THE **HORIZON** REPORT

2010 AUSTRALIA – NEW ZEALAND EDITION

a publication of
The NEW MEDIA CONSORTIUM

*The **2010 Horizon Report: Australia–New Zealand Edition***
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Citation:
Johnson, L., Smith, R., Levine, A., & Haywood, K. (2010). *The 2010 Horizon Report: Australia–New Zealand Edition.* Austin, Texas: The New Media Consortium.

ISBN 978-0-9825334-8-2

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EXECUTIVE SUMMARY

The internationally recognized series of *Horizon Reports* is part of the New Media Consortium's Horizon Project, a comprehensive research venture established in 2002 that identifies and describes emerging technologies likely to have a large impact over the coming five years on a variety of sectors around the globe. This volume, the *2010 Horizon Report: Australia-New Zealand Edition,* examines emerging technologies for their potential impact on and use in teaching, learning, and creative enquiry within higher education in Australia and New Zealand over a five-year time period. This is the third in the annual series of reports focused on higher education in the region.

To create the report, the Horizon Project's Australia-New Zealand Advisory Board, an international body of experts in education, technology, business, and other fields, engaged in a discussion around a set of research questions intended to surface significant trends and challenges and to identify a wide array of potential technologies for the report. This dialog was enriched by a wide range of resources, current research, and practice that drew on the expertise of the NMC community and the communities of the members of the board. These interactions among the Advisory Board are the focus of the *Horizon Report* research, and this report details the areas in which these experts were in strong agreement.

Each edition of the *Horizon Report* introduces six emerging technologies or practices that are likely to enter mainstream use within three adoption horizons over the next five years. Key trends and challenges that will affect current practice over the same time frame add context to these discussions. Over the course of just a few weeks, the Advisory Board came to a consensus about the six topics that appear here in the *2010 Australia-New Zealand Edition.* 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 learning-focused institutions in Australia and New Zealand. The precise research methodology employed is detailed in the closing section of this report.

The report's format is consistent from year to year and edition to edition, and opens with a discussion of the trends and challenges identified by the Advisory Board as most important for the next five years. The format of the main section of this edition closely reflects the focus of the Horizon Project itself, centring on the applications of emerging technologies in higher education settings. Each section is introduced with an overview that describes what the topic is, followed by a discussion of the particular relevance of the topic to teaching, learning, and creative enquiry. Several concrete examples of how the technology is being used are given. Finally, each section closes with an annotated list of suggested readings and additional examples that expand on the discussion in the report, including a link to the tagged resources collected during the research process by project staff, the Advisory Board, and others in the global Horizon Project community.

Key Trends

The technologies featured in this edition of the *Horizon Report* are embedded within a contemporary context that reflects the realities of the time, both in the sphere of education and in the world at large. To assure this context was well understood, the Advisory Board engaged in an extensive review of current articles, interviews, papers, and new research to identify and rank trends that were currently affecting the practices of teaching, learning, and creative enquiry. Once detailed, the list of trends was then ranked according to how significant each was likely to be for learning-focused institutions in Australia and New Zealand over the next five years. The highest ranked of those trends had significant agreement among the Advisory Board members, who considered them to be key drivers of educational technology adoptions for the period 2010 through 2014. They are listed here in the order in which the Advisory Board ranked them.

- *As the availability and use of electronic books continue to grow, the traditional publishing (and textbook) market is undergoing a profound and lasting change.* As the music industry has already discovered, consumers appreciate the ability to purchase raw content formatted for devices of their choice. The content of books is becoming a commodity separate from the form of those books or the device used to access them. This shift is a dramatic one for an industry long accustomed to attaching value to the container and defining ownership in terms of possession of an object. Further, there is a growing expectation that the experience of reading electronic books will be more than

simply viewing a digital version of a printed volume. Consumers are looking for interactive electronic content that is divorced from hardware, offered cheaply and conveniently, and provided in flexible and sharable formats.

Social and open forms of peer review and scholarship are gradually gaining acceptance. As younger professors enter the ranks of academia and as new forms of online publishing slowly gain traction, long-established traditions such as peer review may come under closer examination. New technologies and approaches are emerging that may challenge certain elements of scholarship. Though not a new trend, this tendency may accelerate under the impetus of younger faculty and ready availability of alternatives to traditional scholarly processes.

The availability of educational content for mobile devices is increasing as more providers develop for these platforms. As electronic books and readers move into the mainstream, it is natural that educational content providers will be offering more and more content aimed at these devices. These "texts" can easily contain a wealth of dynamic multimedia, and students can buy or rent entire textbooks or just chapters and selections as needed. Annotation features, now emerging on a wider range of platforms, will allow easy recording and sharing of notes and commentary. As the rate of change and growth of information accelerate, keeping paper-based resources up to date can become an ever more daunting task. Easily-updateable electronic content ameliorates this issue and provides a means to deliver richer, nonlinear materials to support study.

Our notions of space and what constitutes learning environments continues to evolve. This trend, noted a year ago, still influences choices at all levels of the academy. It is now accepted that today's classroom includes people, access to information, and experiences that take place outside the traditional four-walled setting where a class may happen to meet face to face. Nonetheless, institutions are not yet fully committed to supporting the tools that make this possible, though these are gaining traction on more campuses. Social networking tools, semantic applications, mobile devices, virtual worlds, and other emerging technologies for collaboration, communication, and learning are a vital part of the learning environment that will best serve students, and these must be as readily available as books, desks, and whiteboards.

