HORIZON REPORT

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EXECUTIVE SUMMARY

The *Horizon Report* series is the product of the New Media Consortium's Horizon Project, an ongoing research project that seeks to identify and describe emerging technologies likely to have a large impact on teaching, learning, or creative expression within higher education around the globe. This volume, the *Horizon Report: 2008 Australia–New Zealand Edition,* is the first in a new series of regional reports, and examines emerging technologies as they appear in and affect higher education in Australia and New Zealand in particular.

The core of the report describes six areas of emerging technology that will impact higher education in Australia and New Zealand within three adoption horizons over the next five years. To identify these areas, the project has drawn on an ongoing conversation among knowledgeable persons in the fields of business, industry, and education; on published resources, current research and practice; and on the expertise of both the NMC community and the communities of the members of the Horizon Project's Australia–New Zealand Advisory Board. The Advisory Board, chosen to broadly represent a range of perspectives in Australian and New Zealand tertiary education, engages in a discussion around a set of research questions intended to surface significant trends and challenges and to identify a wide range of potential technologies for the *Report.* Using a process detailed in the methodology section, the Advisory Board comes to a consensus about the six topics that will appear here. The examples and readings under each topic area are meant to provide practical models as well as access to more detailed information. Wherever possible, an effort was made to highlight the innovative work going on among tertiary institutions in Australia and New Zealand.

The focus of the Horizon Project centres on the applications of emerging technologies to teaching, learning, and creative expression, and the format of the Horizon Report reflects that focus. Each topic includes an overview to familiarize readers with the concept or technology at hand, a discussion of the particular relevance of the topic to those activities, and examples of how the technology is being or could be applied. Each description is followed by an annotated list of additional examples and readings which expand on the discussion in the *Report.* A list of related tags suggests additional search terms that might be of use if the reader wishes to investigate a topic further.

Key Trends

A portion of the work of the Advisory Board is devoted to reviewing key trends in the practice of teaching, learning, and creativity. The Australia-New Zealand Horizon Advisory Board identified and ranked those it considered most important for campuses in those regions to follow. Trends were identified through a careful analysis of interviews, articles, papers, and published research. The four trends below were determined to be those most likely to have a significant impact in education in Australia and New Zealand in the next five years. They are presented in priority order as ranked by the Advisory Board.

- *Worldwide production of over 1 billion mobile phones per year is driving both innovation and adoption of ever more capable portable devices.* These machines have the capacity to access the network, but they are not owned by the institution, a situation which is revealing an increasing disconnect between policy and reality. This movement away from desktop computers and labs is shifting the locus of control over access to resources from central authorities to users, with a resulting shift in the ways learning spaces are conceptualised and designed.
- *There is an increasingly important set of influences from the workplace that are impacting how learning is designed and conducted.* This is pushing a greater awareness of the value of hands-on, purpose-driven, authentic, and other active learning approaches. Increasingly the

effectiveness of learning is being measured using concepts like engagement and time on task. The increased emphasis of the workplace on skills will fuel a greater focus on certifications, portfolios, and other ways that life experiences can be documented.

- *The increasing connectedness of people around the globe has and continues to dramatically reduce the costs of collaboration.* The decline in these costs is paralleled by tremendous growth in the sorts of free and/or very-low-cost tools available to bring people together in real time, to share assets and resources, and to communicate.
- *As both computers and the network increase in connectedness and capability, the set of technologies available to educators grows ever richer.* The ubiquity of these tools has lowered the cost of entry to use them, and is in turn opening up a range of new opportunities for e-learning and other forms of technology-mediated learning.

Critical Challenges

The Australia–New Zealand Advisory Board noted many challenges facing tertiary education in the region over the next few years, and selected the four listed below as those most likely to impact the practice of teaching, learning, and creative expression over the next five years. The challenges appear in priority order as determined by the Advisory Board.

- *Protectionism limits access to materials, ideas, and collaborative opportunities.* Security concerns too often go too far. Both policies and firewalls are severely limiting access to — and hampering the utility of — the Internet, the use of digital materials, and many benefits of social networking. Adding to this, the mindset of central network planners and administrators is often at odds with the increasingly user-centric nature of Internet applications and tools, limiting innovation.
- *Many teachers do not have the skills to make effective use of emerging technologies, much less teach their students to do so.* The technical skills of teachers are too often out of step with those of their students. Related issues are the capabilities of the staff supporting teachers, which suffer from the same problem, limiting the options available for training.
- *Assessment continues to be a significant barrier to adopting new tools and approaches.* In a sort of chicken-and-egg syndrome, there is a persistent need to have solid data on the efficacy of new tools and approaches that often limits the experimentation required to gain those data in the first place.
- *Poor quality broadband limits options at school and at home.* Public policy and reliance on telecom companies for infrastructure and broadband services has failed to ensure sufficient resources to support the level of quality broadband penetration needed to remain competitive. Metering adds to this by discouraging network use: the more useful the network is, the more it is used, and the more expensive it becomes — a cyclical process that ultimately discourages greater utility of the network because it adds unmanageable costs.

The challenges and trends noted here provide a perspective with which to frame the potential ramifications of the six technologies described in the *Horizon Report: 2008 Australia–New Zealand Edition.* They are indicative of the changing environment in which we work as we pursue the activities associated with teaching, learning, and creative expression and are included as an acknowledgement of the fact that neither technology nor education exists in a vacuum.

Technologies to Watch

The technologies featured in this regional edition of the *Horizon Report* are placed along three adoption horizons that represent what the Advisory Board considers likely time frames for their widespread adoption on university and college campuses. The first adoption horizon assumes the likelihood of broad adoption within the next year; the second, adoption within two to three years; and the third, adoption within four to five years.

We find ready examples of established use on campuses of the two technologies that appear on the nearest adoption horizon, *virtual worlds & other immersive digital environments* and *cloud-based applications.* Those in the mid-term horizon, *geolocation* and *alternative input devices,* are are already commonly in use in the consumer world, and educational examples are not difficult to find on campuses working on the leading edge of technology. As would be expected, the furthest horizon contains the two topics that have been least adopted: *deep tagging* and *next-generation mobile.* Even in this horizon, examples of campus use do exist, although they tend to be in the early stages of development.

In the body of the report, each featured technology includes specific examples, but as the horizon moves further out in time these become more isolated. Our research indicates that each of these six areas will have significant impact on college and university campuses in Australia and New Zealand within the next five years.

- **Virtual Worlds & Other Immersive Digital Environments** The use of virtual worlds and other sorts of immersive digital environments in education has skyrocketed in the last few years. Hundreds of colleges and universities worldwide are using these spaces for all manner of projects. A continuing stream of new developments in the platforms and their underlying technologies promise to keep this an exciting, innovative space for some time to come.
- **Cloud-Based Applications** Most of us use cloud-based applications daily, sometimes without being aware of it. Cloud computing promises nearly infinite storage space, vastly increased processing capability, and distributed services that are beginning to change the way we think about applications and data management.
- **Geolocation** Attaching information about physical location to both our media and ourselves is becoming ever easier to do, and increasingly is being done for us transparently by the devices we use. New and very useful applications for locative information are emerging in the form of data visualization tools, personalized place-based services, and procedures for searching and finding.
- **Alternative Input Devices** We are witnessing the first major innovations in interaction design to take hold since the invention of the mouse — and they will change the way we work with computers. Accelerometers built into handheld controllers and mobiles allow the devices to react to motion and to the way they are being held. Multi-touch interfaces accept intuitive, gesture-based commands and open up possibilities for simultaneous, collaborative work.
- **Deep Tagging** As the amount of rich media available to us increases, so does its potential utility for learning and research. But rich media is difficult to work with; it is problematic to search and find content embedded in long audio or video recordings or large multimedia pieces. Deep tagging, a technology still in development, promises to ameliorate that issue by enabling parts of larger media to be tagged and annotated, with obvious implications for improved search and retrieval.
- **Next-Generation Mobile** With more than 1.2 billion new phones produced each year, the mobile phone markets are bubbling with innovation. Mobiles now routinely have the ability to access cellular, wifi, and even GPS networks; new touch-screen interfaces are redefining how we use the devices; and independently developed third-party applications increase their utility daily. Indeed, mobiles are beginning to rival laptop computers in the range of capabilities they possess. Virtually

every student carries one, and in the coming years, mobiles will become a main source of educational and campus-based activities.

These six key emerging technologies were selected by the Advisory Board from over one hundred technologies and practices identified during the process of preparing this report. While it is striking that there is little overlap between these six topics and those in the global edition of the *2008 Horizon Report,* it is worth noting that the superset of technologies examined by both Advisory Boards was essentially the same. Those whose focus is educational technology are watching the same developments with a careful eye, no matter where they are located. At the same time, it is apparent that there is value in considering the Horizon Project's research questions through a regional lens in addition to the global one used for the past six years. The data seem clear that the prevailing trends and unique challenges of the area are shaping the way technology is adopted in post-compulsory educational settings in Australia and New Zealand.

About the Horizon Project

Since the launch of the Horizon Project in March 2002, the NMC has convened an ongoing series of conversations and dialogs with hundreds of technology professionals, campus technologists, faculty leaders from colleges and universities, and representatives of leading corporations from more than two dozen countries. For the past five years, these conversations have resulted in the publication each January of a globally focused report on emerging technologies relevant to higher education. Each year, as the report is produced, an Advisory Board engages in focused dialogs using a wide range of articles, published and unpublished research, papers, and websites. The result of those dialogs is a list of the key technologies, trends, challenges, and issues that knowledgeable people in technology industries, higher education, and museums are thinking about.

This year, for the first time, the NMC embarked on the first of a new series of regional and sector-based companion editions of the Horizon Report, with the dual goals of understanding how technology is being absorbed using a smaller lens, and also noting the contrasts between technology use in, say, Australia, as compared to the rest of the world, or in museums compared to universities. This report, the *Horizon Report: 2008 Australia–New Zealand Edition,* is the first of these new publications.

