# NMC Horizon Project
## 2011 Short List

### Time-to-Adoption Horizon: One Year or Less

- Cloud Computing
- Collaborative Environments
- Electronic Books
- Mobiles

### Time-to-Adoption Horizon: Two to Three Years

- Augmented Reality
- Game-Based Learning
- Open Content
- Visual Data Analysis

### Time-to-Adoption Horizon: Four to Five Years

- Brain-Computer Interfaces
- Gesture-Based Computing
- Learning Analytics
- Semantic Web

### Trends

### Challenges

*These interim results are part of the workflow for the 2011 Horizon Report and are not intended for public release.*

**Time-to-Adoption: One Year or Less**

# Cloud Computing

Cloud computing first appeared on the near-term horizon in 2009. Since that time, its use for supporting collaboration, file storage, and access to computing cycles has increased, and the number of available applications that rely on cloud technologies has 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.

There is a great deal of agreement among the advisory board that this technology is on the near term horizon. The definition of cloud computing has not changed substantially since it was first introduced, although its use has proliferated and it continues to be an important support technology for teaching and learning.

## Relevance for Teaching, Learning & Creative Inquiry

- Schools that offer distance learning can benefit from cloud computing by reducing the amount of physical material (DVDs and CDs) sent to students, simplifying IT support, and providing remote access to labs and testing equipment.
- Cloud resources can be accessed from a variety of devices, allowing schools to take advantage of equipment students already own.

## Cloud Computing in Practice

- This project from MIT's Climate Modeling Initiative looks at ways to use cloud computing resources to perform scientific research in university labs and K-12 classrooms: http://www-paoc.mit.edu/cmi/technologies/cloudcomputing.htm
- A partnership between the New York City Department of Education, Columbia University, and the Columbia Secondary School has led to the deployment of cloud-based systems for schools: http://www.google.com/a/help/intl/en/edu/case_studies/columbia.html
- A project supported by an HP Innovations in Education grant connects students with scientific researchers, giving them an opportunity to experience professional research practices while also building their own technical skills: http://www.lcmespb.ru/

## For Further Reading

**Briefing: Cloud Computing**
http://www.technologyreview.com/briefings/cloud/

(*MIT Technology Review*, July/August 2009.) This article describes how cloud computing works and discusses its impact on various industries and professions.

**The Start of a Tech Revolution**
http://www.districtadministration.com/viewarticle.aspx?articleid=2004

(Kurt O. Dyril, *District Administration*, May 2009.) This article summarizes how the use of cloud computing can have a positive financial impact for school districts.

**What is Cloud Computing?**
http://www.cloudbook.net/directories/what-is-cloud-computing

(*Cloudbook*, accessed March 5, 2010.) A number of short videos prepared by various professionals and researchers give an overview of, and some perspectives on, cloud computing.

**Time-to-Adoption: One Year or Less**

# Collaborative Environments

The definition of a collaborative environment has not changed significantly since it first appeared two years ago. The technologies that support collaborative work range from small tools for jointly creating a single product, such as Voicethread, to shared document editors like Adobe Buzzword, Google Docs, Prezi, and Etherpad, to wikis and group blogging systems, all the way up to self-contained environments for collaboration, like Moodle, Ning, or PageFlakes. Other tools, like Kaltura, allow people to collaborate around the creation of rich media, including audio and video, and make it easy for members of a community to share, comment on, and remix content. The free, single-purpose tools at one end of the spectrum can be assembled by teachers with a technological bent into a collaborative experience that includes live video, synchronous and asynchronous chat and discussion, media creation tools, and so forth. For those who are less technically-minded, the comprehensive platforms at the other end of the range offer a suite of tools that already work together and that can be easily integrated into day-to-day work. In recent years, the use of collaborative environments to support teaching and learning has become much more common.

## Relevance for Teaching, Learning & Creative Inquiry

- Collaborative environments are an efficient way for students to work together, whether the groups are composed of students in the same physical class or not.
- A class or project group can assemble a collaborative workspace very quickly using widgets that pull information from a range of sources.
- Large-scale collaborative environments can facilitate an almost spontaneous development of communities of people who share similar interests.