Critical Challenges

Any discussion of technology adoption must also consider important constraints and challenges, and the Advisory Board drew deeply from a careful analysis of current events, papers, articles, and similar sources, as well as from personal experience in detailing a long list of challenges institutions face in adopting any new technology. Several important challenges are detailed below, but it was clear that behind them all was a pervasive sense that individual organizational constraints are likely the most important factors in any decision to adopt — or not to adopt — any given technology. While acknowledging that local barriers to technology adoptions are many and significant, the Advisory Board focused its discussions on challenges that are common to institutions and the educational community as a whole.

The highest ranked challenges they identified are listed here, in the order of their perceived importance.

- *Even where technology for learning is strongly promoted, there remains a clear need for professional development opportunities around emerging technology.* One-to-one computer use is an admirable goal and a worthwhile one, and this strategy has been shown to improve student engagement and access to learning materials. Unfortunately, simply making the equipment available is not sufficient to reap the benefits. Where technology is promoted without an accompanying commitment to professional development for staff, learning suffers. This challenge continues from year to year, as emerging technologies change by their very nature, while professional development opportunities fail to keep up with the pace.
- *There is a conceptual mismatch between pedagogical practice and the design of many emerging technologies that makes it difficult for teachers to appreciate or use new tools.* Many new technologies are based on underlying values such as openness, collaboration, and community that simply are not in alignment with the majority of teaching practices. Adoption suffers because teachers do not see the connection between their classroom practice and technology tools, particularly social tools that emphasize communication and sharing

— two activities often seen as antithetical to learning, study, and especially assessment.

- *The need for formal instruction in key new skills, including information literacy, visual literacy, and technological literacy, poses a continuing challenge to educational programs.* As noted a year ago, students need — and often lack — a strong understanding of content and media design, the ability to interpret advertising and other media, and the capacity to create multimedia messages that demonstrate visual fluency. A handful of institutions have begun to integrate the teaching of these skills into a standard curriculum, but the practice is not widespread and too many students remain unschooled in this critical area.
- *In today's networked world, learners are placing greater value on knowing where to find information than on knowing the information themselves.* The ways we learn are changing. The amount of knowledge collectively held by humanity is staggering, and being able to find, evaluate, and synthesize material from a variety of sources is arguably more important than holding much of that knowledge oneself. Young people beginning postsecondary study — and those entering the workforce — are accustomed to constant access to a network of peers on whom they rely for knowledge, expertise, and mutual learning. This cohort may well expect to be able to make use of their own personal learning and social networks, and the technologies that support them, in their places of work or study. Their world is open and mobile, and they expect access to it constantly.

These trends and challenges are a reflection of the impact of technology that is occurring in almost every aspect of our lives. They are indicative of the changing nature of the way we communicate, access information, connect with peers and colleagues, learn, and even socialize. Taken together, they provided the Advisory Board a frame through which to consider the potential impacts of nearly 50 emerging technologies and related practices that were analysed and discussed for possible inclusion in this edition of the *Horizon Report.* Six of those were chosen as key; they are summarized below and detailed in the main body of the report.

Technologies to Watch

The six technologies featured in the *2010 Horizon Report: Australia-New Zealand Edition* are placed along three adoption horizons that indicate likely time frames for their entrance into mainstream use for teaching, learning, or creative enquiry. The near-term horizon assumes the likelihood of entry into the mainstream for institutions within the next twelve months; the mid-term horizon, within two to three years; and the far-term, within four to five years. It should be noted at the outset that the *Horizon Report* is not a predictive tool. It is meant, rather, to highlight emerging technologies with considerable potential for our focus areas of teaching, learning, and creative enquiry. Each of the six is already the focus of work at a number of innovative organizations around the world, and the work we showcase here reveals the promise of a wider impact.

On the near-term horizon — that is, within the next 12 months — are *electronic books* and *mobiles.* Mobiles makes a second appearance on this horizon, reflecting a shift in focus from mobile devices themselves to the networks that support them.

Electronic books are emerging as something quite different from simple digitized versions of printed texts. Modern electronic readers support note-taking and research activities, and are beginning to augment these basic functions with new capabilities — from immersive experiences to support for social interaction — that are changing our perception of what it means to read.

The promise of ***mobiles*** is ubiquitous access to not only the people with whom we communicate via a variety of means, but also to information, tools for learning and productivity, social networks, and more. As mobile devices have continued to evolve, it has become clear that affordable, reliable access to cellular and broadband networks is more important than which device is used. Whether simple or full-featured, mobiles connect us with the larger world, and a strong infrastructure to support that connection is increasingly in demand.

The second adoption horizon is set two to three years out, where we will begin to see widespread adoptions of two well-established technologies — *augmented reality* and *open content.* Augmented reality is entering the mainstream of popular culture and is already in common use on a number of campuses. Open content appears again in this horizon in a reprise of its appearance here last year, an indication of its continuing interest to educators and a reflection of the difficulties still attending its

adoption. Both of these technologies are expected to see much broader use across academia over the next two to three years.