Like the global efforts from which it sprung, the "down under" project, referred to informally as *Horizon.au,* used qualitative research methods to identify the technologies selected for inclusion in the report, beginning with a survey of the work of other organizations and a review of the literature with an eye to spotting interesting emerging technologies. When the cycle started, little was known, or even could be known, about the appropriateness or efficacy of many of the emerging technologies for these purposes, as the Horizon Project expressly focuses on technologies not currently in widespread use in academe. For the current report, more than 100 of these were initially considered.

The 45 members of this year's Advisory Board were purposely chosen to represent a broad swath of Australian education, as well as key writers and thinkers from business and industry. They engaged in a comprehensive review and analysis of research, articles, papers, and interviews; discussed existing applications, and brainstormed new ones; and ultimately ranked the items on the list of candidate technologies for their potential relevance to teaching, learning, and creative expression. Much of this work took place in and around an extraordinary face-to-face gathering in Melbourne in July 2008, using a variety of tools specially purposed for the project. All of this work was captured and may be reviewed on the project wiki, at http://horizon.nmc.org/australia.

For additional background on the Australia–New Zealand project, please see the section on Methodology at the end of this report.

VIRTUAL WORLDS & OTHER IMMERSIVE DIGITAL ENVIRONMENTS

Time-to-Adoption Horizon: One Year or Less

We have watched as hundreds of educational institutions have chosen to enter the virtual arena over the past few years. Early projects that drew heavily on real-world forms and practices gradually have given way to more experimental ventures that take advantage of the unique opportunities afforded by virtual worlds and other immersive digital environments. Now we are seeing increased use of these spaces for truly immersive forms of learning and for a level of collaboration that is erasing traditional boundaries and borders rapidly. The technology that supports virtual worlds is advancing at a rapid rate, paving the way for more realistic environments, connections between different platforms, and new ways to enter and use virtual spaces. As participation and development both continue to increase, these environments are becoming ever more interesting spaces with obvious potential for teaching, learning, and creative expression.

Overview

Virtual worlds are richly immersive and highly scalable 2- or 3-D environments. Most, but not all virtual worlds are multi-user spaces, meaning that many people can be in the same virtual space and interact with one another in real time, generally through a representation of themselves as an avatar. While many popular games take place in virtual worlds, virtual worlds are not themselves games. They are social environments over which a physical context can be laid. The most successful in an educational context are flexible spaces, and as such, it is quite common to find professional development activities like conferences and meetings taking place in settings such as Second Life®, Project Wonderland, OpenSim, Qwaq, Active Worlds, and other immersive environments.

Over the past few years, as hundreds of colleges and universities have begun to experiment with these spaces, and as more educational, professional, and commercial activities have taken place in such environments, our understanding of how these spaces are used and why they are effective has grown apace. While some immersive platforms are essentially analogs to physical spaces and thus primarily used for modelling and prototyping (SketchUp or Maya, for example), the greatest growth by far has been at the intersection of virtual worlds and social networking.

The most successful spaces capitalize on this trend, and include common social networking tools such as profiles, the ability to locate friends within the environment, customizable personas (avatars), and methods for communicating both synchronously and asynchronously. Tools like these support projects and educational gatherings in virtual worlds by enabling people to share space at a distance, which in turn facilitates the formation of social groups.

It has become evident that people generally return to virtual spaces because of the experiences they find there, not because of the spaces themselves. While the physicality of the space may excite initial curiosity and interest, the ongoing attraction of any virtual space is its community — the people that use the space. The space itself, while important, is a secondary attraction. Part of the reasons for this is that convening a group in a virtual world is a palpably different experience from participating in other real-time communication forums, and people find they like the feeling of connection. When people choose to simultaneously inhabit the same space at the same time, as happens in virtual world gatherings, meetings take on a deeper dimension, with a great many parallels to face-to-face gatherings. As a result, it is very common to see the average time per visit to a socially focused virtual space approach 60 minutes or more. This is true even when measured over tens of thousands of visits.

Sophisticated toolkits are being developed to support collaboration at a distance within virtual environments. Specially designed immersive workspaces are emerging that combine familiar collaboration tools with virtual spaces, integrating the comparatively new activity of meeting in virtual worlds with long-established patterns of working at a distance. A product developed by Rivers Run Red and Linden Lab, for example, offers an immersive workspace environment that uses the web and the virtual world of Second Life to integrate productivity applications, online meeting spaces, and communication tools (http://riversrunred.com/immersive-workspaces/). Similar efforts are underway at Sun Microsystems and other organizations, indicating that virtual worlds are likely to continue to grow as a platform for distance collaboration.

With more widespread use has also come increased demand for content and for tools to create content. Since this topic was first addressed in the *2007 Horizon Report,* we have witnessed enormous development in building tools, climate simulators, physics engines, and the overall capability of these platforms to simulate reality. There is increasing activity in this space; Gartner, Inc. has estimated that by 2011, 80% of Internet users will have an avatar in a virtual world, and hundreds of platforms are already available or in development. Interoperability is the next major goal for the industry; work is underway to connect different worlds with one another for seamless transition between them; prototypes of virtual world clients are emerging for mobile devices and the web. The market for virtual worlds is undergoing tremendous growth, and we can expect considerable improvements in system capability, interoperability between systems, and interoperability of development tools in coming years.

Increased capability goes hand in hand with increased demand for processing power and bandwidth. In Australia in particular, the policy implications of these requirements have hampered acceptance and use, and are likely to continue to be a factor. Virtual worlds and immersive spaces require fairly sophisticated computers and a not-insignificant amount of bandwidth. Those requirements will continue and increase as environments become progressively more realistic.

Relevance for Teaching, Learning, and Creative Expression

Among the many avenues that are now being explored and developed in virtual worlds and immersive environments are how to craft alternative learning experiences that cannot be replicated in the real world, and how to use them to stimulate critical thinking, exploratory learning, and experimentation. Infinitely customizable, virtual worlds lend themselves to detailed simulations in fields from accounting to zoology. Creative applications for virtual worlds are emerging in dozens of disciplines like literature, the arts, the sciences, mathematics, medicine, and many other areas.

Virtual worlds and immersive environments are routinely used for academic meetings, classes, and other educational gatherings. It is not at all uncommon to have someone join an otherwise face-to-face meeting from a distant location by being present via a virtual world. The benefit of being able to be present while physically located at a great distance is obvious for colleagues located on opposite sides of the continent; the technology facilitates travel-free interactions between Australians all over the country, from Alice to Ocean, as it were. Virtual worlds can be applied in distance learning, connecting far-flung learning communities with each other and with expertise that may not be readily accessible locally.

Virtual worlds provide a rich environment for scenario-based learning, allowing students to interact with — or even construct — places and objects of historical or scientific significance. They can be used to create immersive experiences not possible for students in real-life settings, like visiting the Forbidden City or a mosque during the call to prayer. Immersive environments are currently being used to visualize real time weather data, model complex mathematical functions, experiment with architectural models, and much more. Courses from dozens of disciplines are making use of virtual worlds at hundreds of colleges and universities. Flexible learning spaces, simulations, and alternative experiences allow students to take part in activities that are difficult to host in real-life classrooms, such as managing mental health or drug issues as a social worker, or touring a working industrial plant.

A wide range of interest groups has sprung up around teaching and learning in these environments, offering opportunities for networked and informal learning both about the spaces themselves and about discipline-specific content. Research is being conducted on topics like creative identity play and exploration, consumer behaviour, and emerging social norms in virtual spaces, all of which will inform the development and use of immersive spaces as well as broaden our understanding of the ways people interact in immersive environments.

A sampling of applications of virtual worlds and immersive environments across disciplines includes the following:

- **Literature** Immersive environments have been created that replicate the author's world, or that of the characters, for students to explore; more interpretive spaces allow students to explore the psychological space of a character, broadening their understanding of the work. A truly unique project conceptualized at the University of Sydney, "Virtual Macbeth," is one such space that gives students the opportunity to explore and deeply experience Macbeth's descent into pathos in an environment that simply could not be created in any other medium.
- **Medicine** The Second Health project used a detailed build in a virtual world to tell a visual story about a unique vision for the near-term future in real life. Created by the medical school at Imperial College in London, the National Physical Lab (NPL) in the UK, and NMC Virtual Worlds, the in-world model of a new type of health care centre was used as the set for a series of videos describing the vision.
- **Religious Studies** The Religion Bazaar, developed at the University of Queensland, is a space in the virtual world of Second Life where students can explore places of worship, see artefacts and regalia associated with different religions, and even witness religious rituals. The project gives students the opportunity to learn about religious experiences that they are unable to experience firsthand.

Examples of Virtual Worlds and Immersive Environments

The following links provide examples of virtual worlds and immersive environments in educational settings.

Australian Film TV and Radio School

http://www.aftrs.edu.au/aboutus/NewsEvents/News/gamesandvirtualworldsanewfrontierofexperience.aspx

The Australian Film TV and Radio School (AFTRS) has created new Graduate Diploma courses in Game Design and Virtual Worlds that explore the link between virtual worlds and cinematic story.

Koru

http://arwennastardust.wordpress.com/about/

Several New Zealand institutions share an island in Second Life, Koru, that is populated with native plants and animals and is used for teaching. Koru is owned by the Nelson Marlborough Institute of Technology; participating institutions include Weltec, Open Polytechnic of New Zealand, Universal College of Learning (UcoL), and Massey University.

Skoolaborate

http://www.skoolaborate.com

Skoolaborate is providing a safe environment for schools from around the world to experiment with virtual worlds and learn from each other in order to transform learning.

