NMC **Horizon Project**

NMC Horizon Project Short List
2012 Higher Education Edition

NMC Horizon Project Short List: 2012 Higher Education Edition

Time-to-Adoption: One Year or Less

Cloud Computing

Cloud computing first appeared on the near-term horizon in the *NMC Horizon Report: 2009 Higher Education Edition*. Since then, its use for supporting collaboration, file storage, and access to computing cycles, and the number of available applications that rely on cloud technologies have grown tremendously. Cloud computing has become the unifying factor among content and applications on the many devices people use in everyday life. Whether connecting at home, work, school, on the road, or in social spaces, nearly everyone who uses computers relies on cloud computing to access their information and applications. This ability to access services and files from any location and on any device is driving development of cloud computing applications in the consumer space.

Relevance for Teaching, Learning, or Creative Inquiry

- Dynamic provisioning services offered by cloud providers like Amazon's S3 have transformed how we add storage and processing power, and scale resources.

- Cloud computing is being used in computer science programs to simulate virtually any computer, from historical machines to super computers.

- Cloud-based services include a wide range of increasingly powerful tools for almost any platform a user might choose, or any task a user might need to do.

Cloud Computing in Practice

- Northwestern University is using the cloud to host a virtual laboratory in which students can run experiments online with real equipment and tools: http://www.ilabcentral.org/.

- The University of Melbourne's CLOUDS Laboratory is developing the next generation of cloud computing systems: http://www.eng.unimelb.edu.au/research/centres/cloud/.

- This project from MIT's Climate Modeling Initiative looks at ways to use cloud computing resources to perform scientific research in university labs:
  http://www-paoc.mit.edu/cmi/technologies/cloudcomputing.htm.

For Further Reading

Cloud Computing and the Power to Choose
http://www.educause.edu/EDUCAUSE+Review/EDUCAUSEReviewMagazineVolume45/CloudComputingandthePowertoCho/205498
> (Rob Bristow, Ted Dodds, Richard Northam, and Leo Plugge. *EDUCAUSE Review*, May/June 2010.) This article discusses how cloud computing helps scale learning resources, citing that over 75% of New Zealand universities have moved their email service to the cloud.

Making the Business Case for the Cloud
http://campustechnology.com/articles/2011/11/30/making-the-business-case-for-the-cloud.aspx
> (David Raths, Rama Ramaswami, and Dian Schaffhauser, *Campus Technology*, 30 November 2011.) This article explores how university and college CTOs and CIOs can build cases for transitioning their current technology infrastructure onto the cloud, including a decrease in general IT costs.

Personal Cloud Will Replace Traditional Operating Systems
http://www.computerweekly.com/news/1280097124/Personal-cloud-will-replace-traditional-operating-systems-says-analyst
> (Cliff Saran, Computer Weekly.com, 17 May 2010.) This writer discusses the view of Forrester Research analyst Frank Gillett who believes the traditional OS will eventually disappear and be replaced by an increasingly sophisticated personal cloud.

Mobile Apps

Mobile phones — distinct from new sorts of larger format mobile devices such as tablets — have as a category proven more interesting and more capable with each passing year. According to a report from mobile manufacturer Ericsson, by 2015 80% of people accessing the Internet worldwide will be doing so from a mobile device. At the 2011 Mobile World Congress, Google CEO Eric Schmidt noted that for every baby born that year, 30 Android phones would be activated. Mobiles are becoming better understood in the academic world; there has been a significant amount of time spent finding creative ways to incorporate them both in the physical space and as a tool to help students learn from a distance. As educational institutions become more adept at developing and using mobile apps, their utility and pervasiveness is only due to increase. Current examples of mobile apps span functions from interpretation and education to campus service directories to specialized apps tied to specific courses.

Relevance for Teaching, Learning, or Creative Inquiry

- As interactive and social features become more integrated into mobile apps, learners can share their findings on topics, making the app an ever-growing repository of information.
- Many disciplines now have mobile apps dedicated to deeper exploration of specific subjects, from the periodic table to art movements.
- Mobile apps facilitate content creation, through the use of cameras, microphones, and other sensors and tools that are inherent in many smartphones.

Mobile Apps in Practice

- CampusM aggregates university services into one free mobile app so that students can easily access time and location-sensitive information.: http://www.ombiel.com/campusm.html.
- Ohio State University's mobile app allows students to view their course grades and schedules in real-time: http://osu.edu/osumobile/.
- Princeton University's free iPrinceton app enables users to catch up on athletic and academic news, browse a full library catalog, and connect to the university's social media pages: http://mobile.princeton.edu/.

For Further Reading

7 Things You Should Know about Mobile App Development

http://www.educause.edu/Resources/7ThingsYouShouldKnowAboutMobil/227508

(EDUCAUSE, 19 April 2011.) This guide provides higher education institutions with helpful information to take into consideration when building an app, including accessibility standards and enterprise system integration opportunities.

Campus Computing Survey: Mobile Apps Grow, Cloud Adoption Slow

http://campustechnology.com/articles/2011/10/20/campus-computing-survey-mobile-apps-grow-cloud-adoption-slow.aspx

(David Raths, *Campus Technology*, 20 October 2011.) A recent study by Campus Computing Project revealed that over 55% of public universities have their own mobile apps.