Like 3D video, ***augmented reality*** is an inherently 3D technology — but it encourages interaction in ways that video does not. By interpreting marker tags or gestures, augmented reality has the potential to supplement a wide range of existing technologies, such as computers, mobile devices, video, and even the printed book. Augmented reality is compelling to experience, feels fresh and new, and is much simpler to use than it was in the past.

Given the amount and quality of ***open content*** that has been produced for nearly every subject, any new course design work would benefit from a review of what is currently available and might be reused. The key challenge to widespread acceptance of open content is that education is not yet a culture that rewards sharing: the reward systems in place promote new work and new thinking, and a "not invented here" mentality infuses decisions about the use of open content all too often.

On the far-term horizon, set at four to five years away for widespread adoption, but clearly already in use in some quarters, are *gesture-based computing* and *visual data analysis.* Neither of these two technologies is yet commonly found in campus settings, but the high level of interest and the tremendous amounts of research in both areas indicates that they are worth following closely.

Gesture-based computing stems from the idea that natural, comfortable motions can be used to control computers. This is opening the way to a host of input devices that look and feel very different from the keyboard and mouse — and that enable our devices to infer meaning from the movements and gestures we make. New interface technologies like Kinect, SixthSense, and Tamper are using very intuitive approaches to how we connect with our computers, allowing users to engage in virtual activities with motions and movements similar to those they would use in the real world.

Visual data analysis blends highly advanced computational methods with sophisticated graphics engines to tap the extraordinary ability of humans to see patterns and structure in even the most complex visual presentations. Currently applied to massive, heterogeneous, and dynamic datasets, such as those generated in studies of astrophysical, fluidic, biological, and other complex processes, the techniques have become sophisticated enough to allow the interactive manipulation of variables in real time with compelling results.

Each of these technologies is described in detail in the main body of the report, where a discussion of what the technology is and why it is relevant to teaching, learning, and creative enquiry may also be found. Given the practical focus of the report, a listing of examples of the technology in use, especially in higher education, is a key component of each of the six main topics. Our research indicates that all six of these technologies, taken together, will have a significant impact on learning-focused organizations within the next five years.

Regular readers of the *Horizon Report: Australia-New Zealand Edition* will note that some topics have strong ties to ones that were featured in past editions. Mobiles, augmented reality, and open content have all appeared in previous editions, but each is sufficiently different as to continue to excite interest in academia. Mobiles have grown as a category to include not only cellular phones and smart phones, but also other specialized devices that are increasingly powerful but still small and light enough to be held easily in one hand. The significance of mobile computing is not so much in the device used, but in the ability to easily access an expanding cellular network and fully-featured tools from the palm of your hand.

Augmented reality, discussed in 2009 as one aspect of immersive virtual experiences, has emerged as an interesting technology in its own right. Recent applications of augmented reality for mobile devices have shown that augmented experiences can be portable, tailored to a user's location and interests, and engaged in without any special equipment. Broad adoption is still two to three years away for education, but augmented reality has established a firm foothold in the consumer space.

Open content continues to gain acceptance, and returns this year with an emphasis on its potential to change the way courses are developed and its compatibility with another key technology, electronic books. While it too remains two to three years away from widespread adoption, the open content movement is attracting more attention, and development of tools and approaches for its creation and use continues to increase.

About the Horizon Project

Since March 2002, under the banner of the Horizon Project, the New Media Consortium has held an ongoing series of conversations and dialogs with hundreds of technology professionals, campus technologists, faculty leaders from colleges and universities, museum professionals, teachers and other school professionals, and representatives of leading corporations from more than two dozen countries. In the ensuing years, these conversations have been the impetus for a series of annual reports focused on emerging technologies relevant to higher education.

In 2008, the NMC embarked on 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 one area compared to another. This report, the *2010 Horizon Report: Australia-New Zealand Edition,* is the third in the series focusing on higher education in that region. To date, companion editions have also been prepared that centre on the region known as Iberoamerica, the K-12 sector, museums, and small- to medium-sized businesses. The flagship *Horizon Report,* published each January, focuses on higher education globally, and is translated into multiple languages every year. Over all editions, the readership of the reports is estimated at well over 500,000 worldwide, with readers in more than 70 countries.

Like the umbrella effort from which it emerged, the Australia-New Zealand project uses qualitative research methods to identify the technologies selected for inclusion in the report. The process begins with a survey of the work of other organizations, a close examination of topics previously detailed in the *Horizon Report* series, and a review of the literature with an eye toward spotting interesting emerging technologies.

The 32 members of this year's Advisory Board were purposely chosen to represent a broad spectrum of Australian and New Zealand education; key writers and thinkers from business and industry rounded out the group. They engaged in a comprehensive review and analysis of research, articles, papers, blogs, 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 enquiry. This work took place entirely online and may be reviewed on the project wiki at http://anz.wiki.nmc.org.

The effort to produce the report began in mid-August 2010 and concluded when the report was released in November, a period of just under three months. The six technologies and applications that emerged at the top of the final rankings — two per adoption horizon — are detailed in the chapters that follow.

Each of those chapters includes detailed descriptions, links to active demonstration projects, and a wide array of additional resources related to the six profiled technologies. Those profiles are the heart of the *2010 Horizon Report: Australia-New Zealand Edition,* and will fuel the work of the Horizon Project throughout 2010-11. For those wanting to know more about the processes used to generate the *Horizon Reports,* many of which are ongoing and extend the work in the reports, we refer you to the report's final section on the research methodology.