VideoTrace

http://www.acvt.com.au/research/videotrace/

Developed by the Australian Centre for Visual

Technologies at the University of Adelaide and the Oxford Brookes Computer Vision Group, VideoTrace is a tool for quickly making 3-D models by tracing objects in video footage.

Virtual Classroom Project
http://jokaydia.com/jokaydia-projects/virtual-classroom-project/

The Virtual Classroom Project at Jokaydia in Second Life is providing a platform for educators to experiment with designing spaces for learning. Participants create their ideal learning spaces, which are used in the virtual world and/or become the basis for a real-world prototype.

Virtual Macbeth
http://virtualmacbeth.wikispaces.com/

An immersive experience set in the virtual world of Second Life, Virtual Macbeth takes learners into the psychological space of the title character. Themes from the play are explored through firsthand experience in surreal settings that evoke the emotions and actions of Macbeth.

For Further Reading

The following resources are recommended for those who wish to learn more about virtual worlds and immersive environments.

2008 Metaverse Tour Video: The Social Virtual World's a Stage
http://www.personalizemedia.com/2008-metaverse-tour-video-the-social-virtual-worlds-a-stage/

(Gary Hayes, PersonalizeMedia, 5 August 2008.) The author visited over fifty virtual worlds; this blog post includes a video with clips from many of them and a summary of a few observations.

The Future Will Be Better Tomorrow
http://www.christianrenaud.com/weblog/2008/05/the-future-will.html

(Christian Renaud, Christian Renaud's Weblog, 9 May 2008.) This blog entry makes eight predictions about developments in virtual worlds over the next 3-5 years.

The Journal of Virtual Worlds Research
http://jvwresearch.org/

This online journal launched in July 2008 and features topics such as Virtual Worlds Research: Past, Present and Future; Consumer Behaviour in Virtual Worlds; the Culture of Virtual Worlds; and Pedagogy, Education and Innovation in 3-D Virtual Worlds.

The Metaverse Journal
http://www.metaversejournal.com/

The Metaverse Journal is devoted to reporting news, projects, events, and other items on the subject of virtual worlds — with a uniquely "down under" perspective.

Second Classroom
http://secondclassroom.ning.com

Second Classroom is an online community dedicated to exploring the ways that educators can use immersive media such as Second Life, multiplayer online games, and social networks with students to create authentic learning.

Second Life in Education Wiki
http://sleducation.wikispaces.com/virtualworlds

The Second Life in Education wiki, maintained by Jo Kay and Sean Fitzgerald, features a list of nearly 100 virtual worlds (active or in development) and links to a wide range of virtual world projects and resources.

***del.icio.us:* Virtual Worlds and Immersive Environments**
http://del.icio.us/tag/hzau08+virtual_worlds

(Australia-New Zealand Horizon Advisory Board and Friends, 2008). Follow this link to find additional resources tagged for this topic and this edition of the *Horizon Report.* To add to this list, simply tag resources with "hzau08" and "virtual_worlds" when you save them to *del.icio.us.*

Related Tags: MMOG, simulation, 3-D worlds, immersive workspaces

CLOUD-BASED APPLICATIONS

Time-to-Adoption Horizon: One Year or Less

The emergence of large "data farms" — specialized data centers that host thousands of servers — has created a surplus of computing resources that has come to be called the cloud. Aspects of computing that used to be considered expensive, like disk storage and computing cycles, are now becoming cheap and ubiquitous. Layered on top of the cloud infrastructure are development platforms that are enabling thin-client, web-based applications for everything from image editing to word processing to music and video manipulation. Specialized applications like Flickr live entirely in the cloud and are unidentifiable as individual machines; there is no single computer, or even specific group of computers, that can be pointed to as housing Flickr, Google, or YouTube. Advances in computer science to ensure redundancy and protection from natural disasters have led to data being shared across many different hosting facilities. As the infrastructure has improved, these cloud-based applications are introducing a new way to think about software and files — and the ways we work with them.

Overview

The *cloud* is the term for networked computers that distribute processing power, applications, and large systems among many machines. *Cloud-based applications* are, simply, programs that use the cloud as their platform, for data storage, or both. These applications run not on a local computer, or on a single server, but on a distributed cluster of computers. The cloud is not made up of a single set of computers, but refers to any group of machines that are used in this way; it is not tied to a particular location or owner, though many companies have proprietary clouds. "Amazon's cloud" refers to the computers used by Amazon.com; "the Amazon EC2 cloud" denotes servers that can be leased from Amazon as part of the Elastic Compute (EC2) group; IBM, Microsoft, Cisco, and many other companies offer cloud-based applications hosted on their clouds.

There are three types of services associated with the cloud, two of which include cloud-based applications. The most straightforward set of services from an end-user perspective are cloud-based applications that serve a single function, such as email or productivity applications. Examples of these include Gmail (http://gmail.com), Quicken Online (http://quicken.intuit.com/online-banking-finances.jsp), Google Docs (http://docs.google.com), and Zoho Office (http://www.zoho.com), among others. The next tier is one step removed from this: instead of offering end-user applications, these services offer the infrastructure on which to build such applications, along with the computing power to deliver them. Examples include Google App Engine (http://code.google.com/appengine/), which allows developers to create and host tailored programs using Google's infrastructure; Heroku (http://heroku.com), which does the same for applications developed in Ruby on Rails; and Joyent (http://joyent.com), which hosts and scales applications in a variety of languages. The final tier of cloud services are those that offer sheer computing resources without a development platform layer, like Amazon's Elastic Compute Cloud (http://aws.amazon.com/ec2/) or GoGrid (http://www.gogrid.com).

To the end user, the cloud is invisible; the technology that supports the applications doesn't matter — just the applications themselves, and the fact that they are always available. Data storage is cheap in these environments — pennies per gigabyte — so cheap that it is often provided in surprising quantities for free.

Cloud-based applications are not without their drawbacks. Unlike off-the-shelf software packages installed on a local computer, which will remain usable as long as the operating system supports them, there is no guarantee that a cloud-based application will be around in the future. If the company that offers the application should collapse, the software may well just go away, as will access to any files specific to that application. Files created and saved on a local computer will remain safe and usable as long as they are backed up and the software remains installed. Files stored exclusively in the cloud, on the other hand, could become inaccessible in the future if the supporting company closes or is acquired, or even changes its business model. As a result there are privacy and ownership issues surround content that is created and stored on cloud systems that have yet to be resolved. Nonetheless, the economics of cloud computing are increasingly compelling.

Relevance for Teaching, Learning, and Creative Expression

Despite the risks, the emergence of cloud-based applications is causing a shift in the way we think about software and files. Rather than locking data and applications inside a single computer, we are gradually moving our software and files into the cloud, making them accessible from any computer using tools that are free or very inexpensive. The type of cloud-based applications that are currently most relevant to teaching, learning, and creative expression are the ready-made applications, hosted on a dynamic, ever-expanding cloud, that enable end users to perform tasks that otherwise would require a separately installed (and licensed) software package. Email, word processing, spreadsheets, presentations, collaboration, media editing, and more can all be done inside a web browser using applications that run in the cloud.

In addition to productivity applications, services like Flickr (http://www.flickr.com), YouTube (http://www.youtube.com), and Blogger (http://www.blogger.com), as well as a host of other browser-based applications, comprise a set of increasingly powerful tools that live in the cloud. Content created with these tools is easily sharable — not only is it easy to distribute the finished work, but it is also easy to collaborate while creating it. For creative expression, digital storytelling, and other purposes, there are cloud-based applications that can handle photo and video manipulation (see www.splashup.com for photos and www.jumpcut.com for videos, to name just two examples) or create presentations and slideshows (www.slideshare.net; www.sliderocket.com). A key feature of cloud-based applications is that they can scale quickly and easily, dynamically accommodating more users and more data.

Cloud-based applications like those listed above can provide students and teachers with free or low-cost alternatives to expensive, proprietary productivity tools. Browser-based, thin-client applications are accessible with a variety of computer and even mobile platforms, making these tools available anywhere the Internet can be accessed. The shared infrastructure approaches embedded in the cloud computing concept offer considerable potential for large scale experiments and research that can make use of untapped processing power.

While direct applications for teaching and learning are just beginning to emerge, this set of technologies is clearly an enabling force in the mix, and could distribute applications across a wider set of devices that are browser-enabled and greatly reduce the overall cost of computing. In addition, the ease of group work and collaboration at a distance could be a benefit applicable to many learning situations. Already, cloud-based applications are being used in the K-12 sector to provide virtual computers to students and staff without requiring each person to own the latest laptop or desktop machine; a handful of basic machines, provided they can access the Internet and support a web browser, are all that is needed for access to virtually unlimited data storage and programs of all kinds.

A sampling of cloud-based applications used across disciplines includes the following:

- **Sciences** Science Clouds, a project that aims to provide cloud computing resources to members of the science community for limited amounts of time in support of specific projects, launched its first cloud in early 2008. Scientists may request time on the clouds in exchange for a short write-up of their project.

- **Meteorology** Applications that combine a desktop interface with the data storage and computing power available in the cloud make powerful tools, once only available at large computing centres, available to anyone. One such example, Earthbrowser (http://www.earthbrowser.com), creates an interactive map populated with weather, geological, and other data; the engine that drives it lives in the cloud.
- **Media Studies** Using cloud-based applications like YouTube, a media culture course at Pitzer College in California tracks emerging up-to-the-moment social trends through real-time news clips and user-created content posted there.

Examples of Cloud-Based Applications

The following links provide examples of cloud-based applications.

CloudTrip: Education

http://www.cloudtrip.com/index.php?category=Education

CloudTrip is a fledgling directory of cloud-based applications, sorted into categories.

Encoding.com

http://www.encoding.com

Encoding.com offers on-demand online video encoding. For small projects, video is encoded and then sent to the destination of choice. Larger projects take advantage of a cluster of computers for job distribution.