## Collaborative Environments in Practice

- The international eLanguages project facilitates collaboration between teachers and classrooms around the world. Teachers can select or propose projects for their classes to take part in, exchange ideas with other teachers, and share resources: http://www.elanguages.org
- An ongoing collaborative social studies project connects students in the United States with their peers in other countries to explore a variety of musical selections from their respective cultures: http://www.carnegiehall.org/article/explore_and_learn/art_cultural_exchange.html

## For Further Reading

**Digital Access, Collaboration a Must for Students**
http://www.eschoolnews.com/2010/03/16/digital-access-collaboration-a-must-for-students/

(Laura Devaney, *eSchool News*, 16 March 2010.) This article describes the results of an educational technology survey undertaken by Project Tomorrow. The survey identifies a new type of student, the "free agent learner," who creates personal learning experiences.

**Howard Rheingold on Collaboration**
http://www.ted.com/talks/howard_rheingold_on_collaboration.html

(Howard Rheingold, *TED: Ideas Worth Spreading*, February 2005.) In this talk from 2005, Howard Rheingold discusses the emerging world of collaboration, participatory media and collective action. His insights then are still pertinent today.

**Jazz as an Extended Metaphor for Social Computing**
http://transliteracies.english.ucsb.edu/post/research-project/research-clearinghouse-individual/research-reports/jazz-as-an-extended-metaphor-for-social-computing

(Aaron McLeran, UC-Santa Barbara Transliteracies Project, 17 May 2009.) This unusual study looks at social computing and jazz and finds some striking — and surprising — similarities.

**Time-to-Adoption: One Year or Less**

# Electronic Books

As the technology underlying electronic readers has improved and more titles have become available, electronic books are quickly reaching the point where their advantages over the printed book are compelling to almost any observer. Now that they are firmly established in the public sector, electronic books are beginning to demonstrate capabilities that challenge the very definition of reading. Publishers are exploring richly visual interfaces that include audiovisual, interactive, and social elements that enhance the textual content of books and magazines. Social tools extend the reader's experience into the larger world, connecting readers with one another and enabling deeper, collaborative explorations of the text. The gestural interfaces of new electronic readers allow reading to become a tactile experience as well as an intellectual one. The content of electronic books and the social activities they enable, rather than the device used to access them, are the keys to their popularity; nearly everyone carries some device that can function as an electronic reader, and more people are engaging with electronic books than ever before. Electronic books have the potential to transform the way we interact with reading material of all kinds, from popular titles to scholarly works.

## Relevance for Teaching, Learning & Creative Inquiry

- Electronic book readers can allow students to record, archive, and share commentary and notes about what they are reading, facilitating the work of study groups and research teams.
- Electronic books offer possibilities for self-directed, interactive experiences; serendipitous exploration; collaborative work; multi-modal, immersive activities; and other deeply engaging approaches to learning.
- Subscription-based services allow students to receive electronic textbooks and ancillary materials on the devices they already own, like smart phones, laptops, and iPads.

## Electronic Books in Practice

- Flipboard is a 'social magazine' for the iPad that flows web content into magazine-style pages: http://www.flipboard.com
- Inkling textbooks offer a new, highly interactive textbook experience, including social networking, rich graphics, video, animation and robust annotation and sharing tools: http://www.inkling.com
- *The Pedlar Lady of Gushing Cross* is an interactive, immersive retelling of a classic story with animation, audio and rich graphics designed for the iPad: http://www.moving-tales.com

## For Further Reading

**2009 Librarian eBook Survey**
http://www.apo.org.au/research/2009-librarian-ebook-survey

(Michael Newman, *HighWire-Stanford University*, 26 March 2010.) This comprehensive report and analysis looks at how electronic books are being used in libraries in 13 countries.

**Handheld E-Book Readers and Scholarship: Report and Reader Survey**
http://www.humanitiesebook.org/heb-whitepaper-3.html

(Nina Gielen, *American Council of Learned Societies (ACLS) Humanities E-Book*, 18 August 2010.) This report describes an experiment and reader survey conducted by the ACLS Humanities E-Book in 2009-10 to assess the effectiveness of electronic scholarly monographs.

**Yes, People Still Read, but Now It's Social**
http://www.nytimes.com/2010/06/20/business/20unbox.html

(Steven Johnson, *NYTimes.com*, 18 June 2010.) Writer Steven Johnson argues that electronic books will transform reading into a more social experience.

**Time-to-Adoption: One Year or Less**

# Mobiles

According to a recent report from mobile manufacturer Ericsson, studies show that by 2015, 80% of people accessing the Internet will be doing so from mobile devices. In Japan, over 75% of Internet users already use a mobile as their first choice for access. This shift in the means of connecting to the Internet is being enabled by the convergence of three trends: the growing number of Internet-capable mobile devices, increasingly flexible web content, and continued development of the networks that support connectivity. Internet-capable mobile devices will outnumber computers within the next year. The available choices are many — smart phones, tablets, laptops, and the newest class of devices like the iPad that blends the functions of all of them — and the boundaries between them are more and more blurred. It has become common practice to develop web content that seamlessly adjusts for optimal display on whichever of these devices is used to access it, increasing the proportion of Internet applications and information that is accessible to mobile users. Mobile and wireless data networks continue to evolve, supporting faster connections and higher bandwidth throughput; the forthcoming 4G network promises the highest speeds yet, and 4G devices are already beginning to appear on the market.