ELECTRONIC BOOKS

Time-to-Adoption Horizon: One Year or Less

As the technology underlying electronic readers has improved and more titles have become available, electronic books are quickly reaching the point where their advantages over the printed book are compelling to almost any observer. Already firmly established in the public sector, electronic books are gaining a foothold on campuses as well, where they serve as a cost-effective and portable alternative to heavy textbooks and supplemental reading selections. The availability of an increasing range of portable electronic reading devices, as well as the many book-reader applications designed for mobiles, has made it easy to carry a wide selection of wirelessly updated reading material. New, highly interactive publications demonstrate that quite apart from their convenience, electronic books have the potential to transform the way we interact with reading material of all kinds, from popular titles to scholarly works.

Overview

The very first electronic versions of books were those digitized by Project Gutenberg in the 1970s. Electronic books were meant to be read using a computer until the late 1990s, when devices specialized expressly for reading electronic books began to appear on the market. The latest readers offer a high-fidelity reading experience that provides most of the affordances of the printed book, with enhancements like wireless connectivity and ample storage that allow the typical device to hold more than 1,000 titles.

Electronic books have now reached mainstream adoption in the consumer sector. The Kindle was Amazon's best-selling product for 2009, with more than 390,000 titles available, and other readers are likewise gaining in popularity. Purchasing and downloading an electronic book is a quick and simple matter; purchases can be made at any time, from virtually any location. Multifunction devices like Apple's iPad represent a new class of tools that merge the utility of electronic book readers with web browsing, a wide variety of applications, and an expanding set of entertainment options. Devices like these make it very easy to integrate electronic books into everyday portable computing. The convenience of having an entire library of books, magazines, and newspapers — each remembering exactly where you left off the last time you looked at it — and all in a single, small device is one of the most compelling aspects driving sales of both electronic books and dedicated electronic readers.

A key question relating to electronic books is to what extent content should be separated from a particular device. Once in digital form, a book or other written material can easily be formatted for any electronic reader, but some publishing models restrict the content such that it is only accessible on a certain platform. Others are more open and allow easy transfer of content between devices. While the benefits of an open model are clear, the profit from selling an electronic reader is but a small fraction of the potential gain to be had by selling electronic books, and publishers who tie content to a particular reader can be sure of a customer base among those who own that model.

The most interesting aspect of electronic books is not the devices they are accessed with; it is not even the texts themselves. What makes electronic books a potentially transformative technology is the new kinds of reading experiences that they make possible. Publishers are beginning to explore richly visual interfaces that include audiovisual, interactive, and social elements that enhance and extend the textual content of books and magazines. The social magazine format used by *Flipboard,* for example, turns the browsing of RSS-enabled web content into a beautiful, serendipitous experience. Magazines like *Time, Wired,* and others include interactive graphs, links that extend the reader's experience, video, and more. *Epicurious* for iPad is an interactive cookbook complete with reviews, tips, recommendations, and the ability to add recipes. When the electronic book ceases to be a digital reproduction of a printed piece, some writers are seeing it becoming something far richer, allowing journeys through worlds real and imagined, undertaken not alone but in company with other readers. For three compelling visions of the future promised by the electronic book, see the five-minute video *The Future of the Book* produced by design firm IDEO (http://vimeo.com/15142335).

Examples of this new form of electronic book are becoming more common, but they are far from the norm. Standards for the creation of electronic publications are still in development, and those that exist often focus on the text and do not include

guidelines for the kinds of interactivity that is possible in electronic books. As more of its media morphs into digital forms, the publishing industry is undergoing a shift very similar to the one that took place in the music industry in the last decade. New business models and methods of distribution are appearing as older ones begin to falter. While there is no clear winner among the many available and emerging formats, the acceptance and widespread use of electronic books has enabled the industry to see a potential path through these wrenching changes.

Relevance for Teaching, Learning, or Creative Enquiry

While the typical electronic reader could conceivably hold the entire sum of textbooks and readings for the entirety of one's academic experience, campuses have been slower to adopt electronic books than the general public for several reasons: scarcity of titles, lack of necessary features in electronic readers, a restrictive publishing model, and digital rights management (DRM) issues. Most of these constraints are vanishing. Many academic titles are now available alongside the broad selection of consumer titles; reader technology has developed to the point that graphs, illustrations, videos, and interactive elements can easily be included, and many enable bookmarking, annotation, commentary, dictionary lookup, and other research activities. Publishers have begun to uncouple print and electronic sales of textbooks, making it easier to choose one or the other as desired.

Particularly in Australia and New Zealand, DRM restrictions continue to impede the adoption of electronic textbooks. Books that are available elsewhere may not be obtainable here at all, and many of those that are available are only offered for specific electronic readers. Until electronic textbooks are divorced from reader-dependent formats, broad adoption will continue to be problematic for universities. Nonetheless, electronic books are being explored in virtually every discipline, and the advantages for students make this technology worth pursuing.