Can the iPhone Save Higher Education?

http://www.networkworld.com/news/2010/032310-iphone-higher-education.html

(John Cox, *NetworkWorld*, 23 March 2010.) This article explores how the iPhone and the growing list of educational apps are impacting teaching and learning at universities.

Social Reading

Social reading is a relatively new phenomenon emerging at the intersection of electronic books and social networking. When e-books began to take hold in the consumer sector over the past two years, the devices and content were constrained with digital rights management that effectively made sharing content impossible. Some publishers, along with a mix of start-ups, saw another way, and began to find ways to enhance content to make it more interactive, to mirror the qualities of a print publication — and to make aspects of the experience sharable. Today a variety of websites and e-reading tools allow users to annotate their e-books, highlight passages, bookmark — and notably — share sections with friends via email, Facebook and Twitter. Several of the new services allow users to store their entire reading experience on any device they want by syncing their tablet or dedicated e-Reader with a social reading service, such as Amazon or Float. These services can record actions taken by the reader and ultimately create for them a personal virtual bookshelf. People who are subscribed to the service are able to share their e-books and comments with each other, as well as people within their social networks.

Editor's Note: Although the advisory board placed social reading on the near-term adoption horizon, that choice is hard to support based on what we have found. The concepts behind making reading a more social experience appear to still be very new and not well defined.

Relevance for Teaching, Learning, or Creative Inquiry

- While there are many interesting social reading products and services in the marketplace, our research was not able to uncover well-documented uses in any sector of education.
- Many social reading services provide users with the option of reading the same e-book across multiple devices, so they can easily switch between computer, tablet, and smartphone. This would be a benefit to readers of academic works.
- Social reading tools could be used to allow study groups to easily exchange notes on electronic books they are reading in their classes, and spur meaningful virtual discussions.

Social Reading in Practice

- Amazon's @author service allows readers to ask the authors questions directly from their Kindles and post questions question to the author's Twitter account: http://www.amazon.com/exec/obidos/tg/feature/-/1000714331/.
- Book Glutton enables users to create virtual reading groups, and attach comments or interactive alerts on pages of digital content: http://www.bookglutton.com/.

For Further Reading

The Meaning of Social Reading and Where It's Headed
http://frontmatters.com/2011/12/01/the-meaning-of-social-reading-and-where-its-headed/
> (Book Glutton, Front Matters: On the Future of Web Publishing, 1 December 2011.) Founders of the social reading platform BookGlutton discuss the recent surge in online conversation around e-books and the "networked knowledge layer" that will be woven into digital content.

Turning Static Text Into Interactive Discussions
http://mindshift.kqed.org/2011/08/turning-static-text-into-interactive-discussions/
> (Audrey Watters, *KQED Mind Shift*, 4 August 2011.) The author explores a company called Highlighter, which enables readers to annotate and share passages and comments from digital content with other users. A professor at the University of Colorado used Highlighter for a Biofundamentals course and observed increased student engagement.

Tablet Computing

In the past year, advances in tablet computers have captured the imagination of educators and museum professionals around the world. Led by the incredible success of the iPad, which in 2011 was selling at the rate of more than 3 million units a month, other similar devices such as the Samsung Galaxy and Sony's Tablet S, have also begun to enter this rapidly growing new market. In the process, tablets (a form that is distinct from tablet PCs) have come to be viewed as not just a new category of mobile devices, but indeed a new technology in its own right, one that blends features of laptops, smart phones, and earlier tablet computers with always-connected Internet, and thousands of apps with which to personalize the experience. As these new devices have become more used and understood, it is clear that they are independent and distinct from other mobile devices such as smart phones, eReaders, or tablet PCs. With significantly larger screens and richer gestured-based interfaces than their smartphone predecessors, they are ideal tools for sharing content, videos, images, and presentations because they are easy for anyone to use, visually compelling, and highly portable.

Relevance for Teaching, Learning, or Creative Inquiry

- Tablets are easily adaptable to almost any learning environment, with tens of thousands of educational applications emerging as part of a new software distribution model.
- As a one-to-one solution, tablets present an economic, flexible alternative to laptops and desktops due to their lower cost, greater portability, and access to apps.
- Tablets are conducive to engaging in learning outside the classroom, with a suite of tools for capturing data in real-time and collaborating on projects.

Tablet Computing in Practice

- Abilene Christian University business students studying in Oxford are using iPads to deploy research plans, present product concepts, and conduct market research: http://www.acu.edu/news/2010/100611_iPadinOxford.html.
- Science students at the University of Adelaide were given iPads in place of the standard set of textbooks: http://www.adelaidenow.com.au/news/ipad-replaces-uni-textbooks-at-university-of-adelaide-science-faculty/story-fn5jhv6y-1225918213032.
- In partnership with Apple, the Zimbabwe government is bringing solar-powered iPads to rural institutions across the country: http://tabtimes.com/news/education/2011/10/27/zimbabwe-wants-take-solar-powered-ipads-rural-schools.

For Further Reading

6 Reasons Tablets are Ready for the Classroom
http://mashable.com/2011/05/16/tablets-education/
> (Vineet Madan, *Mashable*, 16 May 2011.) This article explores the applications of tablets in higher education institutions, citing that they fit with students' current lifestyles.

The B-School Case Study Gets a Digital Makeover
http://www.businessweek.com/business-schools/the-bschool-case-study-gets-a-digital-makeover-07252011.html
> (Erin Zlomek, *Bloomberg Business Week*, 25 July 2011.) This article shows how traditional business school case studies are being transformed with the advent of tablets.