## Relevance for Teaching, Learning & Creative Inquiry

- Mobiles are increasingly capable tools for learning that schools do not have to buy or maintain: students come equipped with mobiles.
- The portability and Internet-capability of mobile devices makes them ideal as a store of reference materials and learning experiences, as well as general-use tools for fieldwork, where they can be used to record observations via voice, text, or multimedia.
- Mobiles embody the convergence of several technologies that lend themselves to educational use, including electronic book readers, location-based services, annotation tools, applications for creation and composition, and social networking tools.

## Mobiles in Practice

- Stanford University's medical school is issuing iPads containing course materials and interactive study aids: http://med.stanford.edu/ism/2010/september/ipads-0913.html
- The Museum of Science in Boston, collaborating with researchers from Tufts University, has created a mobile application for visitors and native Bostonians that allows them to serve as local "citizen scientists" aiding real scientists in a large regional study of firefly populations: https://www.mos.org/fireflywatch/

## For Further Reading

**Pew Internet Research Report Mobile Access 2010**
http://pewinternet.org/Reports/2010/Mobile-Access-2010.aspx

(Aaron Smith, Pew Research Center, 1 June 2010.) This research report by the Pew Internet Project examines mobile computing usage among Americans.

**Smartphones Give You Wings: Pedagogical Affordance of Mobile Web 2.0**
http://www.apo.org.au/research/smartphones-give-you-wings-pedagogical-affordance-mobile-web-20

(Thomas Cochrane, Roger Bateman, *Australasian Journal of Educational Technology*, 7 June 2010.) This paper examines how mobile Web 2.0 tools can be used in tertiary education.

**World's Largest Open University Goes Mobile**
http://www.pr-inside.com/world-s-largest-open-university-goes-r1553595.htm

(Press release, *PR-inside.com,* 29 October 2009.) The Indira Gandhi National Open University, in partnership with Ericsson, offers courses on mobile phones to more than 2.5 million students.

**Time-to-Adoption: Two to Three Years**

# Augmented Reality

Augmented reality enhances the information we can perceive with our senses. Its first applications appeared in the late 1960s and 1970s, and by the 1990s, augmented reality was being put to use by a number of major companies for visualization, training, and other purposes. Now, the technologies that make augmented reality possible are powerful and compact enough to deliver augmented experiences to personal computers and mobile devices. A key characteristic of augmented reality is its ability to respond to user input. This interactivity confers significant potential for learning and assessment; with it, 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 personal space at a scale and in a form easy to understand and work with.

Augmented reality also appeared on the mid-term horizon last year, and early applications and conceptual projects continue to give way to more polished tools. Areas still ripe for development include augmented reality gaming and the use of AR in publishing, indicating that the full potential of this technology is as yet untapped. Despite the tremendous interest in augmented reality — among the advisory board, it was the top-voted topic this year — the current lack of standards for development is keeping it in the mid-term horizon for another year.

## Relevance for Teaching, Learning & Creative Inquiry

- Augmented reality has strong potential to provide powerful, contextual, *in situ* learning experiences and serendipitous exploration and discovery.
- Augmented reality opens the door to visual and highly interactive forms of learning, allowing the overlay of data onto the real world as easily as it simulates dynamic processes.
- 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

- Acrossair's public transit apps use augmented reality to locate public transportation near the user; Nearest Wiki and Nearest Places offer information useful to tourists and travelers: http://www.acrossair.com/default.htm
- The Powerhouse Museum has developed an augmented reality application that allows visitors to use their mobile phones to see Sydney, Australia as it appeared one hundred years ago: http://www.powerhousemuseum.com/layar/

## For Further Reading

**Blended Reality: Superstructing Reality, Superstructing Selves**
http://www.iftf.org/node/2598

(Kathi Vian, Institute for the Future, 4 March 2009.) This in-depth report looks at the impact of augmented reality as it is increasingly integrated into technology and society.

**Collaborative Augmented Reality in Schools**
http://ltee.org/uploads/cscl2009/paper236.pdf

(Lyn Pemberton, Marcus Winter, University of Brighton, 2009.) This research paper discusses the use of augmented reality for collaboration and learning opportunities.