Gmail Accounts at Macquarie University

http://www.pr.mq.edu.au/events/archive.asp?ItemID=3118

Macquarie University has adopted the education edition of Google Apps and given each student a Gmail account.

Google 101 Course Teaches Cloud Computing Concepts

http://uwnews.org/article.asp?articleid=37099

Developed by a Google employee, this course was piloted at the University of Washington and is now being offered at other universities. Students use an open-source version of the software at the heart of Google's cluster to study ways to effectively use cloud computing.

Google Apps at Waikato University and University of Auckland

http://www.zdnet.com.au/news/software/soa/Largest-NZ-uni-picks-Google-Apps/0,130061733,339290511,00.htm?feed=pt_cloud_computing

Waikato University and the University of Auckland are using Google Apps for email and productivity applications across campus.

Virtual Computers for K-12 Staff and Students

http://www.simtone.net/snapbook.htm

A partnership between SimTone Corporation and Frank Porter Graham Elementary School in Chapel Hill, North Carolina, will leverage cloud computing technologies to provide students and staff with virtual computers. An article by Christopher Dawson describing the project is available; see http://education.zdnet.com/?p=1883.

For Further Reading

The following articles and resources are recommended for those who wish to learn more about cloud-based applications.

The 100 Top Web Apps for 2008

http://www.webware.com/html/ww/100/2008/winners.html

(Webware, 21 April 2008.) Nearly two million votes were cast to select the top 100 web applications in 10 categories, including music, productivity, video, communications, tools, and more. The article includes a description of each application.

Cloud Computing Expo: Introducing the Cloud Pyramid

http://cloudcomputing.sys-con.com/node/609938

(Michael Sheehan, Cloud Computing Journal, 21 August 2008.) This article illustrates a pyramid model for thinking about the types of services cloud computing enables.

Computing Heads for the Clouds

http://www.businessweek.com/technology/content/nov2007/tc20071116_379585.htm

(Aaron Ricadela, BusinessWeek, 16 November 2007.) This article defines cloud computing and describes ways it is in use by IBM, Yahoo!, and Google.

Defogging Cloud Computing: A Taxonomy

http://refresh.gigaom.com/2008/06/16/defogging-cloud-computing-a-taxonomy/

(Michael Crandell, Refresh the Net, 16 June 2008.) This blog post includes a description of the layers of cloud computing: applications, platforms, and infrastructure.

Down on the Server Farm

http://www.economist.com/business/displaystory.cfm?story_id=11413148

(The Economist, 22 May 2008.) This article describes the infrastructure of Internet computing and its implications for the future.

How Cloud Computing is Changing the World

http://www.businessweek.com/technology/content/aug2008/tc2008082_445669.htm

(Rachael King, BusinessWeek, 4 August 2008.) This article describes a perceived shift in the way we think about computing as more companies begin to use cloud-based applications for communications and productivity tasks.

Official Launch of the Top 100 Australian Web 2.0 Applications List

http://rossdawsonblog.com/weblog/archives/2008/06/official_launch.html

(Ross Dawson, Trends in the Living Networks, 18 June 2008.) This blog post includes the annotated list of 100 top Australian web applications selected in 2008 for their innovation, rich web-based interfaces, and participatory nature.

The Tower and the Cloud: An EDUCAUSE eBook

http://www.educause.edu/thetowerandthecloud/133998

(Richard N. Katz, ed., EDUCAUSE, 2008.) This book, freely available as a PDF document, includes chapters by leading educators and technologists on all aspects of cloud computing and education, including accountability, implementation, social networking, and scholarship.

Twenty-One Experts Define Cloud Computing

http://cloudcomputing.sys-con.com/node/612375

(Jeremy Geelan, Cloud Computing Journal, 27 August 2008.) Brief quotes from twenty-one recent descriptions of cloud computing are gathered in this article to help draw a picture of what exactly it is.

Web 2.0 and Cloud Computing

http://radar.oreilly.com/2008/10/web-20-and-cloud-computing.html#definitions

(Tim O'Reilly, O'Reilly Radar, 26 October 2008.) This blog post describes three types of cloud computing and considers the impact of each on business.

***del.icio.us:* Cloud-Based Applications**

http://del.icio.us/tag/hzau08+cloudcomputing

(Australia–New Zealand Horizon Advisory Board and Friends, 2008.) Follow this link to find resources tagged for this topic and this edition of the *Horizon Report,* including the ones listed here. To add to this list, simply tag resources with "hzau08" and "cloudcomputing" when you save them to *del.icio.us.*

Related Tags: cloud computing, distributed systems, grid computing, webware, web applications, webapps, online apps, online productivity apps

GEOLOCATION

Time-to-Adoption Horizon: Two to Three Years

It is becoming increasingly easy to capture and use geolocative data associated with photographs, videos, and other media. Often, these data are automatically captured by your device, transparently, enabling simple, readily available tools to create mashups of data and maps that are changing the way we understand, display, and analyse information. One's own location can be gathered and transmitted using common devices like mobile phones and laptop computers, enabling Internet services to customize a visitor's experience based on where he or she is in the real world. These two features of geolocation — placement of media and of people in the physical world — have implications for research, data visualization, and social networking.

Overview

Geolocation technology is not new, but can now be rendered so small that it is now beginning to appear in a range of common devices like mobile phones, cameras, and other handheld devices. As a result, the ability to record and transmit geolocative data is available to almost anyone. Hand-encoding geolocative data is time-consuming and cumbersome, but that is changing as ordinary tools gain the capability to encode that data automatically. It will soon be very common for most photos in online collections to "know" where they were taken. Social networking updates from mobile devices can be geotagged automatically now, and many mobile services can respond to geolocative data.

Web services are beginning to make use of geolocative data in creative and useful ways. Radar (http://outside.in/radar) serves up local information like news, blog posts, restaurant reviews, and so on, based on a viewer's location. The service can determine a computer's location automatically based on IP address (if the user permits), allowing travellers to instantly get local information on their laptops wherever they may be. Buzzd (http://buzzd.com) is a city guide and social networking tool for mobile devices, including not only local information but also user ratings and tips. These relatively simple applications of geolocative data represent its earliest uses in websites and mobiles, and we can expect further development soon.

Similarly, the mapping of geolocative data is not new; but the ability to easily create map mashups online using multimedia and geotagged data is. Now that geolocative data are becoming easy to capture and apply as tag data, we are beginning to see applications for research and learning that are quick and inexpensive but still very effective. Google Maps (http://maps.google.com) offers a one-click way to overlay public, geotagged media onto the relevant section of a map as you view it; simply click the "more" button in the upper right of the map. Choose photos or videos, and they will fall into place on the map. With Flickr Maps (http://www.flickr.com/map), viewers can see at a glance what tags are currently being uploaded in a given region, or find locations in Australia where photographs of kookaburras were taken (mostly around the southern and eastern coasts, incidentally) by searching on those terms.

"Hyperlocal" information — minute details about a specific location in the form of everyday photographs, blog entries, and video clips — offers opportunities for research that were previously only available by actually living in the location in question. Geotagging these items facilitates searching and finding pertinent information for a given place and enables web services to pull in local information from a wider variety of sources. As it becomes easier to capture geolocative data, more media will be geotagged, increasing the availability of hyperlocal information.

Not all cameras, phones, and other devices have geolocative capability yet. In the meantime, a number of free or very low-cost tools to capture and display geolocative data are available. The Photo Finder by

ATP Electronics (http://www.atpinc.com/newweb/p2-4a.php?sn=00000257) is one example; it captures GPS data and synchronizes it to a camera's data card to geotag the photos automatically. Another approach is to use something like the GPS Trackstick (http://www.gpstrackstick.com), a small device that can be carried in a pocket or glove box. It records the path it travels, and the data can be uploaded to create custom maps.

Naturally, the easy availability of geolocative data raises questions about privacy and personal safety. As it becomes easier to gather, display, and use geolocative data, common sense must dictate how much information to share — and when and where to share it.

Relevance for Teaching, Learning, and Creative Expression

Geolocation has obvious application for research in a wide range of disciplines. It opens up opportunities for learning and data acquisition in the field for the sciences, social observation studies, medicine and health, cultural studies, architecture, and other areas. Researchers can study migrations of animals, birds, and insects or track the spread of epidemics using data from a multitude of personal devices uploaded as geotagged photographs, videos, or other media plotted on readily-available maps. Research material can be gleaned from everyday media uploaded by the millions of people using geo-aware cameras and recording devices, creating an ever-updating library of material online.

Existing collections of geolocative data are also becoming more accessible as the tools to search, organize, filter, and display such data become more sophisticated, easier to access, and simpler to use. The array of emerging web applications that can combine topographical data with geotagged media and information are at the heart of geolocation's importance to educational practice. Combined with free datasets like Geobase (http://geobase.ca/geobase/en/), a Canadian database of geospatial information, web applications can be used to produce custom visualizations layered over detailed maps or 3-D landscapes using real-world data.

Mobile learners can receive context-relevant information about nearby resources, points of interest, historical sites, and peers seamlessly, connecting all this with online information for just-in-time learning. Social networking tools for handheld and mobile devices or laptop computers can already suggest people or places that are nearby, or show media related to one's location. Mobile Twitter clients like Trak (http://www.trak.fr/site/en/) and Twinkle (http://tapulous.com/twinkle/) add the user's location to tweets, indicate nearby friends, and show messages tweeted in the user's vicinity. Collage (http://tapulous.com/collage/), a photo application for the iPhone, lets the viewer upload geotagged photos, browse photos taken nearby, and see photos as they are taken all over the world. Mobile Fotos (http://xk72.com/mobilefotos/) is another iPhone application that automatically geotags photos taken on the device before uploading them to Flickr. The technology to capture and use geolocative data in user-friendly ways on mobile devices is just beginning to hit the mainstream, and we can expect to see tremendous development in this area in the coming months.

