn into the classroom community in meaningful and engaging ways. While reflecting on this unit, McKay wrote:

> *We were not only working to promote tolerance and appreciation for diversity in our community. We also were resisting an oppressive educational context. In the midst of the pressure to perform on tests that were isolating and divisive, we united in*

collaborative work that required critical thinking and troubleshooting. In a climate that valued silence, antiquated skills, and high-stakes testing, we engaged in peer-connected learning that highlighted 21st century skills and made an impact on our community.

Just-in-time Learning: Janelle Bence: How Do I Teach What I Do Not Know?

Texas teacher Janelle Bence was looking for new ways to engage and challenge her students, the majority of whom are English language learners from low-income families. After observing her students' motivation to persist through game challenges, she wondered if games held a key to getting them similarly engaged in classwork. After attending a session on gaming at a National Writing Project Annual Meeting, Bence was inspired to incorporate gaming into her classroom. She did not know anything about gaming and so, as is the case for many teachers seeking to bridge the gap between students' social interests and academic subjects, she had to figure out how to teach what she did not know.

Bence started by reading a book about using video games to teach literacy. As she read, she shared her ideas and questions on her blog and talked to other educators, game designers, and systems thinkers. Through these collaborations, she decided that by creating games, her students would be required to become informed experts in the content of the game as well as to become powerful storytellers.

As she explored games as a way to make academic tasks more engaging and accessible for her students, Bence found it was important to take advantage of professional learning and peer networks, take risks by moving from a passive consumer of knowledge to actually trying the tasks that she planned to use with students, and put herself in her students' shoes.

Bence shared that "finding a way to connect to students and their passions—by investigating what makes them tick and bridging [those passions] to academic tasks—educators are modeling risks that encourage the same behavior in their learners."

Building Student Agency: Jason Sellers: Text-based Video Games

Aware of the popularity of video games among his students, and as a longtime fan of video games himself, teacher Jason Sellers decided to use gaming to develop his 10th-grade students' ability to use descriptive imagery in their writing. Specifically, Sellers introduced his students to text-based video games. Unlike graphics-based games in which users can view graphics and maneuver through the game by using controller buttons, text-based games require players to read descriptions and maneuver by typing commands such as go north or unlock the door with a key. Sellers decided his students could practice using descriptive imagery by developing their own text-based games.

Using tutorials and other resources found on Playfic, an interactive fiction online community, Sellers created lessons that allowed students to play and eventually create interactive fiction games. Prior to the creation of the games, Sellers's class analyzed several essays that skillfully used descriptive imagery, such as David Foster Wallace's *A Ticket to the Fair*, and composed short pieces of descriptive writing about their favorite locations in San Francisco.

Students then transferred their newly honed descriptive storytelling skills to the development of an entertaining text-based game. Because Sellers's students wanted to develop games their peers would

want to play, they focused on ways to make their games more appealing, including, as Sellers described, “using familiar settings (local or popular culture), familiar characters (fellow students or popular culture), and tricky puzzles.”

According to Sellers, this project allowed students to work through problems collaboratively with peers from their classroom and the Playfic online community and motivated them to move beyond basic requirements to create projects worthy of entering competitions.

Rethinking Teacher Preparation

Teachers need to leave their teacher preparation programs with a solid understanding of how to use technology to support learning. Effective use of technology is not an optional add-on or a skill that we simply can expect teachers to pick up once they get into the classroom. Teachers need to know how to use technology to realize each state’s learning standards from day one. Most states have adopted and are implementing college- and career-ready standards to ensure that their students graduate high school with the knowledge and skills necessary to succeed.

For states that have voluntarily adopted the Common Core State Standards [http://www.corestandards.org/], there are more than 100 direct mentions of technology expectations, and similar expectations exist in states adopting other college- and career-ready standards. Many federal, state, and district leaders have made significant investments in providing infrastructure and devices to schools. Without a well-prepared and empowered teaching force, our country will not experience the full benefits of those investments for transformative learning.