Math That Moves: Schools Embrace the iPad
http://www.nytimes.com/2011/01/05/education/05tablets.html?pagewanted=all
> (Winnie Hu, *The New York Times*, 4 January 2011.) The iPad is being used to expand learning outside of the classroom, and this article addresses its impact.

Time-to-Adoption: Two to Three Years

Adaptive Learning Environments

Adaptive learning environments (ALEs) are seen as the next logical step in the continuum that begins with personal learning environments by first incorporating data from learning analytics, and then using software to modify the learning environment as needed. While personal learning environments are seen by many as primarily a way of organizing tools, content, examples, and concepts to support self-directed and group-based learning, adaptive learning environments are envisioned as responsive, allowing the tools, content, examples, and concepts to be modified in real-time based on how the students are actually learning. The term itself was coined in 1998, but 14 years hence, adaptive learning environments still remain more of a vision than a reality.

The topic has resurfaced recently as a potential application for learning analytics, but work that bridges the two concepts is hard to locate, and the editors were unable to locate any prototypes or examples in which this idea is being explored.

Relevance for Teaching, Learning, or Creative Inquiry

- Adaptive learning environments may cater to students with differing learning styles.
- ALEs enable modifications to learning environments based on how each student is performing, catering to their specific learning needs.
- As ALEs become more in tune with various learners' needs, educators can use the data to develop new courses and new materials that cater to different learning styles.
- Ongoing online courses can be changed in real-time with little manual, time-consuming intervention.

Adaptive Learning Environments in Practice

- Carnegie Mellon University's Open Learning Initiative offers adaptive learning courses in a dozen subjects, including statistics: https://oli.web.cmu.edu/openlearning/initiative.
- Under the HP Catalyst Initiative, Amrita University in India is designing an adaptive learning environment that provides real-time evaluations to students so that they can concentrate more on the skills they need to master (video): http://youtu.be/ITlUrf1EVNs.

For Further Reading

Adaptive Learning Technology: An Introduction
http://www.onlinecollege.org/2011/08/30/adaptive-learning-technology-an-introduction/
> (Melissa Venable, OnlineCollege.org, 30 August 2011.) This article explains how adaptive learning works, highlights the instructional strategies behind it, and provides current examples of its use in higher education.

Big Data and the Promise of Personalized Learning
http://www.insidehighered.com/blogs/hack-higher-education/pearson-and-knewton-big-data-and-promise-personalized-learning - ixzz1fmqThyAR
> (Audrey Watters, *Inside Higher Ed*, 1 November 2011.) Knewton and Pearson are teaming up around adaptive learning platforms. with the view that more research in student data and learning analytics will allow professors to glean insight into the learning progress of each student, and intervene in real-time.

Seeing the Whole Picture with Vantage Learning
http://edtechdigest.wordpress.com/2011/10/27/interview-seeing-the-whole-picture-with-vantage-learning/
> (Victor Rivero, *EdTech Digest*, 27 October 2011.) This interview with John P. Fallon, VP, Global Marketing at Vantage Technologies addresses new adaptive learning platforms, and their integration into the current education setting.

Augmented Reality

Augmented reality (AR), a capability that has been around for decades, is shifting from what was once seen as a gimmick to a tool with tremendous potential. The layering of information over 3D space produces a new experience of the world, sometimes referred to as "blended reality," and is fueling the broader migration of computing from the desktop to the mobile device, bringing with it new expectations regarding access to information and new opportunities for learning. While the most prevalent uses of augmented reality so far have been in the consumer sector (for marketing, social engagement, amusement, or location-based information), new uses seem to emerge almost daily, as tools for creating new applications become even easier to use. A key characteristic of augmented reality is its ability to respond to user input. This interactivity confers significant potential for learning and assessment; students can construct new understanding based on interactions with virtual objects that bring underlying data to life. Dynamic processes, extensive datasets, and objects too large or too small to be manipulated can be brought into a student's learning space at a scale and in a form easy to understand and manipulate.

Relevance for Teaching, Learning, or Creative Inquiry

- Augmented reality has strong potential to provide both powerful contextual, *in situ* learning experiences and serendipitous exploration and discovery of the connected nature of information in the real world.
- Students visiting historic sites can access AR applications that overlay maps and information about how the location looked at different points of history.
- Games that are based in the real world and augmented with networked data can give educators powerful new ways to show relationships and connections.

Augmented Reality in Practice

- At Georgia Tech, computer programmers are developing games that enable users to visualize car repairs by looking at a car engine through their smartphones:
  http://www.npr.org/templates/story/story.php?storyId=125588087.
- The MoonWalking app transforms users' surroundings into the site of the first Apollo moon landing:
  http://itunes.apple.com/us/app/moonwalking/id434074320.
- The University of Canterbury and HITLabNZ are exploring how mobile augmented reality can reveal data sets that would be helpful in the reconstruction of a demolished building:
  http://www.hitlabnz.org/index.php/research/augmented-reality?view=project&task=show&id=24.

For Further Reading

Augmented Reality for Chemists (video)
http://youtu.be/gZxK6j4JTHQ
> (Art Olson, Chemical & Engineering News, 19 September 2011.) This video shows how augmented reality is built, using a webcam to track all the motions of a 3D chemical model.