**How Augmented Reality Apps Can Catch On**
http://radar.oreilly.com/2010/10/two-ways-augmented-reality-app.html

(Mac Slocum, *O'Reilly Radar*, 13 October 2010.) This article discusses standards for development of AR applications.

**Time-to-Adoption: Two to Three Years**

# Game-Based Learning

The interest in game-based learning has accelerated considerably in recent years, driven by clear successes in military and industrial training. The military, in particular, is using games and simulations to refine skills across the range of their training needs, from basic training to field medicine, to IED removal, to advanced operational strategies. 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. Despite these advancements, the full potential of games for learning has yet to be realized. One area in which there is currently a great deal of development is social games, especially those that can be taken along and played anywhere at all using a mobile device. With social games, players are never far from a game environment, whether it be a mobile in a pocket, a desktop or laptop computer, or a networked gaming console. Games are becoming a pervasive part of everyday life, and our notions of what constitutes a game are changing as fast as the applications of games themselves.

## Relevance for Teaching, Learning & 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

- *Virtual Battlespace II* is a game-based operational simulation environment, developed with the Australian Defense Forces, that is used by militaries all over the world as an operational planning tool: http://www.bisimulations.com
- *Ghosts of a Chance* allows visitors to the Smithsonian American Art Museum a chance to decipher codes, follow treasure maps, send text messages, and uncover hidden objects in this multimedia scavenger hunt: http://ghostsofachance.com/
- *World without Oil* was a collaborative and social imagining of the first 32 weeks of a global oil crisis: http://worldwithoutoil.org/

## For Further Reading

**Deep Learning Properties of Good Digital Games: How Far Can They Go?**
http://www.jamespaulgee.com/node/37

(James Paul Gee, Arizona State University, January 2009.) This study by noted games-based learning researcher James Paul Gee discusses the design and effects of digital games.

**Moving Learning Games Forward (PDF)**
http://education.mit.edu/papers/MovingLearningGamesForward_EdArcade.pdf

(E. Klopfer, S. Osterweil and K. Salen, *The Education Arcade*, 2009.) This white paper provides an overview of the field of game-based learning.

**Reality is Broken, Game Designers Can Fix It (video)**
http://www.avantgame.com/

(Jane McGonigal, Institute for the Future, 2010.) This TED talk advocates incorporating principles of game design into the real world to effect social change.

**Time-to-Adoption: Two to Three Years**

# Open Content

Open content was identified in the short-term horizon (one year or less) in the *2010 Horizon Report*, and this year's advisory board was not at all in agreement as to where it should currently be placed. It appeared to be something that would take academia by storm, but this clearly has not happened; in fact, there is less agreement today about what is needed to tip open content into the mainstream than there was one year ago. Open content continues to be of interest to educators, due perhaps to its focus on collective knowledge and on the sharing and reuse of learning and scholarly materials. At its core, the notion of open content is to take advantage of the Internet as a global dissemination platform for collective knowledge and wisdom, and to design learning experiences that maximize the use of it. Open content pairs naturally with the affordances of electronic books and digital content; open resources are generally, though not always, electronic. Because they are digital in nature, open learning materials can incorporate activities to support multiple modes of study — reading, listening, interacting — though they can be challenging to create as a result.

## Relevance for Teaching, Learning & Creative Inquiry

- Open content promotes a set of skills that are critical in maintaining currency in any discipline: the ability to find, evaluate, and put new information to use.
- The same set of materials, once placed online and made sharable via the appropriate licensing, can inform a wide variety of learning modalities.
- Open content allows teachers to customize their courses quickly and inexpensively with materials that keep up with emerging information and ideas.

## Open Content in Practice

- Developed using data and interpretations from recent archaeological research at a 9,000-year-old settlement in central Turkey, *Remixing Çatalhöyük* includes tools to make it easy to use and remix its content: http://wiki.creativecommons.org/Case_Studies/Remixing_Çatalhöyük
- CK-12 aims to lower the costs of textbooks by providing electronic versions through their website and the iBookstore: http://www.ck12.org/flexr
- Wikipublisher is an open source project that allows wikis and other open web content to be easily formatted for print publication: http://www.wikipublisher.org/wiki/Wikipublisher

## For Further Reading

**Around the World, Varied Approaches to Open Online Learning**
http://chronicle.com/article/Countries-Offer-Different/48775

(Simmi Aujla and Ben Terris, *The Chronicle of Higher Education,* 11 October 2009.) Many countries are using open educational resources to reach students who would otherwise be unable to attend university.