For those with smart phones, iPads, and similar devices, subscription-based services are available that allow students to receive textbooks and ancillary materials on the devices they already own. Some models offer free membership with a pay-per-book feature; others charge on a per-course basis. Business models are emerging that may lower costs for students, including textbook rentals and bulk purchases by the institution. For-profit universities such as the University of Phoenix have begun requiring faculty to assign electronic texts, and in 2010, the California State University system is piloting a similar program. While this reduces student choice, it also provides a way for the university to secure cheaper buying options for students. Course management systems (CMS) are another point of entry to electronic texts; Blackboard has partnered with McGraw-Hill and two booksellers to enable faculty to assign, and students to buy, electronic texts within the Blackboard system. CourseSmart, a consortium of five publishers, has also developed CMS integration for assigning and purchasing electronic texts.

Scholarly journals are beginning to appear in electronic form as well. The European-based Directory of Open Access Journals lists some 5,500 titles — nearly half of which are searchable online at the article level — and a typical university research library will have access to many more. Scholarly journals are not yet common in the mobile space, although electronic versions of many consumer periodicals are already available as custom apps. Pricing models for mobile periodicals vary widely; paper subscribers can sometimes receive mobile versions free, but others must pay separately per issue — sometimes at a higher rate than for a paper subscription.

Pricing and DRM issues aside, electronic books have the potential to truly transform educational practice. Currently, most electronic books and journals are merely copies of printed versions that can be read on a computer or mobile device. This simply reinforces old models of teaching as the delivery of content to passive learners. A few counter-examples are emerging that hint at the possibilities offered by electronic books — possibilities for self-directed, interactive experiences; serendipitous exploration; collaborative work; multi-modal, immersive activities; and other deeply engaging approaches to learning. Mobile applications like Inkling facilitate social interaction around electronic books that could support group study and rich teacher-student interaction at any point in the text. Electronic texts can be linked to a myriad of supporting materials that extend and enrich them. To characterize electronic books as digital versions of paper texts is to overlook the transformative power that lies in the ways they are different from printed materials. It is this, rather than faithful replication, that makes electronic books so powerful a tool for education.

A sampling of applications of electronic books across disciplines includes the following:

- **Sciences, English, and Mathematics.** The New Zealand-based site StudyIt provides a range of student study guides for core subjects online. Contributors can add to the resources, post questions, communicate with teachers and share information related to their subject. Part electronic book, part learning community, StudyIt exemplifies the social aspects of electronic books.
- **History.** Project Gutenberg Australia provides access to free, public-domain electronic books and texts, such as rich compilations of Australia's history and early exploration. The books can be accessed by a wide variety of readers, mobile and otherwise.
- **Humanities.** The Humanities E-Book (HEB), offered to institutions on a subscription basis by the American Council of Learned Societies, is a digital collection of 2,200 humanities texts. Students at subscribing institutions may browse and read the collection online or order printed copies on demand.

Electronic Books in Practice

The following links provide examples of electronic books in educational settings.

eBooks@Adelaide

http://ebooks.adelaide.edu.au

The University of Adelaide maintains a repository of nearly 1,500 electronic works of literature, philosophy, science, and medicine, all free for use.

Cooliris Releases a Wikipedia Magazine Experience for iPad

http://www.padgadget.com/2010/07/27/cooliris-releases-a-wikipedia-magazine-experience-for-ipad

The Cooliris Wikipedia application draws in content from the online encyclopaedia, transforming it into a visually rich, magazine-like display that invites browsing and exploration.

How Flipboard Was Created and Its Plans Beyond iPad

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

Flipboard is a 'social magazine' for the iPad that flows web content into magazine-style pages. This interview with its creator discusses how the idea came about and where Flipboard is headed.

Inkling Interactive Textbooks

http://www.inkling.com

Inkling textbooks offer a new, highly interactive textbook experience, including social networking, rich graphics, video, animation and robust annotation and sharing tools.

The Pedlar Lady of Gushing Cross

http://www.moving-tales.com

This electronic storybook for the iPad and other iOS mobile devices is an interactive, immersive retelling of a classic story with animation, audio and rich graphics.

For Further Reading

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

2009 Librarian eBook Survey

http://www.apo.org.au/research/2009-librarian-ebook-survey

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

Handheld E-Book Readers and Scholarship: Report and Reader Survey

http://www.humanitiesebook.org/heb-whitepaper-3.html

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

Unboxed - Yes, People Still Read, but Now It's Social

http://www.nytimes.com/2010/06/20/business/20unbox.html

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

Wesley College Investigates eReaders

http://slav.globalteacher.org.au/2010/06/21/wesley-college-investigates-ereaders

(School Library Association of Victoria (SLAV), http://slav.globalteacher.org.au, 21 June 2010.) This post summarizes new research into how electronic readers are used in Australian schools.

What Publishers Can and Should Learn from "The Elements"
http://radar.oreilly.com/2010/08/what-publishers-can-and-should.html

(Mac Slocum, *O'Reilly Radar,* 12 August 2010.) This article interviews Theodore Gray, author of *The Elements,* and discusses how the digital version pushes the envelope of electronic book publishing.