Using Augmented Reality as a Medium to Assist Teaching in Higher Education
http://coventry.academia.edu/FotisLiarokapis/Papers/922181/Using_Augmented_Reality_as_a_Medium_to_Assist_Teaching_in_Higher_Education
> (Eike Falk Anderson and Fotis Liarokapis, Coventry University, May 2010.) This paper explores the use of augmented reality to construct collaborative education applications.

Game-Based Learning

Game-based learning has gained considerable traction since 2003, when James Gee began to describe the impact of game play on cognitive development. Since then, research — and interest in — the potential of gaming on learning has exploded, as has the diversity of games themselves, with the emergence of serious games as a genre, the proliferation of gaming platforms, and the evolution of games on mobile devices. Developers and researchers are working in every area of game-based learning, including games that are goal-oriented; social game environments; non-digital games that are easy to construct and play; games developed expressly for education; and commercial games that lend themselves to refining team and group skills. Role-playing, collaborative problem solving, and other forms of simulated experiences are recognized for having broad applicability across a wide range of disciplines.

Relevance for Teaching, Learning, or Creative Inquiry

- Educational games offer opportunities for both discovery-based and goal-oriented learning, and can be very effective ways to develop teambuilding skills.
- Simulations and role-playing games allow students to re-enact difficult situations to try new responses or pose creative solutions.
- Educational games can be used to teach cross-curricular concepts that touch on many subjects in an engaging way.

Game-Based Learning in Practice

- 3D GameLab is a learning platform that helps teachers tie innovative, quest-based learning activities to standards: http://3dgamelab.org.shivtr.com/.
- EVOKE is a social networking game that simulates real global issues to empower people to find new and innovative solutions: http://www.urgentevoke.com/.
- *Ikariam* is a browser-based game simulating life in ancient civilizations, where players learn about economics and social studies by building up the economy and caring for the residents on virtual islands: http://en.ikariam.com/.

For Further Reading

5 Teaching Tips for Professors — From Video Games

http://chronicle.com/article/5-Lessons-Professors-Can-Learn/63708/

(Jeffrey R. Young, *The Chronicle of Higher Education*, 24 January 2010.) This article shares best practices on how to successfully incorporate gaming into university and college curriculum.

Games and Learning: Teaching as Designing

http://www.huffingtonpost.com/james-gee/games-and-learning-teachi_b_851581.html

(James Gee, *The Huffington Post*, 21 April 2011.) James Gee builds a case for games as catalysts for more interaction, creativity, and critical thinking in learning. He likens gamers to designers as they must understand the "rule system" to be successful.

What Does Game-Based Learning Offer Higher Education?

http://www.onlineuniversities.com/blog/2011/10/what-does-game-based-learning-offer-higher-education/

(Justin Marquis, OnlineUniversities.com, 14 October 2011.) This article explores the benefits of gaming at the university level, including increased productivity and engagement.

Learning Analytics

Learning analytics refers to the interpretation of a wide range of data produced by and gathered on behalf of students in order to assess academic progress, predict future performance, and spot potential issues. Data are collected from explicit student actions, such as completing assignments and taking exams, and from tacit actions, including online social interactions, extracurricular activities, posts on discussion forums, and other activities that are not directly assessed as part of the student's educational progress. The goal of learning analytics is to enable teachers and schools to tailor educational opportunities to each student's level of need and ability. Learning analytics promises to harness the power of advances in data mining, interpretation, and modeling to improve understandings of teaching and learning, and to tailor education to individual students more effectively. Still in its early stages, learning analytics responds to calls for accountability on campuses and leverages the vast amount of data produced by students in academic activities.

Relevance for Teaching, Learning, or Creative Inquiry

- The promise of learning analytics is that when correctly applied and interpreted, it will enable teachers to more precisely identify students' learning needs and tailor instruction appropriately.
- If used effectively, learning analytics can help surface early signals that indicate a student is struggling, allowing teachers and schools to address issues quickly.

Learning Analytics in Practice

- Northeast Regional Learning Analytics is a NERCOMP initiative dedicated to exploring the applications of learning analytics by hosting meetings and workshops for educators: http://www.nercomp.org/events/event_single.aspx?id=6817.
- The Signals system at Purdue University provides tools for faculty to identify and help students through analytical data mining: http://www.itap.purdue.edu/tlt/signals/.
- Under the Emerging Media Initiative, Ball State University professors are developing a software system using techniques of interaction design and information visualization to encourage continuous formative evaluation: http://emergingmediainitiative.com/project/learning-analytics/.

For Further Reading

Learning Analytics: The Coming Third Wave
http://net.educause.edu/ir/library/pdf/ELIB1101.pdf
> (Malcolm Brown, EDUCAUSE Learning Initiative, April 2011.) This article discusses the current position of learning analytics in education, and how third party applications are beginning to make the tools more cost-effective. It also addresses the ethics involved in deploying learning analytics platforms.

Social Learning Analytics: Technical Report
http://kmi.open.ac.uk/publications/pdf/kmi-11-01.pdf
> (Simon Buckingham Shum and Rebecca Ferguson, Knowledge Media Institute, the Open University, UK, June 2011.) This paper studies the technological needs of implementing accurate learning analytics in an online academic setting.