**Open Societies Need Open Systems**
http://news.bbc.co.uk/2/hi/technology/8493006.stm

(Bill Thompson, BBC News, 2 February 2010.) Bill Thompson argues the need for open systems in this editorial piece for *BBC News*.

**The Open University's Patrick McAndrew: Open Education and Policy**
http://creativecommons.org/weblog/entry/23521

(Timothy Vollmer, Creative Commons, 27 September 2010.) Creative Commons interviews Patrick McAndrew of The Open University, who discusses his thoughts on the value of open content and how it can used in higher education.

**Time-to-Adoption: Two to Three Years**

# Visual Data Analysis

Placed on the far-term horizon in the *2010 Horizon Report*, visual data analysis continues to evolve and move closer to widespread adoption as exciting new examples of its use come to light. Visual data analysis is characterized by its focus on making use of the pattern matching skills that seem to be hard-wired into the human brain and also by the way in which it facilitates the work of teams collaborating to tease out meaning from complex sets of information. While the most sophisticated tools are still mostly found in research settings, a variety of tools are emerging that make it possible for almost anyone with an analytical bent to easily interpret all sorts of data. One of the most compelling aspects of visual data analysis is in the way it augments the natural abilities humans have to seek and find patterns in what they see. By manipulating variables, or simply seeing them change over time (as Gapminder has done so famously), it is easy to discover whether or not patterns exist. Such tools have applicability in nearly every field.

The full promise for teaching and learning remains further afield, but because of the intuitive ways in which it can expose complex relationships to even the uninitiated, there is tremendous opportunity to integrate visual data analysis into undergraduate research, even in survey courses. Models of complex processes in quantum physics, organic chemistry, medicine, or economics are just a few of the ways in which the outcomes of visual data analysis can be applied to learning situations.

## Relevance for Teaching, Learning & Creative Inquiry

- Visual data analysis provides a way for engineering students to come to grips with massive amounts of data generated through research, system monitoring, or other standard processes.
- The Visual Understanding Environment (VUE) created at Tufts University enables students and faculty to work with large amounts of electronic content. The visualizations can be annotated, and users can create and save paths through them to make guided walk-throughs.
- Ready-to-use visualization tools and public data provide an avenue for exploring a wide variety of relationships, as the Google Public Data Explorer shows.

## Visual Data Analysis in Practice

- Truthy analyzes Twitter posts to identify memes, aiding in the study of social epidemics and helping users to distinguish between actual organic memes and those planted by marketing campaigns: http://truthy.indiana.edu
- The Visual Complexity project explores and collects visualization tools, best practices, and examples: http://www.visualcomplexity.com/vc
- Crimespotting is an interactive map of crimes in San Francisco and Oakland that visualizes crime by location, type, date, and time, allowing users to quickly grasp patterns and trends: http://sanfrancisco.crimespotting.org

## For Further Reading

**Report from the DOE/ASCR Workshop on Visual Analysis and Data Exploration at Extreme Scale**
http://www.sci.utah.edu/vaw2007/DOE-Visualization-Report-2007.pdf

(Chris Johnson, Rob Ross, et al., October 2007.) This report describes fundamental research in visualization and analysis involving computational science applications at extreme scale.

**Visualizing**
http://www.visualizing.org

(Accessed 10 October 2010.) *Visualizing* is a community of practice for sharing work, best practices, and academic resources, and engaging in dialog about the field.

**Time-to-Adoption: Four to Five Years**

# Brain-Computer Interfaces

Research in the area of brain-computer interfaces (BCI) has its roots in assistive technology designed to help people who cannot communicate or who are paralyzed. In essence, a brain-computer interface interprets the signals created when the brain's neurons fire, allowing a computer to translate these into commands that can be used to control output of one kind or another. Researchers are developing brain-controlled robots that can learn to perform actions for paralytics, and brain-computer interfaces for communicating with sufferers of neurodegenerative diseases such as ALS. While still much the stuff of science fiction, some of the research has been very promising, and the first real BCI products are now coming into the market — with some aimed at consumer use.

Even so, educational applications for brain-computer interfaces remain a long way away. Tasks such as typing or performing basic operations with a robot are tremendously useful for patients who are unable to do those things in any other way, but the actions are too slow to be useful to people generally. Early demonstrations of brain-controlled games show some promise, and a number of researchers and developers are working toward improving the state of the art, but brain-computer interfaces are essentially where augmented reality was several years ago: the equipment is awkward to use, unattractive, and not effective enough to appeal to a wide audience yet.