***Delicious:* Electronic Books**
http://delicious.com/tag/hz10anz+ebooks

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 "hz10anz" and "ebooks" when you save them to *Delicious.*

MOBILES

Time-to-Adoption Horizon: One Year or Less

According to a recent Gartner report, mobiles will be the most common way for people to access the Internet by 2013. Perhaps more important for education, Internet-capable mobile devices will outnumber computers by 2011. The available choices for mobiles are many — smart phones, tablets, laptops, and the newest class of devices like the iPad that blends the functions of all of them. Access to the Internet is less and less dependent on location, as users increasingly connect via 3G and similar networks. The devices we carry are more capable with each new release, and the boundaries between them more and more blurred. In the developed world, mobile computing has become an indispensable part of day-to-day life in the workforce, and a key driver is the increasing ease and speed with which it is possible to access the Internet from virtually anywhere in the world via the ever-expanding cellular network.

Overview

Mobiles continue to merit close attention as an emerging technology for teaching and learning. The devices available today are multi-functional and robust, but the story of mobiles is no longer about the devices we carry. Instead, mobiles — in whatever form we choose — are always-available doorways to the larger world. In Australia and New Zealand, adoption of mobile devices has moved very quickly, but the infrastructure to support connectivity continues to lag behind. Efforts are underway in both countries to improve broadband and cellular access both in terms of where it is available and of how much it costs, but coverage is far from universal, and plans are still priced so as to limit everyday use.

For many people all over the world, but especially in developing countries, mobiles are increasingly the access point not only for common tools and communications, but also for information of all kinds, training materials, and more. An ever more common pattern is for people to look to mobile computing platforms as their device of choice, as they are cheaper than desktop or laptop computers. For this group, mobile computing devices are more affordable, more accessible, and easier to use than desktop computers, and provide more than enough functionality to serve as their primary computing device.

Users increasingly expect continuous access to data and services that not very long ago were available only while sitting in front of a computer linked to the network via a cable. In addition to software for email, communication, and calendaring, new tools allow users to manage personal information (such as Evernote, Nozbe, and TripIt), collaborate and easily access and share files (Dropbox and Outpost are two of many possible examples), or keep abreast of social networks (Limbo, Facebook, Twitter, or Foursquare) — and generally make checking and updating work, school, or personal information flows something easily done on the fly.

Thousands of applications designed to support a wide range of tasks on virtually any smart-phone or tablet operating system are readily available, with more entering the market all the time. These mobile computing tools have become increasingly essential aids in daily life, giving us on-the-go access to tools for business, video/audio capture and editing, sensing and measurement, geolocation, social networking, personal productivity, references, just-in-time learning — indeed, virtually anything that can be done on a desktop. With the increased screen real estate, battery life, and input device options offered by the iPad and its counterparts, mobiles are a viable alternative to heavier, more expensive laptop computers. Whatever device is used, the power of mobiles lies in their ability to access the Internet through the growing cellular network.

Relevance for Teaching, Learning, or Creative Enquiry

The portability and Internet-capability of mobile devices makes them ideal as a store of reference materials and learning experiences, as well as general-use tools for fieldwork, where they can be used to record observations via voice, text, or multimedia, and access reference sources in real time. The potential of mobile computing is being demonstrated in hundreds of projects at higher education institutions. At the University of Melbourne, Quickpoll is used to work with students in large group lectures, drawing them into discussion in a way that was not possible before. The University of Auckland offers a mobile library application that students can use to search for or renew books, find specific libraries on campus, and see new additions to collections. Twitter and Facebook

integration increase the application's appeal and reach. In a report entitled *Beyond the Yellow Brick Road,* researchers conducting a three-year mobile learning project at Unitec in New Zealand concluded that mobiles are a powerful means of disrupting traditional learning patterns and enabling constructivist approaches for deeper learning.

Mobiles embody the convergence of several technologies that lend themselves to educational use, including electronic book readers, annotation tools, applications for creation and composition, and social networking tools. GPS and compasses allow sophisticated location and positioning, accelerometers and motion sensors enable the device to be used in completely new ways, digital capture and editing bring rich tools for video, audio, and imaging — more and more, mobiles encompass it all.

Even so, it may well be the very simple tools that are easily integrated into classroom activities that finally tip the scale for mobiles in the classroom. For instance, some faculty are beginning to use Twitter, a short-message micro-blogging service, as an in-class discussion tool. Students participate by sending messages to ask and answer questions or expand on thoughts. Another simple tool, Poll Anywhere, turns mobiles into personal response systems, enabling teachers to quiz students, assess their understanding before, during, and after a lesson, and reveal patterns of thinking in the classroom. Any mobile will work for either of these purposes; all that is required is the ability to send text (SMS) messages.

The unprecedented evolution of these devices continues to generate great interest. They are increasingly capable tools for learning that schools do not have to buy or maintain: students come equipped with mobiles. Over time, the vast potential of these devices for learning will begin to outweigh concerns about misuse that currently dominate most conversations about their use in school settings. It is the sheer power of these devices that make them interesting, and that power derives from their ubiquity, their portability, the wide range of things that can be done with them, and their ability to access the Internet nearly anywhere.

A sampling of applications of mobiles across disciplines includes the following:

- **Engineering.** Students are able to use the iPhone's Seismometer and a variety of accelerometer-based applications in simulations that explore the dampening effects of various construction techniques designed to increase the survivability of structures during earthquakes.
- **English.** Primary school students from a Language Background Other Than English (LBOTE) used mobiles (iPod Touches) loaded with language exercises to practice English in and out of school. The exercises helped the students achieve grade-level mastery of English.
- **Vocational Education.** Students in a work-based apprenticeship program at a New Zealand polytechnic used mobiles to communicate with their tutor while out in the field, to respond to multiple-choice questions sent via SMS, and to collect photo and video evidence for summative evaluation. The study found that as a result of using the mobiles, apprentices took greater ownership of their learning, reflected more on workplace learning, and were more thoughtful about the kinds of evidence to capture.