What are Learning Analytics?
http://www.elearnspace.org/blog/2010/08/25/what-are-learning-analytics/
> (George Siemens, *eLearnspace*, 25 August 2010.) This article presents an overview of learning analytics and discusses how it might be applied in learning institutions. A chart is included to depict the process of learning analytics.

Digital Identity

Digital identity management focuses on enabling users to create a single digital identity that can be used in any place where a login is required to access a website or service. It is not a single technology, but a group of related technologies and ideas. In the simplest terms, one's digital identity is a method that allows recognition any place where a log-in is needed. A variety of different systems are being developed, and though they have the same broad purpose of creating a sign-on system that is convenient and secure for an individual rather than a company or organization, ideas about what precisely defines a user-centric identity system and how that would be implemented are still widely varied. Both Google and Facebook are positioning their systems to be the "home" of one's digital identity.

Relevance for Teaching, Learning, or Creative Inquiry

- Digital identity allows for broader control beyond information systems; there is one path to trace when profiling an individual's digital footprint, i.e. content delivery.
- Digital identity has the potential to personalize curriculum through profiling learners' interests based on their historic content consumption.
- A single ID and password helps educators and students seamlessly connect to resources across multiple devices and websites.

Digital Identity in Practice

- Higgins Personal Data Service allows users to control how personal information is shared through their digital identities: http://eclipse.org/higgins/.
- The Future of Identity in the Information Society is an organization dedicated to studying and documenting the forensic applications, privacy, mobility, and evolving definition of digital identity: http://www.fidis.net/.
- The Gravatar service offers a way for users to personalize their digital identity with an avatar that is associated with their user ID anywhere that person posts online: http://en.gravatar.com/.

For Further Reading

The Challenge of Creating Web-Based Identity Standards
http://mashable.com/2011/11/14/google-consumer-authentication/
> (John Fontana, *Mashable*, 14 November 2011.) The author discusses the battle between corporations, including Google, Facebook, and Yahoo, to own users' digital identities, as well as the security implications.

Digital Identity Development in Higher Education
http://edcabellon.com/leadership/digitalidentity/
> (Ed Cabellon, *On the Go*, 29 August 2011.) This article addresses the importance of students carefully crafting their digital identities — online profiles are becoming critical in helping them build their reputations.

Using Espresso (Establishing Suggested Practices Regarding Single Sign On) to Streamline Access (pdf)
http://www.niso.org/apps/group_public/download.php/7058/ESPReSSO_pres_NASIG_2011.pdf
> (Andy Ingham, University of North Carolina – Chapel Hill, 4 June 2011.) This presentation outlines the goals of project Espresso to perfect user authentication when using single sign-on.

Time-to-Adoption: Four to Five Years

Gesture-Based Computing

It is already common to interact with a new class of devices entirely by using natural gestures. The Microsoft Surface, iPad, iPhone and iPod Touch, the Nintendo Wii, and other gesture-based systems accept input in the form of taps, swipes, and other ways of touching, hand and arm motions, or body movement. These are the first in a growing array of alternative input devices that allow computers to recognize and interpret natural physical gestures as a means of control. We are seeing a gradual shift towards interfaces that adapt to — or are built for — humans and human movements. Gesture-based computing allows users to engage in virtual activities with motion and movement similar to what they would use in the real world, manipulating content intuitively. The idea that natural, comfortable motions can be used to control computers is opening the way to a host of input devices that look and feel very different from the keyboard and mouse — and that enable our devices to infer meaning from the movements and gestures we make.

Relevance for Teaching, Learning, or Creative Inquiry

- Gestural interfaces allow users to easily perform precise manipulations that can be difficult to manage with a mouse or controller.
- Gesture-based computing facilitates the convergence of a user's thoughts with their movements, which appeals to kinetic learners who learn by acting.
- Large multi-touch displays support collaborative work, allowing multiple users to interact with content simultaneously.

Gesture-Based Computing in Practice

- European-based company Extreme Reality is creating software to allow users to control computer programs, games, and mobile devices with their hand gestures and movements: http://www.news10.net/life/entertainment/game-guys/story.aspx?storyid=127197&catid=99
- A pair of MIT graduate systems have created a gesture-based interaction system that would cost $1 to produce, using off the shelf computer cameras and a pair of Lycra gloves: http://www.threegear.com/.
- Researchers at Texas A&M University have developed a multi-touch system from infrared sensors that allows precision free-air interaction: http://ecologylab.net/research/zerotouch/index.html.

For Further Reading

7 Areas Beyond Gaming Where Kinect Could Play A Role
http://radar.oreilly.com/2010/12/dancing-with-kinects-future-in.html
(Alex Howard, O'Reilly Radar, 3 December 2010.) This article looks at how the gesture-based Kinect System from Microsoft can have broad use beyond its intended use as a gaming platform. Uses include applications in art, health, and education.

Google Updates Its Search App For iPads
http://www.mobilemag.com/2011/11/21/google-updates-its-search-app-for-ipads/
(Andrew Grush, *Mobile Magazine*, 21 November 2011.) Google has updated its Google iOS/iPad app to be gesture-driven. Users can now easily return back to their search results, simply by swiping a finger across the screen.

To Win Over Users, Gadgets Have to Be Touchable
http://www.nytimes.com/2010/09/01/technology/01touch.html
(Claire Cain Miller, *New York Times*, 1 September 2010.) This article discusses how gesture-based computing has become a prevalent way we that we interact with our computers, especially mobile devices such as smartphones and tablets.