## Relevance for Teaching, Learning & Creative Inquiry

Currently, brain-computer interfaces are either used in research studies or intended for patient use, with a few consumer applications designed chiefly for games. The assistive qualities of BCI devices may make it possible for patients to study or continue some occupations that they enjoyed before falling ill, but general educational application remains several years away.

## Brain-Computer Interfaces in Practice

- Intendix is a BCI system designed to assist patients who are unable to use a keyboard. The user concentrates on a letter or an action button in a grid, and the system types that letter or carries out that action: http://www.intendix.com
- Emotiv has developed a low-cost headset that detects brain activity and drives games, assistive programs, and art-making software based on the user's thoughts: http://www.ted.com/talks/tan_le_a_headset_that_reads_your_brainwaves.html
- XWave is a relatively inexpensive BCI headset that connects to an iPhone, iPad, or iPod Touch, allowing a user to control games or meditation exercises: http://www.plxwave.com

## For Further Reading

**Brain Chips, Battle Suits, and Cochlear Implants**
http://www.mcgilldaily.com/articles/37040

(Rebecca Falvey, *The McGill Daily*, 5 November 2010.) Advances in BCI research may eventually allow the control of devices such as prosthetic limbs and wheelchairs.

**Mind Over Matter: Brain Control Interfaces Become a Reality**
http://www.extremetech.com/article2/0,2845,2359071,00.asp

(Robert Oschler, *ExtremeTech.com*, 12 February 2010.) BCI researcher Dr. Gerwin Schalk has developed an advanced pattern detection and visualization tool.

**The Robot That Reads Your Mind To Train Itself**
http://www.bbc.co.uk/news/technology-11457127

(Lakshmi Sandhana, *BBC News Technology*, 24 October 2010.) Researchers at the University of Washington's Neural Systems Laboratory are developing a BCI system to control robots.

**Time-to-Adoption: Four to Five Years**

# Gesture-Based Computing

Gesture-based computing remains an interesting technology, and the number of gestural devices on the market has grown over the past year. As the underlying technologies evolve, a variety of approaches to gesture-based input are being explored. The screens of the iPhone, the iPad, and the Surface, for instance, react to pressure, motion, and the number of fingers touching the devices. The smaller devices additionally can react to manipulation — shaking, rotating, tilting, or moving the device in space. The Wii and similar gaming systems use a combination of a handheld, accelerometer-based controller and a stationary infrared sensor to determine position, acceleration, and direction. The technology to detect gestural movement and to display its results is improving very rapidly, increasing the opportunities for this kind of interaction. Two new gaming systems — the Sony PlayStation 3 Motion Controller and the Microsoft Kinect system — take a step closer to stripping the gesture-based interface of anything beyond the gesture and the machine, at least in terms of how it is experienced by the user. An interesting area of development is the intersection of haptics — touch-sensitive interfaces that also give physical feedback — and gesture-based computing, where we are beginning to see new kinds of interactions that combine the affordances of both approaches.

## Relevance for Teaching, Learning & Creative Inquiry

- Gestural interfaces allow users to easily perform precise manipulations that can be difficult to manage with a mouse.
- Gesture-based games like those developed by researchers at Georgia Tech University can help deaf children learn linguistics at a critical time of language development.
- Large multi-touch displays support collaborative work, allowing multiple users to interact with content simultaneously.

## Gesture-Based Computing in Practice

- This innovative project at the Auckland Museum uses touch-screen interfaces to allow visitors to create custom virtual orchids in lifelike detail: http://vimeo.com/6580702
- Researchers at MIT are developing inexpensive gesture-based interfaces that track the entire hand: http://web.mit.edu/newsoffice/2010/gesture-computing-0520.html
- Microsoft's Kinect system works with the XBox 360 platform to deliver immersive, gesture-based gaming and interactive experiences: http://www.xbox.com:80/en-US/kinect

## For Further Reading

**IDENT Technology's Near Field Electrical Sensing Interfaces**
http://www.ident-technology.com

IDENT Technology uses near field electrical sensing to allow mobiles to respond to grip and proximity sensing. A ringing mobile will put the call through if it is picked up and held, but will send it to voice mail if it is picked up and quickly put down again.

**Point, Click: A Review of Gesture Control Technologies**
http://games.venturebeat.com/2010/02/09/point-click-a-review-of-gesture-control-technologies

(Damian Rollison, VentureBeat.com, 9 February 2010.) This article discusses the key developers and platforms working with gesture-based technologies.