Mobiles in Practice

The following links provide examples of mobiles in educational settings.

App-titude

http://www.app-titude.com.au

Designed expressly for Australian schools, App-titude provides high-quality educational games that run on mobile devices (iPhones and iPod Touches). Student progress data are transmitted to a teacher website, where they can be used for evaluation, friendly competition, and collaboration.

In Their Hands – iPads for Learning Trial

http://www.vicipadtrial.org

The Victorian Government, in collaboration with Apple, is exploring ways to use iPads in the classroom.

iPad-Enhanced Learning at the University of Adelaide

http://www.adelaide.edu.au/news/news41241.html

The University of Adelaide's Faculty of Sciences is pioneering a digital mobile curriculum. Each incoming student is to be issued an iPad, and course materials will be gradually moved to or created for this platform over the next two years.

Will iPad Transform Med School?

http://med.stanford.edu/ism/2010/september/ipads-0913.html

Stanford University's medical school is issuing iPads to all incoming freshmen. The devices contain course syllabi and reading materials as well as interactive applications to aid in study.

For Further Reading

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

The Mobile Campus

http://www.insidehighered.com/news/2009/09/21/iphones

(Steve Kolowich, *Inside Higher Ed,* 21 September 2009.) One year after implementing its campus-wide policy of issuing each freshman an iPhone or iPod Touch, Abilene Christian University challenged instructors to integrate mobile learning into their classes and surveyed the campus community about the results.

Pew Internet Research Report Mobile Access 2010

http://pewinternet.org/Reports/2010/Mobile-Access-2010.aspx

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

Pockets of Potential: Using Mobile Technologies to Promote Children's Learning

http://joanganzcooneycenter.org/Reports-23.html

(Carly Shule, *Cooney Center,* January 2009.) This research report looks at the use of mobile devices in K-12 education worldwide and highlights their potential as tools for teaching and learning.

Smartphones Give You Wings: Pedagogical Affordance of Mobile Web 2.0

http://www.apo.org.au/research/smartphones-give-you-wings-pedagogical-affordance-mobile-web-20

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

Using Mobile Web 2.0 to Transform Pedagogy and Engage Learners

http://akoaotearoa.ac.nz/ako-hub/good-practice-publication-grants-e-book/resources/pages/using-mobile-web-20-transform-pedago

(Thomas Cochrane, *Unitec New Zealand,* 16 November 2009.) This multimedia report describes how mobile technologies are being integrated at Unitec in New Zealand. Trials in design, music, and landscape courses show positive results.

World's Largest Open University Goes Mobile

http://www.pr-inside.com/world-s-largest-open-university-goes-r1553595.htm

(Press release, *PR-inside.com,* 29 October 2009.) The Indira Gandhi National Open University, in partnership with Ericsson, will now offer courses on mobile phones to more than 2.5 million students, allowing learners in rural India to seek a higher education.

Delicious: Mobiles

http://delicious.com/tag/hz10anz+mobiles

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 "hz10anz" and "mobiles" when you save them to *Delicious.*

AUGMENTED REALITY

Time-to-Adoption Horizon: Two to Three Years

While the capability to deliver augmented reality experiences has been around for decades, it is only very recently that those experiences have become easy and portable. Advances in mobile devices as well as in the different technologies that combine the real world with virtual information have led to augmented reality applications that are as near to hand as any other application on a laptop or a smart phone. New uses for augmented reality are being explored and new experiments undertaken now that it is easy to do so. Emerging augmented reality tools to date have been mainly designed for marketing, social purposes, amusement, or location-based information, but new ones continue to appear as the technology becomes more popular. Augmented reality is increasingly common in the consumer sector.

Overview

The concept of blending (augmenting) data — information, rich media, and even live action — with what we see in the real world is a powerful one. Augmented reality enhances the information we can perceive with our senses. Its first applications appeared in the late 1960s and 1970s, and by the 1990s, augmented reality was being put to use by a number of major companies for visualization, training, and other purposes. Now, the technologies that make augmented reality possible are powerful and compact enough to deliver augmented experiences to personal computers and mobile devices. Early mobile applications began to appear in 2008, and now many augmented reality applications and tools for mobiles are on the market.

Wireless applications offer a great deal of promise for mobile augmented experiences. Initially, augmented reality required unwieldy headsets and kept users largely tethered to their desktop computers. The camera and screen embedded in smart phones and other mobile devices now serve as the means to combine real-world data with virtual data; using GPS capability, image recognition, and a compass, augmented reality applications can pinpoint where the mobile's camera is pointing and overlay relevant information at appropriate points on the screen.