Haptic Interfaces

Haptic interfaces are a well-understood, mature technology; the topic first appeared in the *NMC Horizon Report: 2004 Higher Ed Edition*, where it was highlighted as an example of multimodal interfaces and placed on the mid-term horizon. Since then, haptic interfaces have found broad use in medical, engineering, military and other simulations, theme parks, and games. The most common haptic interfaces use vibration as a sensory cue, but haptics also make use of sensations such as movement, temperature, texture, and pressure to convey non-verbal cues and information to the user. Often, very subtle cues can make an experience much more authentic, a feature that has broad use in medical and flight simulators, as well as in the popular simulator rides found in theme parks, but such feedback is expensive to produce. Sometimes discussed in the same conversation as gesture-based computing, the two are distinctly different. Gesture-based computing is centered on input to a device — it does not require direct touch and does not generate any feedback from the device. On the other hand, haptic interfaces are output-oriented, used to pull information out of the device.

Relevance for Teaching, Learning, or Creative Inquiry

- Haptic interfaces help in medical simulations, enabling students to perform mock surgeries while learning the different sensation of actions, such as cutting through tissue and muscle.
- Haptic interfaces have much potential for aiding the visually impaired, allowing users to touch a surface to hear a specific audio explanation.
- Resistance, heat, and traction are features of haptic interfaces that mirror physical reality, allowing learners to immerse themselves in new environments they otherwise may not have access to.

Haptic Interfaces in Practice

- At McGill University researchers are developing a haptic feedback system that allows people with visual impairments to get more feedback with fine degrees of touch: http://www.cim.mcgill.ca/~haptic/laterotactile/papers/VL-VH-EH-10.pdf.
- The haptic cow is a virtual cow anatomy simulation that uses force feedback, developed by The Royal Veterinary College: http://www.live.ac.uk/html/projects_haptic_01.html
- Developed at RWTH Aachen University, MudPad is a localized active haptic feedback interface that offers users more nuanced ways to interact with screens through touch: http://hci.rwth-aachen.de/mudpad.
- Researchers at École Polytechnique Fédérale de Lausanne Swiss Federal Institute of Technology invented a way to control the texture of a haptic screen so that a touchscreen can feel like raised keys under a person's fingertips on smartphones, tablets, computers, and vending machines: http://actu.epfl.ch/news/a-touchscreen-you-can-really-feel/.

For Further Reading

Haptic Technology: An Animated Explanation
http://www.isfh.org/comphap.html
(International Society for Haptics, accessed 7 December 2011.) This animation explains the role of force-feedback technology in creating virtual objects, haptic rendering and interfaces.

A Touchscreen You Can Really Feel
http://www.kurzweilai.net/a-touchscreen-you-can-really-feel
(*Kurzweil News*, 17 November 2011.) This article discusses a new interface with tactile surfaces, developed by the Integrated Actuators Laboratory, where users can feel raised keys beneath their fingers, along with vibrations. The interface is being explored for use by the visually impaired.

Internet of Things

The "Internet of Things" has become a sort of shorthand for network-aware smart objects that connect the physical world with the world of information. A smart object has four key attributes: it is small, and thus easy to attach to almost anything; it has a unique identifier; it has a small store of data or information; and it has a way to communicate that information to an external device on demand. The Internet of Things extends that concept by using TCP/IP as the means to convey the information, thus making objects addressable (and findable) on the Internet. Objects that carry information with them have long been used for the monitoring of sensitive equipment or materials, point-of-sale purchases, passport tracking, inventory management, identification, and similar applications. Smart objects are the next generation of those technologies — they "know" about a certain kind of information, such as cost, age, temperature, color, pressure, or humidity — and can pass that information along easily and instantly. They can be used to digitally manage physical objects, monitor their status, track them throughout their lifespan, alert someone when they are in danger of being damaged or spoiled — or even to annotate them with descriptions, instructions, warranties, tutorials, photographs, connections to other objects, and any other kind of contextual information imaginable. The Internet of Things would allow easy access to these data.

Relevance for Teaching, Learning, or Creative Inquiry
- Attached to scientific samples, the Internet of Things can alert scientists and researchers to conditions that may impair the quality or utility of the samples.
- Pill-shaped microcameras are used in medical diagnostics and teaching to traverse the human digestive tract and send back thousands of images to pinpoint sources of illness.
- QR codes bridge the gap between physical and digital content as people can "scan" printed materials with their mobiles and be immediately directed to the corresponding place on the web.

Internet of Things in Practice
- Amarino, developed by MIT, is a toolkit that allows users to control the lights in a room, and detect exposure levels to radiation or other potentially harmful environmental factors through their smartphones: http://www.amarino-toolkit.net/.
- Otago Museum is installing a radio tracking system to monitor all of its objects. Each artefact will be tagged, and RFID readers will track the items as they move around the museum space: http://www.odt.co.nz/news/dunedin/143086/plans-made-radio-tracking-system.