A sampling of geolocation applications across disciplines includes the following:

- **Geosciences** Geolocation can be used to map the locations of key geological features or to plot mineral occurrences over large regions. Similarly, geotagged photographs of important outcrops found in Flickr can be easily mapped to give a visual overview of where they are located.
- **Urban Planning** Geolocative data can be applied to track and map commuter patterns or movements of pedestrians over time to improve the design and efficiency of urban transit systems.
- **Lifelong Learning** Mobile devices that are location-aware can supply information related to monuments, museums, civic centres, libraries, and other public buildings that are nearby.

Travellers can easily find performances or exhibitions that are currently underway in any city they visit.

Examples of Geolocation

The following links provide examples of applications of geolocation.

A Collaborative Map of Modernism in Australia

http://www.cityofsound.com/blog/2008/09/a-collaborative.html

This map displays the locations of modernist architecture across Australia, with links and images. It was developed after the author visited and critiqued the Modern Times exhibition at the Powerhouse Museum as a way of extending the reach of the exhibition across Australia.

CommunityWalk

http://www.communitywalk.com/

CommunityWalk is a tool that provides a way to create and annotate custom maps with geotagged data and photographs uploaded or pulled from Flickr.

'Flickr Bikes' Photo-Map Locations Across the Globe

http://www.lifehacker.com.au/tips/2008/09/16/flickr_bikes_photomap_locales_across_the_globe-2.html

As part of their "Purple Pedals" campaign, Yahoo shipped bikes outfitted with solar-powered camera phones to riders all over the world. As the bicycle moves, the camera takes a photo every 60 seconds, automatically geotagging and uploading each one to Flickr.

Introducing Geode

http://labs.mozilla.com/2008/10/introducing-geode/

In the near future, web browsers will have the ability to supply location information (if the user permits it) to websites that request it. An early instance of this technology, Mozilla's Geode, is an experimental add-on to Firefox 3 that allows developers and users to assess some of the possibilities of location-aware websites.

Locative Media: Eyes on the Prize

http://www.locative-media.org/projects/C82/

When the civil rights documentary *Eyes on the Prize* was re-released in the U.S., a public television network partnered with an Oakland, California high school to create a social justice project in which students documented social justice issues in their community, geotagged the events, and created a digital story and interactive map of their neighbourhood.

MIT's Senseable City Project

http://senseable.mit.edu

The Senseable City project at MIT seeks to create meaning, and art, from geolocative data.

Radar

http://outside.in/radar

Radar is a web service that provides local information, including news, restaurant reviews, blog postings, and the like. Radar can now accept geolocative data directly from the web browser, providing location-aware information to users without requiring the user to type in an address.

For Further Reading

The following articles and resources are recommended for those who wish to learn more about geolocation.

GeoPodcasting — Adding Location to Audio

http://www.randomconnections.com/?Fp?D1158

(Tom, Random Connections, 1 November 2007.) This post describes ways to geotag audio material like podcasts.

Geotag Your Digital Photos

http://www.macworld.com/article/135225/2008/10/geotagging.html

(Ben Long, Macworld.com, 3 October 2008.) This article describes several ways to geotag photographs, how to view and share them, and useful tools.

Guardian.co.uk Gets Maps

http://www.guardian.co.uk/help/insideguardian/2008/oct/09/1

(Paul Carvill, Inside Guardian.co.uk Blog, 9 October 2008.) This article describes how the Guardian.co.uk website implemented and used geolocation and maps to enhance articles submitted by journalists on the road.

How Your Location-Aware iPhone Will Change Your Life

http://lifehacker.com/395171/how-your-location+aware-iphone-will-change-your-life

(Adam Pash, Lifehacker, 5 June 2008.) The iPhone's location-aware features enhance a host of applications from social networking tools to geotagging photos taken by the phone to nearby restaurant recommendations.

Location Technologies Primer

http://www.techcrunch.com/2008/06/04/location-technologies-primer/

(Eric Carr, TechCrunch, 4 June 2008.) This article explains the technologies that are used for location-awareness applications.

What's the Best Web Site for Geotagged Photos?

http://news.cnet.com/8301-17939_109-9847536-2.html

(Stephen Shankland, CNET News, 10 January 2008.) This article compares a variety of websites that allow users to geotag their photographs.

del.icio.us: Geolocation

http://del.icio.us/tag/hzau08+geolocation

(Australia–New Zealand Horizon Advisory Board and Friends, 2008.) Follow this link to find resources tagged for this topic and this edition of the *Horizon Report,* including the ones listed here. To add to this list, simply tag resources with "hzau08" and "geolocation" when you save them to *del.icio.us.*

Related Tags: geotagging, maps

ALTERNATIVE INPUT DEVICES

Time-to-Adoption Horizon: Two to Three Years

The way we expect to interact with computers is changing as movement and gesture-based interfaces accompany popular games, mobile phones, and new computers and peripherals. Two advancements in particular — the accelerometer and the multi-touch screen — have already begun to show us more natural, intuitive ways to communicate with computers and work with electronic content. As more devices with these capabilities enter the marketplace, interface designers and software engineers are developing novel ways to use these interfaces that are ever more comfortable physically and more engaging and satisfying emotionally.

Overview

All around us, new interfaces are changing the way we work with computers and other technology. First appearing in the gaming world, the Nintendo Wii and its "wand" controller broke away from the traditional handheld controller and keyboard/mouse models. Along with other innovative interfaces like Activision's Guitar Hero, these devices allow players to engage in virtual activities with motion and movement similar to what they would use in the real world. Apple's iPhone and the table-sized Microsoft Surface broke similar barriers in the realm of interactive displays with their multi-touch screen-based controls. These two innovations — accelerometer-based devices and multi-touch screens — allow users to manipulate content intuitively, using natural gestures like flicking the wrist or sweeping the fingertips over a display.

Accelerometer-based devices use speed, direction, and momentum as inputs. The Wii-mote (the controller for the Wii) acts like an extension of the body, conveying movements of the wrist, fingers, and arm to the device's sensors. Other devices like the Wii Balance Board detect body posture, allowing the system to react to the user's entire body and enabling the simulation of physics concepts and principles of motion through kinaesthetic experience. Mobile devices like the iPhone use an accelerometer to determine the device's orientation, causing text and photos to rotate when the mobile is turned on its side, and enabling it to detect when it is being shaken so applications can react. For instance, dice games are available on the iPhone that allow the player to roll the dice by shaking the phone back and forth; a driving game for the iPod Touch is played by turning the device as if it were a steering wheel.

Large multi-touch displays also open up possibilities for collaborative activity; only one person can use a mouse at a time, but the Surface responds to several users at once. Perceptive Pixel's multi-touch system (www.perceptivepixel.com) reacts to multiple areas of contact (i.e. all the fingers on both hands, or several people's hands at one time), allowing a more natural, gestural movement than single-touch interfaces. Forty years after the computer mouse was first demonstrated, these devices and other alternatives are just beginning to suggest new ways to interact with computers — ways that are based on movements that are more closely associated with the task at hand, easier to do in a hurry, or more natural.

The Wii remote is not irrevocably locked to the Wii console as its only computing device. Some have experimented with connecting the Wii with a personal computer to use as an interface for basic operations and gaming (see www.youtube.com/watch?v=jkX1oQsvNe0). At Carnegie Mellon University, for example, a graduate student developed and demonstrated an interactive whiteboard created with a laptop computer, a standard projector and screen, and a homemade infrared pen (see a video of Johnny Lee's talk at TED 2008 at http://www.youtube.com/watch?v=0H1zrLZwPjQ). Others have implemented his model, providing interactive, multi-touch whiteboards in schools where the cost of purchasing one is simply too prohibitive.

Experiments like these are increasing our understanding of how alternative input devices can be designed and used. Combined with increasingly affordable large screens and video hardware capable of large-scale, multiscreen projection, alternative input devices will lead to new interfaces and displays that take advantage of natural motion, increased resolution, and larger display size. The result, still several years away, will be interaction devices that are as big a leap over the mouse as the mouse was over typing at the command line.

Relevance for Teaching, Learning, and Creative Expression

New applications that use the iPhone's accelerometer and multi-touch input screen are appearing daily, but most of them are designed for entertainment and gaming, and few are targeted specifically for education. One recent example is Grafly (http://grafly.com), a graphing calculator for the iPhone that uses the touch interface to zoom, and also allows the user to view graphs from any angle by simply moving the phone "around" the graph to change the view. Music and language applications that capture sound or written words are emerging, but these seem still to be in their infancy.

The Microsoft Surface is currently too expensive for most schools, but devices like the Wii remote show promise for both their flexibility and affordability. Homemade smartboards created with the Wii remote are already being used in K-12 and college classes around the world. Accelerometers in mobile devices and in the Wii remote are sophisticated enough to be used for science experiments and are affordable as teacher tools, and they are already being adapted for use in schools.

Many other potential applications for these devices exist. Portable, motion sensitive devices, can be used for all sorts of data capture collection, and especially lend themselves to field work. Multi-sensory input devices that combine touch with visual, aural, and tactile feedback engage the user on multiple levels. Such devices have the potential to create simple but powerfully engaging learning experiences. Input devices that behave or respond like instruments (Ocarina) or artists' materials (Trace) enhance the transfer of real-world skills to computer-assisted music and art, enabling artists to experiment with a wider range of forms for creative expression — or simply to create.

The alternative input devices already widely available are driving development of increasingly sophisticated applications, and as this technology matures, we can expect a great deal more. Tools continue to emerge that take greater advantage of the capabilities for gestural input and multiple streams of feedback that mobiles, gaming systems, and even computers increasingly possess. Over time, innovative educational uses for these devices will certainly look to take advantage of them.