**TeslaTouch**
http://teslatouch.com

Developed at Disney Research, Pittsburgh, TeslaTouch provides physical feedback for touch interfaces. Different sensations convey information about the items being tapped or dragged.

**Time-to-Adoption: Four to Five Years**

# 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. Analysis models that process and display the data assist teachers and school personnel in interpretation. The goal of learning analytics is to enable teachers and schools to tailor educational opportunities to each student's level of need and ability.

At its heart, learning analytics is about measuring a wealth of information about students in a way that would allow schools to take action. While EDUCAUSE has announced a major program in partnership with the Gates Foundation, the Hewlett Foundation, and others that identifies learning analytics as one of five key areas for development, it is still very early and most of the work in this area is conceptual. Learning analytics carries with it certain concerns about student privacy and profiling that will need to be addressed as the work moves forward. The potential for learning is clear, but the technology to deliver that potential is still very young.

## Relevance for Teaching, Learning & Creative Inquiry

- The promise of learning analytics is that when correctly applied and interpreted, they will enable teachers to more precisely identify student 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

- The analytics software Socrato has been used to track students in Boston Public High Schools: http://www.socrato.com/solutions/case-studies/
- 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/
- SNAPP analyzes and visualizes data from discussion forum posts to allow teachers to perceive behavioral patterns: http://research.uow.edu.au/learningnetworks/seeing/snapp/index.html

## For Further Reading

**7 Things You Should Know About Analytics**
http://net.educause.edu/ir/library/pdf/ELI7059.pdf

(EDUCAUSE, April 2010.) This brief report explains how analytics are used for teaching, learning and assessing student progress.

**Academic Analytics**
http://net.educause.edu/ir/library/pdf/PUB6101.pdf

(John P. Campbell and Diana G. Oblinger, *Educause*, October 2007.) This paper gives an overview of academic analytics and includes a guide to references and resources.

**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 they might be applied in learning institutions.

**Time-to-Adoption: Four to Five Years**

# The Semantic Web

The idea behind the semantic web is that although online data might be easily available for searching, their meaning is not: computers are very good at returning keywords, but very bad at understanding the context in which keywords are used. A typical search on the term "turkey," for instance, might return traditional recipes, information about the bird, and information about the country; the search engine can only pick out keywords, and cannot distinguish among different uses of the words. Similarly, although the information required to answer the question "Which original paintings by Arthur Dove are housed in the United States?" is readily available to a search engine, it is scattered among many different pages and sources. Semantic-aware applications use the context of information as well as the content to make determinations about relationships between bits of data; examples like TripIt, SemaPlorer, and Xobni organize information about travel plans, places, or email contacts and display it in convenient formats based on semantic connections.

## Relevance for Teaching, Learning & Creative Inquiry

- Semantic portals that aggregate information from a variety of sources could facilitate research.
- A fully-developed semantic search tool could return results from a topical search with video, images, text, and other content aggregated and presented in a meaningful way.
- As the amount of available information continues to grow, semantic tools that can deliver context-sensitive information will become more key for research and sense-making.

## The Semantic Web in Practice

- Apture is a free semantic application that allows users to find and add relevant multimedia easily to blogs: http://www.apture.com
- CultureSampo is a web 2.0 portal and a publication channel for Finnish cultural heritage based on the semantic web: http://www.seco.tkk.fi/applications/kulttuurisampo/
- Hakia, created using Yahoo's new Build your Own Search Service (BOSS), is a semantic web service that provides results based on quality, not popularity. One criterion, for example, is that results come from librarian-recommended sites: http://company.hakia.com/about.html
- Type a phrase into Kosmix.com — such as "semantic web" — and receive a multimedia report including definitions, top search results, relevant blog entries, photos, videos, and more: http://www.kosmix.com

## For Further Reading

**Semantic Web at Data.gov**
http://www.data.gov/semantic

This site provides a number of examples of how the semantic web could be used to analyze government data in a visual context.

**Talis' *Nodalities* Magazine**
http://www.talis.com/nodalities/

This free publication is a good resource for staying up to date on current and emerging semantic web technologies. The articles provide many examples and case studies.

**Tim Berners-Lee on the Next Web**
http://www.ted.com/talks/tim_berners_lee_on_the_next_web.html

(*TED Talks*, February 2009.) Sir Tim Berners-Lee discusses the history and future of the web.

# Trends

**The abundance of resources and relationships made easily accessible via the Internet is increasingly challenging us to revisit our roles as educators in sense-making, coaching, and credentialing.** This multi-year trend was again ranked very highly, indicating its continued influence. 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.** The computer is smaller, lighter, and better connected than ever before, without the need for wires or bulky peripherals. In many cases, smart phones and other mobile devices are sufficient for basic computing needs, and only specialized tasks require a keyboard, large monitor, and a mouse. Mobiles 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.