Schools should be able to rely on teacher preparation programs to ensure that new teachers come to them prepared to use technology in meaningful ways. No new teacher exiting a preparation program should require remediation by his or her hiring school or district. Instead, every new teacher should be prepared to model how to select and use the most appropriate apps and tools to support learning and evaluate these tools against basic privacy and security standards. It is inaccurate to assume that because pre-service teachers are tech savvy in their personal lives they will understand how to use technology effectively to support learning without specific training and practice. This expertise does not come through the completion of one educational technology course separate from other methods courses but through the inclusion of experiences with educational technology in all courses modeled by the faculty in teacher preparation programs.

Aligning Education With Technology Standards: University of Michigan

Pre-service teachers at the University of Michigan School of Education are experiencing the kind of learning with technology their students will one day know. The curriculum addresses each of the five ISTE Standards for Teachers [https://edtechbooks.org/-QMb]21 and aligns with skills from the Partnership for 21st Century Skills. Each standard also has related course projects designed for teacher candidates to use technology actively to demonstrate their understanding of the material through practice and feedback. For example, teacher candidates are asked to design and teach a 20-minute webinar for fourth graders that is based on Next Generation Science Standards and to design and teach a lesson that uses technology and meets the needs of their learners as part of their student teaching placement.

Preparing to Teach in Technology-enabled Environments: Saint Leo University

A 2006 survey of Saint Leo University teacher preparation program alumni showed satisfaction with their preparation with one notable exception—technology in the classroom. As a result, the education department established a long-term goal of making technology innovation a keystone of its program. Saint Leo faculty redesigned their program on the basis of the Technological Pedagogical and Content Knowledge model, in which pre-service teachers learned to blend content, pedagogical, and technological knowledge in their PK–12 instruction.

Faculty developed their expertise with different technologies so that every course models the use of technology to support teaching and learning. The school built an education technology lab where teacher candidates can practice using devices, apps, and other digital learning resources. Students regularly reflect on their experience using technology to increase effectiveness and efficiency as well as its value in the learning process.

Perhaps most notably, Saint Leo ensures all pre-service teachers have basic technologies available at their student teaching placements. Each pre-service teacher is given a digital backpack with a tablet, portable projector, speakers, and a portable interactive whiteboard. A student response system is also available for pre-service teachers to use in their field placements.

Advancing Knowledge and Practice of Assistive Technologies for New Teachers: Illinois State University

Illinois State University's Department of Special Education is one of the largest special education training programs in the nation. Recognizing the value of assistive technology in meeting the needs of each student, the special education teacher preparation program at the University includes an extensive emphasis on selection and use of assistive technologies.

Classroom learning is brought to life through ongoing clinical and field-based experiences in schools and at the university's Special Education Assistive Technology Center. The center provides hands-on experiences to pre-service teachers enrolled in the special education programs at Illinois as well as opportunities for teachers, school administrators, family members, and businesses to learn about assistive technologies. Furthermore, faculty work in partnership with a variety of public, private, and residential schools to enhance student field experiences and provide opportunities for students to work with learners with a range of disabilities and in a variety of settings, including rural, urban, and suburban areas.

Building Digital Literacy in Teaching: University of Rhode Island (uri)

A critical aspect of ensuring that young Americans learn appropriate digital literacy skills is equipping educators at all levels with the same skills. To that end, URI offers a graduate certificate in digital literacy [https://edtechbooks.org/-mK] for graduate students, classroom teachers, librarians, and college faculty. By targeting a broad audience to participate in the program, URI is expanding the number of educators with the professional capacity to help students to learn, access, analyze, create, reflect, and take action using digital tools, texts, and technologies in all aspects of their lives.

During the program, students are introduced to key theories of digital literacy in inquiry-driven learning and given time to experiment with and explore a wide range of digital texts, tools, and technologies. In collaboration with a partner, they create a project-based instructional unit that

enables them to demonstrate their digital skills in the context of an authentic learning situation. Throughout the program, students participate in hands-on, minds-on learning experiences; participants build a deeper understanding of digital literacy while developing practical skills and have time to reflect on the implications of the digital shift in education, leisure, citizenship, and society.