A sampling of applications of alternative input devices across disciplines includes the following:

- **Physics** Two physicists in Italy designed an experiment for secondary students using a Wii remote to measure acceleration of a pendulum. The remote provided an affordable accelerometer that could be easily obtained by secondary school teachers for use in science classes.
- **Language** Multi-touch and touch-sensitive screens or interactive whiteboard setups can capture a student's effort to write characters in Arabic, Chinese, Cyrillic, Hebrew, Japanese, or other languages, giving feedback on whether the character is correctly written.
- **Art** Touch sensitive devices create new ways for artists to express themselves using digital tools and techniques — and to open creative doors to new audiences as well. For example, the Wii remote has been used to control a painting program via the movement of a wheelchair.

Examples of Alternative Input Devices

The following links provide examples of educational applications of alternative input devices.

au Design Project x Yamaha

http://www.kilian-nakamura.com/blog-english/index.php/au-design-project-x-yamaha-merges-music-with-mobile-in-new-ways/

Au, the mobile division of Japanese company KDDI, develops a series of projects intended to push the envelope of mobile device design. One project, in collaboration with Yamaha, has resulted in mobile phones that double as musical instruments.

gMote

http://techie-buzz.com/featured/control-pc-with-mouse-gestures.html

gMote is software that allows the user to capture gestures — custom mouse motions — and assign them to various computer tasks, such as copying and pasting, text formatting, opening programs, and more.

iKana Touch

http://www.thinkmac.co.uk/ikanatouch/

iKana Touch is a language application for the iPhone that allows Japanese language learners to review Hiragana and Katakana, see an animation of how each character is written, and practice forming a character by drawing it directly on the touch screen.

Microsoft Surface

http://www.microsoft.com/surface/index.html

The Microsoft Surface is a tabletop, multi-touch interactive display. Designed for businesses like hotels or conference centres, it includes applications for viewing photographs, creating maps, and listening to music.

Nintendo Wii Fit

http://www.nintendo.com/wiifit

The Wii Fit combines the Wii Balance Board, the Wii remote, and the Wii console into a full-body input package. It includes sports games, strength and yoga exercises, and balance games. Special remotes shaped like golf clubs, tennis racquets, and baseball bats are available.

QuickGraph

http://www.colombiamug.com/EN/QuickGraph.html

QuickGraph is a graphing calculator for the iPhone. Users can zoom in and out or rotate the graphs using the touch interface, or shake the phone to reset the view.

Wiimote in My Classrooms

http://heyjude.wordpress.com/2008/09/02/wiimote-in-my-classrooms/

In her blog, Judy O'Connell reports on classes at St. Joseph's College, Hunters Hill that are using techniques developed by Carnegie Mellon graduate student Johnny Lee to adapt the Wii remote as an interactive whiteboard.

Wiimote Wheelchair Helps Disabled People Paint (Roughly Speaking)

http://gizmodo.com/5013758/wiimote-wheelchair-helps-disabled-people-paint-roughly-speaking

A Wii remote was used to control a painting program by allowing people to move the brush with a wheelchair.

For Further Reading

The following articles and resources are recommended for those who wish to learn more about alternative input devices.

Accelerometer

http://en.wikipedia.org/wiki/Accelerometer

(Wikipedia.) This article describes accelerometers and lists some applications for them, including the Wii and several mobile phones that use the technology.

Hacking the Wii Remote for Physics Class

http://www.physorg.com/news104502773.html

Physicists in Italy designed experiments for secondary school science students using the accelerometer in a Wii remote.

Johnny Chung Lee: Projects

http://www.cs.cmu.edu/~johnny/projects/wii/

Johnny Chung Lee's projects include interactive whiteboard surfaces and other tracking applications that use the Wii remote. Videos demonstrating the projects and the source code that make them work are available on the site.

Multi-touch

http://en.wikipedia.org/wiki/Multi-touch

(Wikipedia.) This article discusses the history of multi-touch technology and describes recent developments.

Steven Levy on Melding the Digital and Physical Realms

http://www.wired.com/gadgets/gadgetreviews/magazine/16-11/ts_levy

This brief article describes the Wii, Guitar Hero, and the iPhone as the long-promised merging of the virtual and the real.

Top 15 Interactive Display Technologies

http://www.gizmowatch.com/entry/top-15-interactive-display-technologies/

(Naveen, Gizmo Watch, 15 May 2007.) This article lists fifteen interactive display technologies, including tabletop and wall-mounted multi-touch screens.

del.icio.us: Alternative Input Devices

http://del.icio.us/tag/hzau08+altinteraction

(Australia–New Zealand Horizon Advisory Board and Friends, 2008.) Follow this link to find resources tagged for this topic and this edition of the *Horizon Report,* including the ones listed here. To add to this list, simply tag resources with “hzau08” and “altinteraction” when you save them to *del.icio.us.*

Related Tags: alternative interaction devices, accelerometer, multi-touch interface, alternative interfaces

DEEP TAGGING

Time-to-Adoption Horizon: Four to Five Years

Deep tagging is a way to access the content buried within rich media like video, podcasts, Flash applets, and even images. With deep tagging, a component of a larger piece of media can be identified and labelled — tagged — according to what it is about, who is featured, or other relevant information for more precise searching and finding. Deep tagging as a technology is still in development; while there are a few proprietary solutions that show promise, the realization of easy deep tagging for most online media content is several years away. At the same time, the essential challenges are being solved as this is written, and adoption of this technology will happen quickly once that happens. As development continues, the technology's implications for just-in-time content delivery, remixing and reuse will undoubtedly prove to be of great value for education.

Overview

Tagging, the practice of attaching a descriptive word or phrase to a piece of online content for the purpose of linking it to other related content, has become a mainstream activity. A vision for the next generation of tagging is deep tagging, which would allow people to create a direct link to a small part of a larger piece of media, such as an image or a video. Others who search for those tags would be able to retrieve specific content via these tags, with the promise of facilitating just-in-time learning and creating new possibilities for research and scholarly work.

Currently, development efforts in deep tagging fall into three categories. The first is proprietary collections of materials that have been tagged for the purpose of selling the content. Collections of deep-tagged media facilitate research by making it easier to discover relevant segments of longer video clips, as in the case of old television or news broadcasts or recorded lectures and performances. Drawbacks of this type of service are that it can be expensive and the sources are limited to those the company chooses to archive. Critical Mention (http://www.criticalmention.com/web/overview.php) is one service that hosts a tagged archive of news broadcasts.

A second application of deep tagging allows users to upload and tag their own videos and other media, creating customized collections that may be linked to and shared. Flickr (http://www.flickr.com) has offered deep tagging of images for some time — when an image is uploaded, the owner can select a portion of it and label it with a text annotation. If the owner permits, others who view the image may add annotations as well. While this type of service is more flexible in that users can upload their own content, it results in collections of videos that are tied to the service — if the company disappears, so does the hosting — and that must be viewed on the service's site rather than on the user's. Sites that offer uploading and deep tagging services for personal videos include Deeptagging (http://en.deeptagging.com), VeoTag (http://www.veotag.com) and Viddler (http://www.viddler.com). YouTube (http://www.youtube.com) now offers deep *linking,* but not tagging, to any point within any video on the site using a time code embedded in the hyperlink.

The third application of deep tagging is the least developed. The vision here is that it will be easy to attach tags to any part of any image or any place in a video or audio clip, the way viewers can now with Flickr image annotations. Existing methods for tagging video or audio in this way rely either on transcriptions or owner-added tags. Gotuit (http://www.gotuit.com) offers a software package that content producers can use to index and tag media prior to upload to make it easier to search; EveryZing (http://www.everyzing.com) uses transcriptions to create searchable indexes of a client's content. Neither offers the ability for viewers to tag as they watch or listen. The next step in deep tagging, which has yet to be realized, is to develop tools that allow any viewer to add tags to any part of any image or any video or audio clip, wherever it may be found online.

Relevance for Teaching, Learning, and Creative Expression

Although the technology behind deep tagging has been in development for several years, direct educational examples are few. It is not difficult to project uses for deep tagging, however. If the technology continues to develop over the next few years, deep tagging could increase the granularity of time-based media, allowing parts of media clips to be more easily remixed, linked, and reused.

Many disciplines could benefit from the resulting video and audio libraries that would be as easy to search and tag as text-based resources are now. Searches would turn up tagged brief but pertinent segments of longer videos that might otherwise be missed, providing just-in-time delivery of only the content that the searcher is looking for. Student portfolios and professional resumes could include an RSS feed for the parts of podcasts that include the featured person. And students reviewing a recorded course lecture or podcast while preparing for an exam could skip to just the parts they need the most.

Tagging within video and audio clips could also facilitate the organisation and description of rich media in social software environments and enable users to co-create content by annotating the media. Voicethread (http://www.voicethread.com) currently offers something similar; a media file is uploaded and viewers can leave comments in text, audio, video, or other media that remain attached to specific points in the original content. If deep tagging continues to mature, we could see tools that easily enable this kind of collaboration around content anywhere online.

While there are few educational examples of deep tagging in use today, a sampling of possible applications for deep tagging across disciplines might include the following:

- **Cinematography and Film Studies** Tags attached to specific points in cinema recordings could indicate the type of shot, lighting effects, blocking, or other strategies. Students could find precisely the point in a film demonstrating a given topic; exams could include untagged clips for students to label.
- **Medicine** Archival films could be tagged with diagnostic information to identify medically relevant details, such as examples of gait that indicate certain diseases or injuries. Films of surgical procedures could be annotated and tagged.
- **Earth Sciences** Films or simulations of physical processes could be annotated with information related to what the viewer is seeing: for instance, video clips of avalanches could be tagged with information that describes some of the fluid dynamics at play.

Examples of Deep Tagging

The following links provide examples of tools that currently support deep tagging within rich media.