For Further Reading
Internetting Every Thing, Everywhere, All the Time
http://edition.cnn.com/2008/TECH/11/02/digitalbiz.rfid/
(Cherise Fong, *CNN*, November 2008.) This article describes the Internet of Things and illustrates some current examples of smart object technology.
A New Laboratory Radio Frequency Identification (RFID) System for Behavioural Tracking of Marine Organisms
http://www.mdpi.com/1424-8220/11/10/9532/
(Jacopo Aguzzi, Valerio Sbragaglia, et al., MDPI Publishing, 10 October 2011.) This paper discusses how an RFID system is being used to track marine animals' behavior.
NFC Technology: 6 Ways it Could Change Our Daily Lives
http://mashable.com/2010/05/06/near-field-communication/
(Sarah Kessler, Mashable, 6 May 2010). Contactless payment and infotags containing schedules and announcements are listed among the potential applications of NFC.

Key Trends

The abundance of resources and relationships made easily accessible via the Internet is increasingly challenging us to revisit our roles as educators. Institutions must consider the unique value that each adds to a world in which information is everywhere. In such a world, sense-making and the ability to assess the credibility of information are paramount. Mentoring and preparing students for the world in which they will live, the central role of the university when it achieved its modern form in the 14th century, is again at the forefront. Universities have always been seen as the gold standard for educational credentialing, but emerging certification programs from other sources are eroding the value of that mission daily.

Computers as we know them are in the process of a massive reinvention because we increasingly expect media to be touchable and interactive. The computer is smaller, lighter, and better connected than ever before, without the need for wires or bulky peripherals. In many cases, smartphones and other mobile devices are sufficient for basic computing needs, and only specialized tasks require a keyboard, large monitor, and a mouse. Devices like Apple's iPad are filling a niche that is neither 'big smartphone' nor 'small laptop.' They are connected to an ecosystem of applications supported by cloud computing technologies that can be downloaded and used instantly, for pennies. As the capabilities and interfaces of small computing devices improve, our ideas about when — or whether — a traditional computer is necessary are changing as well.

Education paradigms are shifting to include online learning, hybrid learning and collaborative models. Budget cuts have forced institutions to re-evaluate their education platforms and find alternatives to the exclusive face-to-face learning models. As such, what may have began as a challenge has now become an increasingly interesting trend. Students already spend much of their free time on the Internet, learning and exchanging new information through various resources, including social networks. Institutions that embrace face-to-face/online hybrid learning models have the potential to leverage the online skills learners have already developed independent of academia. We are beginning to see developments in online learning that offer similar — if not better — environments than physical campuses, including opportunities for increased collaboration while equipping students with stronger digital skills. Hybrid models, when designed and implemented successfully, enable students to learn at their own pace and style, whenever they want from wherever they are.

Increasingly, students want to use their own technology for learning. As new technologies are developed at a more rapid and at a higher quality, there are a wide variety of different devices, gadgets, and tools from which to choose. Utilizing a specific device has become something very personal — an extension of someone's personality and learning style — for example, the iPhone vs. the Android. There is comfort in giving a presentation or performing research with tools that are more familiar and productive at the individual level. And, with handheld technology becoming mass produced and more affordable, students are more likely to have access to more advanced equipment in their personal lives than at school.

Institutions are increasingly exploring technologies that allow teachers and students to better collaborate. Social networks and cloud-based tools and applications are changing the ways teachers and students communicate with each other. Open resources such as wikis and Google Apps also enable the free exchange of ideas and prompt insightful discussions between teachers and students. The result is more opportunities for collaboration, and a change in the dynamic of the teacher-student relationship that promotes more of an equilibrium.

Lecture capture, podcasting, and cheap personal video recorders increasingly make it much easier to prepare lecture-style content for students to see/hear before coming to class. There is an ever-growing cadre of professors posting lectures, pre-lectures, and other video-based reflections online. Similar to how students would prepare for class by reading a book, they can now watch or listen to educators exploring the course material beforehand. This frees up time during class to engage in responsive activities and collaborative problem-solving. The driving forces behind this trend are popular models such as Khan Academy, which contains thousands of brief video tutorials that convey material.

People expect to be able to work, learn, and study whenever and wherever they want to. Life in an increasingly busy world where learners must balance demands from home, work, school, and family poses a host of logistical challenges with which today's ever more mobile students must cope. A faster approach is often perceived as a better approach, and as such people want easy and timely access not only to the information on the network, but to their social networks that can help them to interpret it and maximize its value. The implications for informal learning are profound, as are the notions of "just-in-time" learning and "found" learning, both ways of maximizing the impact of learning by ensuring it is timely and efficient.

The technologies we use are increasingly cloud-based, and our notions of IT support are decentralized. The continuing acceptance and adoption of cloud-based applications and services is changing not only the ways we configure and use software and file storage, but even how we conceptualize those functions. It does not matter where our work is stored; what matters is that our information is accessible no matter where we are or what device we choose to use. Globally, in huge numbers, we are growing accustomed to a model of browser-based software that is device-independent. While some challenges still remain, specifically with notions of privacy and control, the promise of significant cost savings is an important driver in the search for solutions.

There is a new emphasis in the classroom on more challenge-based and active learning. Challenge-based learning and similar methods foster more active learning experiences, both inside and outside the classroom. As technologies such as tablets and smartphones now have proven applications in higher education institutions, educators are leveraging these tools, which students already use, to connect the curriculum with real life issues. The active learning approaches are decidedly more student-centered, allowing them to take control of how they engage with a subject and to brainstorm and implement solutions to pressing local and global problems. The hope is that if learners can connect the course material with their own lives and their surrounding communities, then they will become more excited to learn and immerse themselves in the subject matter. Studies of challenge-based learning in practice, including two authored by the NMC, depict an increase in the uptake of 21st Century Skills among learners, including leadership and creativity.