**Devices like Apple's iPad are filling a niche that is neither 'big smart phone' or 'small laptop.'** As more people use, and discuss the ways they are finding to use, devices like the iPad, it is becoming clear that these are neither oversized phones nor stripped-down laptops. Instead, they represent a new class of devices that perhaps we were not even aware we wanted until they became available — and almost ubiquitous. They are more and more commonly seen, and are already gaining a footing in education, the health industry, and other sectors as tools for learning and for serious work.

**People expect to be able to work, learn, and study whenever and wherever they want to.** This highly-ranked trend, noted last year, continues to permeate all aspects of daily living. 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 used 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 growing willingness on the part of administrators to consider new approaches to combining face-to-face and technology-assisted instruction.** While blended methods of instruction have been part of the toolset available to faculty for over two decades, they are becoming increasingly common. Older students with jobs and families, and students who live in remote locations that prevent regular on-campus attendance, have long sought alternative means of

attending courses. Today we are seeing a growing number of conventional students opting for blended classes, and remote instruction is also seen as a viable means of supporting increasingly large survey courses that cannot be accommodated in existing classroom spaces. For these and other reasons, administrators are more interested than ever in these kinds of approaches.

**What were previously thought of as new and disruptive forms of scholarship are now becoming the norm for scholarly communication.** Blogs, open textbooks, electronic journals, and forms of expression embodied in new media formats have challenged the notions of scholarly writing and communication for several years. Yet these techniques are increasingly common and are readily accepted as informal outlets for scholarly work. A more gradual trend toward official acceptance is moving slowly, but its stirrings are visible in the adoption of electronic content, experiments with crowd-sourcing, and open, online peer review of scholarly work. This trend is related to the challenge of developing metrics for evaluating such work, noted in 2010 as well as again this year.

**The world of work is increasingly collaborative, driving changes in the way student projects are structured.** This trend is being driven by the increasingly global and cooperative nature of business interactions facilitated by Internet technologies. The days of isolated desk jobs are disappearing, giving way to models in which teams work actively together to address issues too far-reaching or complex for a single worker to resolve alone. While this trend is not widespread, where schools have created a climate in which students, their peers, and their teachers are all working towards the same goals, where research is something open even to first year students, the results have shown tantalizing promise. Over the past few years, the emergence of a raft of new (and often free) tools has made collaboration easier than at any other point in history.

# Challenges

**Appropriate metrics of evaluation lag the emergence of new scholarly forms of authoring, publishing, and researching.** Citation-based metrics, to pick one example, are hard to apply to research based in 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.** The challenge is due to the fact that despite the widespread agreement on its importance, training in digital literacy skills and techniques is rare in teacher education programs. In higher education, formal training is virtually non-existent. As faculty and instructors 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.

**Economic pressures and new models of education are presenting unprecedented competition to traditional models of the university.** Across the board, institutions are looking for ways to control costs while still providing a high quality of service. Schools 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 survey courses over the network so students can attend from their dorm or other locations to free up lecture space. As these pressures continue, other models may emerge that diverge from traditional ones.

**Educators are increasingly expected to teach digital citizenship.** The notion of digital citizenship, and our role as educators in instilling it, is not well understood. Clearly, people of all ages need to understand how to behave civilly and responsibly online, but there is disagreement as to what constitutes responsible behavior and whose province it is to teach it. Like other social mores, online etiquette varies from community to community and culture to culture; the challenge arises in the ease with which community and cultural borders are crossed or even blended in a networked world.

**Increasingly, it is becoming part of the public debate that educators need to improve the ability to measure learning in real time.** Current assessment models are criticized for not supporting learners when they are most in need, and educational outcomes are limited by our inability to accurately assess individual student abilities and areas for improvement. Learning analytics is increasingly interesting as a possible avenue for addressing this problem, so much so that major efforts are being undertaken to explore and develop it by EDUCAUSE, the Gates Foundation, and other learning-focused bodies.

**Our ability to remix and reuse content is increasingly limited.** Over the last eighty or so years, but especially within the last decade, copyright laws have become more and more restrictive. Where once it was natural to study, learn from, and build upon the creative works of the past, it is now difficult even to understand what is permissible and what is not. Open content and digital scholarship are impeded by laws that circumscribe the ability of teachers and scholars to reuse material of all kinds that could be employed in the service of learning.

**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.