EveryZing

http://www.everyzing.com

EveryZing provides a software solution for indexing, searching, and connecting multimedia content to search engines.

Gotuit

http://www.gotuit.com

Gotuit makes software to manage searching and finding in video libraries through deep tagging.

SWFAddress

http://www.asual.com/swfaddress/

SWFAddress is a tool that allows developers to insert tags in rich media for later linking or searching.

Viddler

http://www.viddler.com

Viddler is an online video sharing service that enables users to upload completed videos, record directly to the web with webcam, tag or comment specific points in the video, and share videos using RSS and iTunes.

For Further Reading

The following articles and resources are recommended for those who wish to learn more about deep tagging.

All the Cool Kids Are Deep Tagging

http://www.techcrunch.com/2006/10/01/all-the-cool-kids-are-deep-tagging/

(Michael Arrington, TechCrunch, 1 October 2006.) Written when deep tagging was first introduced, this post discusses deep tagging and websites that offer it.

Audio Indexing: EveryZing's New Video Player Points Towards the Future of Online Video

http://www.readwriteweb.com/archives/everyzings_speech_to_text_metaplayer.php

(Frederic Lardinois, ReadWriteWeb, 22 October 2008.) This article describes EveryZing's video player that also allows users to search online videos using keywords and tags.

Deep Tag It

http://www.writetech.net/2007/03/deep_tag_it.html

(Michelle Lentz, WriteTechnology, 2 March 2007.) This blog post describes deep tagging, suggests ways to use tagged video, and describes a deep tagging product by Veotag.

Video Search Catches Up with Video Tagging

http://www.clickz.com/showPage.html?page=3624735

(Jeremy Lockhorn, ClickZ, 29 January 2007.) This article describes video tagging and outlines why it is useful, as well as identifying a few websites that offer video tagging.

YouTube Enables Deep Linking Within Videos

http://www.techcrunch.com/2008/10/25/youtube-enables-deep-linking-within-videos/

(Jason Kincaid, TechCrunch, 25 October 2008.) This blog post describes a newly released feature on YouTube that enables users to link directly to a spot in any YouTube video by adding a time code tag to the link. Additionally, YouTube automatically links time codes mentioned in video comments to that point in the video.

***del.icio.us:* Deep Tagging**

http://del.icio.us/tag/hzau08+deeptagging

(Australia–New Zealand Horizon Advisory Board and Friends, 2008.) Follow this link to find resources tagged for this topic and this edition of the *Horizon Report,* including the ones listed here. To add to this list, simply tag resources with "hzau08" and "deeptagging" when you save them to *del.icio.us.*

Related Tags: deep linking, tagging within rich media

NEXT-GENERATION MOBILE

Time-to-Adoption Horizon: Four to Five Years

Considerably smaller and less expensive than a laptop, the mobile is clearly evolving into the next form of portable computer. New interfaces, the ability to connect to wifi and GPS in addition to a variety of cellular networks, and the availability of third-party applications have created an almost entirely new device with nearly infinite possibilities for education, networking, and personal productivity. The continuing pace of innovation around mobile devices and software promises that even greater capabilities are on the way, and ensures that mobile will continue to be a space to watch.

Overview

Mobiles have been evolving rapidly over the past few years. Initially just for voice calls, mobiles became multimedia devices with the addition of cameras. Increased storage capability led to mobiles holding images and video so seamlessly, they became the storehouse of our digital lives almost overnight, holding address books and photos and connecting us with text messaging as well as voice. Mobiles then became ubiquitous multimedia capture devices. In the process they changed the news and our perceptions of how it is gathered forever — CNN.com, for example, invites visitors to send in newsworthy video captured on cell phones — because it is so likely a phone is near breaking news to capture it on video. Smartphones extended the capabilities of mobiles with advanced features like geolocation, web browsing, and email. Personal digital assistants (PDAs) became history as mobile phones absorbed their functions.

Then, in June of 2007 with the introduction of the iPhone, devices with very different displays and capabilities appeared on the market. We interact with them very differently than we did even with smartphones. These new devices can access the Internet over the cell network or by using wifi. They can sense motion and orientation and react accordingly thanks to built-in accelerometers. They use GPS to locate themselves and they can run robust applications. Most significantly, their manufacturers are working with the developer community to open up the device to all the innovation that third-party developers can bring. Multimedia production, social networking, productivity, communication, and geolocation collapsed into one small device: the next generation of mobile.

The fact that third-party applications can be developed and deployed for our phones represents a profound shift in the way we think about mobile devices. The App Store for the Apple iPhone (http://www.apple.com/iphone/appstore/) is bursting with small applications, including software for games, productivity, education, business, health and fitness, reference, travel, and more. Other mobile platforms are emerging that will encourage similar development, such as the Android platform developed by Google and the Open Handset Alliance (http://en.wikipedia.org/wiki/Google_Android). The first Android phone was released to market in October 2008, and the number of applications in the Android Market (http://www.android.com/market/) is growing by the day. Open APIs encourage the creation of custom widgets that offer even more services; combined with webware applications, the capabilities of mobiles rival those of a computer with a web browser.

Because these applications can be written by anyone, we are seeing a daily stream of new applications that leverage the technical advances of mobiles in ever more creative ways. Applications like TinEye Music (http://www.ideeinc.com/products/tineyemobile/) and SnapTell (http://snaptell.com/) use the camera to record a photograph of a CD, video, or book, then compare it with an online database to retrieve information about the artist or author, publisher, reviews, and where to buy it. Shazam (http://www.shazam.com/music/web/pages/iphone.html) does the same for ambient music — the microphone records a snippet of any song that is playing, and the waveform is compared in a database to identify the song, artist, and album, along with links to purchase the music from several sources. Mobile cameras can record barcodes to get information about products and pricing comparisons, or read quick-response (QR) codes in advertisements or on objects to download further information. E-readers are available that present text in an endless scroll, rather than paginated; tilting the phone up or down slows or accelerates the scrolling.

Newly developed networked applications are supported by multi-frequency radios built into mobile devices. Without the speed and increased access of wifi, many social networking and other web applications would be too slow to use. Location-aware applications take advantage of GPS in mobiles, whether it be pseudo-GPS enabled via cell tower triangulation or newer GPS built right into the phones.

The hardware and software advances are exciting, but they do not represent the whole picture. An equally important facet of next-generation mobile is the way that we use it to connect with one another. Mobile is increasingly about networking on the go. Social networking applications already link us with friends, family, colleagues, and the larger world; those links become even more powerful and meaningful when we can access and interact with our networks on a pocket-sized, portable device. When we are out and about, our mobiles can tell us who is nearby, recommend places to visit, find things we are looking for, and even tell us how to get from here to there. With a mobile in hand, we are in touch with our social networks wherever and whenever we wish to be.

Relevance for Teaching, Learning, and Creative Expression

The applications of mobile technology to teaching and learning are virtually limitless. Adoption rate and availability of bandwidth are the limiting factors. Once infrastructure is in place and students routinely carry mobile devices, they will be a natural choice for content delivery and even field work and data capture.

For the newest generation of mobiles, third-party applications for language, maths, science, and elementary education are easy to find. The most obvious materials — flash cards — are already available at all levels for almost every discipline. Tools that tap into the unique capabilities of mobile devices, like the camera, the microphone, and the accelerometer are appearing by the day. Language learners can install applications on their mobiles that let them look up words and even hear the word pronounced in the language they are learning, and it is not unreasonable to project that before long, they will be able to speak into the phone and hear their own voice compared to a native speaker's saying the same thing.

Reference materials for writing, chemistry, medicine, physics and astronomy — from dictionaries to calculators to interactive periodic tables — can be installed on mobile devices, ready for anytime, anywhere access. Pocket astronomy charts range from iAstronomica (http://artistictechworks.com/iastronomica.html), which includes planetarium-perspective illustrated star maps, to Distant Suns (http://www.distantsuns.com/index.html), a mobile version of an established desktop astronomy package. Google Earth is available for the mobile, complete with zoom and spin implemented through the touch screen. The variety and quality of content available for next-generation mobile devices is growing at a fantastic pace.

The use of mobiles in education is not without issue. Privacy is a very real concern for young people who carry what is essentially a geolocator that is quite capable of broadcasting their whereabouts to the Internet. Further, the continuing question of whether mobiles are more helpful or more distracting during class has yet to be answered. Yet the argument can be made that in class is not where they are most effective; the potential of mobiles for education is that they enable just-in-time learning, exploration, and immersive experiences outside the classroom.

A sampling of next-generation mobile applications across disciplines includes the following:

- **Mathematics** By selecting custom applications, students can turn their iPhones into sophisticated calculators. SpaceTime (http://www.spacetime.us/iphone/) and QuickGraph (http://www.colombiamug.com/EN/QuickGraph.html) are just two examples of graphing calculators that display graphs in two- or 3-D; SpaceTime also includes a scripting language for custom computations.

- **Music** Instrument simulators for piano, guitar, drums, and other instruments let students practice fingering and chords or compose simple pieces. Applications for ear training, reading music, and generating warm up exercises assist with basic practice. Artists can record multiple tracks or experiment with mixers that capture ambient sounds or voice recordings to create unique compositions. With the right applications, a mobile is instrument, tutor, and recording studio all in one.

- **Campus Life** iStanford is a custom application commissioned by Stanford University that includes campus maps, course listings, the campus directory, current sports scores, and other campus-related information (http://stanford.terriblyclever.com/). A future version will include functions to register for courses, view personal course history and grades, and more.

Examples of Next-Generation Mobile

The following links provide examples of applications for next-generation mobile.

Australia Mobile Wind Readings

http://www.apple.com/webapps/sports/australiamobilewindreadings.html

Select a region in Australia and receive wind readings, updated automatically every ten minutes, on your iPhone.