The world of work is increasingly collaborative, driving changes in the way student projects are structured. As more and more employers are valuing collaboration as a critical skill, silos both in the workplace and at school are being abandoned in favor of collective intelligence. To facilitate more teamwork and group communication, projects rely on tools like wikis, Google Docs, Skype, and online forums. Projects are increasingly evaluated by educators not just on the overall outcome, but also on the success of the group dynamic. In many cases, the online collaboration tool itself is an equally important outcome as it stores — and even immortalizes— the process and multiple perspectives that led to the end results.

Appropriate metrics of evaluation lag the emergence of new scholarly forms of authoring, publishing, and researching. Traditional approaches to scholarly evaluation such as citation-based metrics, for example, are often hard to apply to research that is disseminated or conducted via social media. New forms of peer review and approval, such as reader ratings, inclusion in and mention by influential blogs, tagging, incoming links, and re-tweeting, are arising from the natural actions of the global community of educators, with increasingly relevant and interesting results. These forms of scholarly corroboration are not yet well understood by mainstream faculty and academic decision makers, creating a gap between what is possible and what is acceptable.

The demand for personalized learning is not adequately supported by current technology or practices. The increasing demand for education that is customized to each student's unique needs is driving the development of new technologies that provide more learner choice and control and allow for differentiated instruction. It has become clear that one-size-fits-all teaching methods are neither effective nor acceptable for today's diverse students. Technology can and should support individual choices about access to materials and expertise, amount and type of educational content, and methods of teaching.

Digital media literacy continues its rise in importance as a key skill in every discipline and profession. This challenge, driven by a related trend, appears here because despite the widespread agreement on the importance of digital media literacy, training in the supporting skills and techniques is rare in teacher education and non-existent in the preparation of faculty. As lecturers and professors begin to realize that they are limiting their students by not helping them to develop and use digital media literacy skills across the curriculum, the lack of formal training is being offset through professional development or informal learning, but we are far from seeing digital media literacy as a norm. This challenge is exacerbated by the fact that digital literacy is less about tools and more about thinking, and thus skills and standards based on tools and platforms have proven to be somewhat ephemeral.

Dividing learning into fixed units such as credit hours limits innovation across the board. For a long time now, credit hours have been the primary way of marking the progress of students in earning their college degrees. This method implies that time is an accurate and effective measure for knowledge comprehension and skill. This industrial construct hinders the growth of more authentic learning approaches, where students and teachers might make use of more creative strategies not bound by such constraints.

Economic pressures and new models of education are bringing unprecedented competition to the traditional models of tertiary education. Across the board, institutions are looking for ways to control costs while still providing a high quality of service. Institutions are challenged by the need to support a steady — or growing — number of students with fewer resources and staff than before. As a result, creative institutions are developing new models to serve students, such as streaming introductory courses over the network. As these pressures continue, other models may emerge that diverge from traditional ones. Simply capitalizing on new technology, however, is not enough; the new models must use these tools and services to engage students on a deeper level.

Institutional barriers present formidable challenges to moving forward in a constructive way with emerging technologies. Too often it is education's own processes and practices that limit broader uptake of new technologies. Much resistance to change is simply comfort with the status quo, but in other cases, such as in promotion and tenure reviews, experimentation or innovative applications of technologies is often seen as outside the role of researcher or scientist.

The global drive to increase the number of students participating in undergraduate education is placing pressure across the system. The off-cited relationship between earning potential and educational attainment, plus the clear impact of an educated society on the growth of the middle class is pushing many countries to encourage more and more students to enter universities and colleges. In many countries, however, the population of students prepared for undergraduate study is already enrolled — expanding access means extending it to students who may not have the academic background to be successful without additional support. Many in universities feel that these institutions do not have sufficient time and resources to help this set of students.

Most academics are not using new and compelling technologies for learning and teaching, nor for organizing their own research. Many researchers have not had training in basic digitally supported teaching techniques, and most do not participate in the sorts of professional development opportunities that would provide them. This is due to several factors, including a lack of time, a lack of expectations that they should, and the lack of infrastructure to support the training. Academic research facilities rarely have the proper processes set up to accommodate this sort of professional development; many think a cultural shift will be required before we see widespread use of more innovative organizational technology. Many caution that as this unfolds, the focus should not be on the technologies themselves, but on the pedagogies that make them useful.

New modes of scholarship are presenting significant challenges for libraries and university collections, how scholarship is documented, and the business models to support these activities. While the university library has traditionally housed collections of scholarly resources, social networks and new publishing paradigms such as open content are challenging the library's role as curator. Students and educators are increasingly able to access important, historic research in web browsers on devices of their choosing. As such, libraries are under tremendous pressure to evolve new ways of supporting and curating scholarship.

Simply staying organized and current presents a challenge in a world where information, software tools, and devices proliferate at the rate they do today. New developments in technology are exciting and their potential for improving quality of life is enticing, but it can be overwhelming to attempt to keep up with even a few of the many new tools that are released. User-created content is exploding, giving rise to information, ideas, and opinions on all sorts of interesting topics, but following even some of the hundreds of available authorities means sifting through a mountain of information on a weekly or daily basis. There is a greater need than ever for effective tools and filters for finding, interpreting, organizing, and retrieving the data that is important to us.

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