In its evaluation of the program, URI has found that participants experienced a dramatic increase in digital skills associated with implementing project-based learning with digital media and technology. Their understanding of digital literacy also shifted to focus more on inquiry, collaboration, and creativity.

Fostering Ongoing Professional Learning

The same imperatives for teacher preparation apply to ongoing professional learning. Professional learning and development programs should transition to support and develop educators' identities as fluent users of technology; creative and collaborative problem solvers; and adaptive, socially aware experts throughout their careers. Programs also should address challenges when it comes to using technology learning: ongoing professional development should be job embedded and available just in time.

Increasing Online Professional Learning: Connected Educator Month Builds Collaboration Across the Country

Connected Educator Month, part of the U.S. Department of Education's Connected Educators project, began with a monthlong online conference that included a centralized guiding structure, kickoff and closing events, engagement resources, and an open calendar to which organizations of all types could submit professional learning events and activities. Educators used these resources and the calendar to create their own professional development plan for the month. Available activities included webinars, Twitter chats, forum discussions, and actively moderated blog discussions based on personal learning needs and interests.

In the first year, more than 170 organizations provided more than 450 events and activities, with educators completing an estimated 90,000 hours of professional learning across the month. More than 4 million people followed the #ce12 hashtag on Twitter, generating 1.4 million impressions per day.

Now led by partner organizations from the original Connected Educators project—American Institutes for Research (AIR), Grunwald Associates LLC, and Powerful Learning Practice—Connected Educator Month features more than 800 organizations and has provided more than 1,000 events and activities. Australia, New Zealand, and Norway hosted their own iterations of Connected Educator Month, and educators in more than 125 countries participated in some way.

Putting Learning in Teachers' Hands: Denver Public Schools Personalizes Professional Development

In 2014, 80 teachers from 45 schools engaged in the pilot year of Project Cam Opener, an initiative of the Personalized Professional Learning team in Denver Public Schools. Now in its second year with 425 teachers and leaders, Project Cam Opener allows educators to record their teaching with customized video toolkits and share those videos for self-reflection and feedback within an online

community of practice.

In the program's pilot year, the first 80 teachers recorded hundreds of videos using tools such as Swivls, iPads, high-definition webcams, and microphones. The videos were uploaded to private YouTube channels and shared via a Google+ community for feedback. For many of these teachers, it was the first time that they had seen the teaching practices of other teachers in their district. The videos sparked daily conversations and sharing of ideas.

Three measures are used to determine the effectiveness of Project Cam Opener: engagement, retention, and observation. In the first end-of-year survey, 90 percent of respondents said that taking part in Project Cam Opener made them more engaged in their own professional learning and growth. In addition, not a single teacher from the pilot group left Denver Public Schools after their year with Project Cam Opener (the overall district rate of turnover is 20 percent). Although teacher observation scores are harder to attribute to this project specifically, the growth of this cohort of teachers outpaced that of their non–Project Cam Opener counterparts, according to the district's Framework for Effective Teaching.

Micro-credentialing Teacher Learning: Kettle Moraine Introduces Teacher-led Professional Learning

Kettle Moraine School District in Wisconsin is creating a professional learning environment in which practicing teachers can be the masters and architects of their own learning. Using the Digital Promise educator micro-credentialing framework as a guide (for more information on Digital Promise's micro-credentialing work, see Section 4: Leadership [https://edtechbooks.org/-vMe]), teachers in the district take a technology proficiency self-assessment, which they use as a baseline for their personal professional growth. The teachers then work by themselves and in collaborative teams to develop specific professional learning goals aligned to district strategic goals, which they submit to district leadership for approval.

Once these goals are approved, the teachers establish measurable benchmarks against which they can assess their progress. Both the goals and benchmarks are mapped to specific competencies, which, in turn, are tied to micro-credentials that can be earned once teachers have demonstrated mastery. Demonstrations of mastery include specific samples of their work, personal reflections, classroom artifacts, and student work and reflections, which are submitted via Google Forms to a committee of 7 to 10 teachers who review them and award micro-credentials.