ChemiCal

http://www.twssworldwide.com/ChemiCal.html

This chemical calculation application for the iPhone returns the mass of one mole of the chemical that results from a given formula.

Google Earth for iPhone

http://googleblog.blogspot.com/2008/10/introducing-google-earth-for-iphone.html

The iPhone version of Google Earth includes all the detail of the desktop version and is available in 18 languages.

iPhone in Medicine

http://jeffreyleow.wordpress.com/2008/06/10/iphone-in-medical-education/

(Jeffrey Leow, Monash Medical Student, 10 June 2008.) Medical resources developed for the iPhone can be used by students and practitioners; a few are reviewed here.

Monash University Courses on Mobiles

http://walkabout.netcomp.monash.edu.au/walkabout/fit1011/index.html

Walkabout u-Learning courses at Monash University are offered online and are also formatted for mobile devices. The courses include Web Systems, Web Development, and Internet Applications Development.

Phone a Friend in Exams

http://www.smh.com.au/news/national/phone-a-friend-in-exams/2008/08/19/1218911717490.html

(Anna Patty, Sydney Morning Herald, 20 August 2008.) Presbyterian Ladies' College at Croydon in Sydney is experimenting with allowing the use of mobile phones for research — including calling sources — during exams.

For Further Reading

The following articles and resources are recommended for those who wish to learn more about next-generation mobile.

Forget iPhone or GPhone, 3 to debut "Facebook phone" next week

http://www.last100.com/2008/11/06/3-to-debut-facebook-phone-next-week/

A new low cost cellphone that puts Facebook and other social applications at its center will debut next week on Hutchinson-owned 3 in the UK and Australia.Apart from a dedicated

Facebook client the device will also include applications for Skype, email and IM.

How Mobile Is Changing Our Society

http://tarina.blogging.fi/2008/10/18/speaking-at-mobile-monday-amsterdam/

(Teemu Arina, Tarina, 18 October 2008.) This blog post explores the blurring boundary between mobile devices and computers and the potential future of what we now call mobiles.

iPhone: 3 Features That Will Impact Education

http://www.edutechie.com/2007/06/iphone-3-features-that-will-impact-education/

(Jeff VanDrimmelen, EduTechie.com, 12 June 2007.) This blog post describes three features of the iPhone — multi-touch display, widgets, and iPhone applications with full Internet access — and explains why the author believes they will make a difference for education in particular.

Next Generation Mobile Networks: Industry Leaders on Challenges Ahead

http://blogs.cisco.com/sp/comments/next_generation_mobile_networks_industry_leaders_on_challenges_ahead/

(Larry Lang, SP360: Service Provider, 28 June 2008.) This blog post summarizes the remarks of several industry leaders in a session at the Second NGMN Industry Conference in June 2008.

Please Wait a Sec, Just Need to Check Training Info on My Mobile Phone

http://aquaculturepda.edublogs.org/2007/08/21/please-wait-a-sec-just-need-to-check-training-info-on-my-mobile-phone/

(Sue Waters, Mobile Technology in TAFE, 21 August 2007.) This blog post describes ways that training is being delivered on mobile devices.

The Scannable World: Mobile Phones as Barcode Scanners

http://www.readwriteweb.com/archives/the_scannable_world_mobile_phones_as_barcode_scanners.php

(Sarah Perez, ReadWriteWeb, 24 September 2008.) This article describes how cell phones can be used as barcode scanners, and why one might want to do that. Two subsequent articles, linked at the bottom of the first one, explore further uses for scannable barcodes.

So Much More than Phone Calls

http://betch.edublogs.org/2007/10/10/so-much-more-than-phone-calls/

(Chris Betcha, Betchablog, 10 October 2007.) An Australian educator shares the tools he uses on a broadband-enabled cell phone.

Time to Leave the Laptop Behind

http://online.wsj.com/article/SB122477763884262815.html

(Nick Wingfield, The Wall Street Journal, 27 October 2008.) Road warriors are increasingly using mobiles to perform business tasks while travelling, leaving their laptops in the office or the hotel.

Top Ten Android Launch Apps

http://www.techcrunch.com/2008/10/22/top-ten-android-launch-apps/

(Erick Schonfeld, TechCrunch, 22 October 2008.) This blog post describes ten of the applications that are available as of the October 2008 launch of the first Android phone and why they are useful.

***del.icio.us:* Next-Generation Mobile**

http://del.icio.us/tag/hzau08+mobile

(Australia–New Zealand Horizon Advisory Board and Friends, 2008.) Follow this link to find resources tagged for this topic and this edition of the *Horizon Report,* including the ones listed here. To add to this list, simply tag resources with “hzau08” and “mobile” when you save them to *del.icio.us.*

Related Tags: iPhone, Android platform, smartphone, mobile broadband

METHODOLOGY

The process used to research and create the *Horizon Report: 2008 Australia–New Zealand Edition* is very much rooted in the methods used to develop the global edition of the *Horizon Report* that is released each January. All editions of the *Horizon Report* are produced using a carefully constructed process that is informed by both primary and secondary research. Nearly a hundred technologies, as well as dozens of meaningful trends and challenges are examined for possible inclusion in the report for each edition. Every report draws on the considerable expertise of an internationally renowned Advisory Board that first generates a broad set of important emerging technologies, challenges, and trends, and then examines each of them in progressively more detail, reducing the set until the final listing of technologies, trends, and challenges is selected.

Much of the process takes place online, but when new editions are created for the first time, a face-to-face meeting is often also part of the process, as a way to quickly build an engaged community among the advisors. All the work, wherever it occurs, is captured and placed in the Horizon Project wiki, which is the project's home on the web. The Horizon wiki is intended to be a completely transparent window to the process, and contains the entire record of the research. The wiki for the *Australia–New Zealand Edition* can be found at http://horizon.nmc.org/australia.

The procedure for selecting the topics that will be in the report includes a modified Delphi process now refined over five years of producing *Horizon Reports,* and it begins with the assembly of the Advisory Board. The board as a whole is intended to represent a wide range of backgrounds, nationalities, and interests, yet each member brings a particularly relevant expertise. To date, more than 275 internationally recognized practitioners and experts have participated in a Horizon Project Advisory Board; in any given year, as many as half the members are new.

Once the Advisory Board for a particular edition is constituted, their work begins with a systematic review of the literature — press clippings, reports, essays, and other materials that pertain to emerging technology. Advisory Board members are provided with an extensive set of background materials when the project begins, and are then asked to comment on them, identify those that seem especially worthwhile, and add to the set. The group discusses existing applications of emerging technology and brainstorms new ones. A key criterion for the inclusion of a topic is the potential relevance of the topics to teaching, learning, research, or creative expression. A carefully selected set of RSS feeds from at least dozen relevant publications ensures that these background resources stay current as the project progresses, and they are used to inform the thinking of the participants throughout the process.

Following the review of the literature, the Advisory Board engages in the central focus of the research — the five research questions that are at the core of the Horizon Project. These questions are designed to elicit a comprehensive listing of interesting technologies, challenges, and trends from the Advisory Board:

1. *What would you list among the established technologies that learning-focused institutions should all be using broadly today to support or enhance teaching, learning, or creative expression?*
2. *What technologies that have a solid user base in consumer, entertainment, or other industries should learning-focused institutions be actively looking for ways to apply?*
3. *What are the key emerging technologies you see developing to the point that learning-focused institutions should begin to take notice during the next 3 to 5 years? What organizations or companies are the leaders in these technologies?*

4 *What do you see as the key challenges related to teaching, learning, or creative expression that learning-focused institutions will face during the next 5 years?*

5 *What trends do you expect to have a significant impact on the ways in which learning-focused institutions approach our core missions of teaching, research, and service?*

One of the Advisory Board's most important tasks is to answer these five questions as systematically and broadly as possible, so as to generate a large number of potential topics to consider. To help with this, past Horizon Reports are revisited and the Advisory Board is asked to comment on the current state of technologies, challenges, and trends identified in previous years, and to look for metatrends that that may be evident only across the results of multiple years.

The regional and sector-based reports add one additional step as a way to seed the responses, and in a reverse-ranking process are asked to consider which of the six technologies are least likely to appear in the special edition. This process was used in Melbourne as part of the Australia-New Zealand Edition.

At this point, the Advisory Board is asked to generate as many new responses to the questions as possible, and to also comment on the existing responses. Once this work is done, usually within just a few days, the Advisory Board moves to a unique consensus-building process that uses an iterative Delphi-based methodology.

In the first step of this approach, the responses to the research questions are systematically ranked and placed into adoption horizons by each Advisory Board member using a multi-vote system that allows members to weight their selections. Each member is asked to also identify the timeframe during which they feel the technology would enter mainstream use — defined for the purpose of the project as about 20% of institutions adopting it within the period discussed. (This figure is based on the research of Geoffrey A. Moore and refers to the critical mass of adoptions needed for a technology to have a chance of entering broad use.) These rankings are compiled into a collective set of responses, and inevitably, the ones around which there is the most agreement are quickly apparent.

From the more than 100 technologies originally considered for this report, the twelve that emerged at the top of the initial ranking process — four per adoption horizon — were further researched. Once this "short list" was identified, the group, working with both NMC staff and practitioners in the field, began to explore the ways in which these 12 important technologies might be used in for teaching, learning, research, and/or creative expression. A significant amount of time was spent researching real and potential applications for each of the areas that would be of interest to practitioners.

For every edition, when that work is done, each of these twelve "short list" items is written up in the format of the Horizon Report. With the benefit of the full picture of how the topic will look in the report, the "short list" is then ranked yet again, this time in reverse. The six technologies and applications that emerge are those detailed in the Horizon Report.

For additional detail on the project methodology or to review the actual instrumentation, the ranking, and the interim products behind the report, please visit http://horizon.nmc.org/australia.

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