Currently, 49 staff members are working to earn a micro-credential for personalized learning, which requires them to conduct their own background research and engage in regularly scheduled Twitter chats as well as blogging, networking, and other forms of self-guided learning using technology. Many also have begun to engage with teachers across the country, allowing them to give and receive ideas, resources, and support.

Embracing the Unconference: Going to Edcamp

An educator attending an Edcamp [http://www.edcamp.org/] event engages in a professional learning experience vastly different from traditional professional development. Sessions are built on the interests and needs of the people who attend and are created on the day by using a cloud-based collaborative application that is open to all (including those unable to participate in person). Each teacher chooses which sessions to attend on the basis of individual interests or needs.

Because using technology in learning effectively is one of the challenges facing teachers, sessions frequently are organized around sharing practices and overcoming common challenges when improving practices around the use of technology. Teachers collaborate to overcome challenges together, often making connections that lead beyond the single session or day, as partnerships are formed to engage their students with each other. The shared documents created at these events become an archive and resource for whoever attended, in person or virtually.

The first Edcamp was organized in Philadelphia by a group of local educators interested in new unconference (self-organizing) approaches to a conference for professional learning. The model took off, and five years later there have been more than 750 Edcamps all organized by local educators. The enormous popularity of the format has led to the formation of the Edcamp Foundation, a nonprofit organization that will formalize much of the ad hoc support that has been provided to Edcamp organizers until now.

Recommendations

Provide pre-service and in-service educators with professional learning experiences powered by technology to increase their digital literacy and enable them to create compelling learning activities that improve learning and teaching, assessment, and instructional practices. To make this goal a reality, teacher preparation programs, school systems, state and local policymakers, and educators should come together in the interest of designing pre- and in-service professional learning opportunities that are aligned specifically with technology expectations outlined within state standards and that are reflective of the increased connectivity of and access to devices in schools. Technology should not be separate from content area learning but used to transform and expand pre- and in-service learning as an integral part of teacher learning.

Use technology to provide all learners with online access to effective teaching and better learning opportunities with options in places where they are not otherwise available. This goal will require leveraging partner organizations and building institutional and teacher capacity to take advantage of free and openly licensed educational content such as that indexed on LearningRegistry.org [http://learningregistry.org/]. Adequate connectivity will increase equitable access to resources, instruction, expertise, and learning pathways regardless of learners' geography, socio-economic status, or other factors that historically may have put them at an educational disadvantage.

Develop a teaching force skilled in online and blended instruction. Our education system continues to see a marked increase in online learning opportunities and blended learning models in traditional schools. To meet the need this represents better, institutions of higher education, school districts, classroom educators, and researchers need to come together to ensure practitioners have access to current information regarding research-supported practices and an understanding of the best use of emerging online technologies to support learning in online and blended spaces.

Develop a common set of technology competency expectations for university professors and candidates exiting teacher preparation programs for teaching in technologically enabled schools and post-secondary education institutions. There should be no uncertainty of whether a learner entering a PK–12 classroom or college lecture hall will encounter a teacher or instructor fully capable of taking advantage of technology to transform learning. Accrediting institutions, advocacy organizations, state policymakers, administrators, and educators have to collaborate on a set of clear

and common expectations and credentialing regarding educators' abilities to design and implement technology-enabled learning environments effectively.

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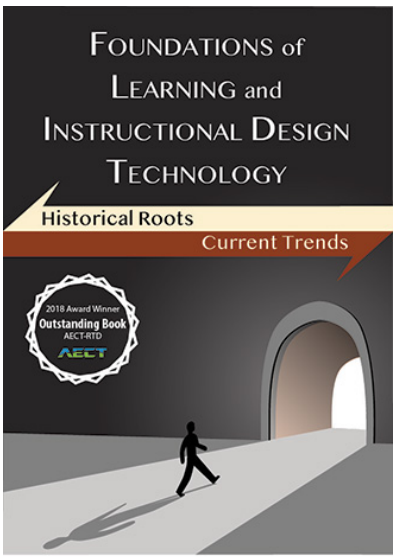

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