Augmented reality applications can either be marker-based, which means that the camera must perceive a specific visual cue in order for the software to call up the correct information, or gravimetric. Gravimetric applications use positional data, such as a mobile's GPS and compass, to interpret where the device is located, which way it is facing, and what known objects are in front of it. Gravimetric applications have wide applicability since they function anywhere without the need for special labelling or supplemental reference points, but instead depend upon fixed objects or communication with other devices. Marker-based systems use a physical reference point to interpret their location and the nature of objects in their field of view. This has typically involved 'tagging' objects with machine-readable codes, making it difficult to use such systems on the fly. As marker-based systems develop, they are beginning to recognize common real-world objects and cues as markers, increasing their flexibility. Some applications use image recognition, where input to the camera is compared against a library of images to find a match; more recently, applications are emerging that can detect and interpret gestures and postures as commands to perform certain functions.

The improvement in technology has allowed more streamlined approaches and wider user adoption. Market projections for augmented reality on mobile devices predict revenues to rise from about US$2 million in 2010 to several hundred million by 2014 (US$350 million, according to ABI Research; Juniper Research's projections are even higher). Augmented reality is already entering the mainstream in the consumer sector, and the social, gaming, and location-based applications that are emerging point to a strong potential for education and interpretation applications in the next few years.

Relevance for Teaching, Learning, or Creative Enquiry

A key characteristic of augmented reality is its ability to respond to user input. This interactivity confers significant potential for learning and assessment. Augmented reality is an active, not a passive technology; students can use it to construct new understanding based on interactions with virtual objects that bring underlying data to life. Dynamic processes, extensive datasets, and objects too large or too small to be manipulated can be brought into a student's personal space at a scale and in a form easy to understand and work with. Augmented reality has strong potential to provide

powerful, contextual, *in situ* learning experiences and serendipitous exploration and discovery of the connected nature of real-world information.

One of the most promising aspects of augmented reality is that it can be used for visual and highly interactive forms of learning, allowing the overlay of data onto the real world as easily as it simulates dynamic processes. Mechanics in the military and at companies like Boeing already use augmented-reality goggles while they work on vehicles; the goggles demonstrate each step in a repair, identify the tools needed, and include textual instructions as well. This kind of augmented experience is especially effective in training for specific tasks. Still, much of the most exciting development for augmented reality centres around mobile devices; the potential for just-in-time learning and exploration, without needing special goggles or other equipment, is a deeply compelling aspect of this technology.

A tremendous market is emerging for network-aware applications that convey information about a place. Visitors to historic sites, for example, can already access mobile applications that overlay maps and information about how the location looked at different points of history onto their view of the real world. A recent European research project, iTacitus, allowed visitors to pan across a location — the Coliseum, say — and see what it looked like during an historical event, complete with cheering spectators and competing athletes. People, too, will soon be explored through augmented reality. The TAT Augmented ID application, still in development, uses facial recognition technology to display certain, pre-approved information about a person when he or she is viewed through the camera of a mobile device. SREngine is another augmented reality application, also in development, that will use object recognition to display information about everyday things one encounters in the real world — comparing prices in a shopping centre, for instance, or identifying trees.

Of particular relevance to education is augmented reality gaming. Games that are based in the real world and augmented with networked data can give educators powerful new ways to show relationships and connections. Games using marker technology often include a flat game board or map which becomes a 3D setting when viewed with a mobile device or a webcam. This kind of game could easily be applied to a range of disciplines, including archaeology, history, anthropology, or geography, to name a few. Another approach to AR gaming allows players or game masters to create virtual people and objects, tying them to a specific location in the real world. Players interact with these constructs, which appear when the player approaches a linked location.

Researchers in the Human Interface Technology Laboratory at the University of Canterbury in New Zealand have created a tool that translates sketches into 3D objects and uses augmented reality to allow students to explore the physical properties and interactions between objects. Simple controls, drawn on slips of paper, are used to alter the properties of the sketched objects. (See a demonstration video at http://www.youtube.com/watch?v=M4qZ0GLO5_A.) At Mauricio De Nassau College in Brazil, architecture students are exploring the possibilities of using augmented reality to project scale models of buildings, cutting down on the time required to construct and present architectural proposals. For another idea of how augmented reality could be applied to the study of architecture, see the concept video Realtà Aumentata (http://vimeo.com/2341387), created as a thesis project by a student at the Valle Giulia Faculty of Architecture in Italy.

Augmented books, now just beginning to enter the market, are another interesting application of this technology. The German company Metaio is developing books that include AR elements, such as globes that pop up on the pages. The books are printed normally. Then, after purchase, consumers install special software on their computers and point a webcam at the book to see the visualizations. The technology allows any existing book to be developed into an augmented reality edition after publication; an atlas featuring 3D views of geographic locations is currently in development.

A sampling of applications of augmented reality across disciplines includes the following:

- **Art and Cultural History.** Museums are already experimenting with augmented reality applications; students equipped with mobiles can reconstruct a dinosaur when looking at its skeleton, or call up a virtual tour guide who explains what they are looking at in the gallery.
- **Audiology.** Augmented reality is being employed to assist practicing audiology clinicians in New Zealand in demonstrating and maintaining professional competence. When fully developed, the augmented reality system

will supplement the existing manikin-based simulations that are currently used for this purpose.

- **Nursing.** At the University of Canterbury in New Zealand, nursing students interact with augmented reality patients to practice communication skills for assessment and diagnosis. Tools in development will assist students in practicing complex procedures involved with medical care.

Augmented Reality in Practice

The following links provide examples of augmented reality in educational settings.

Accessible AR

http://www.hitlabnz.org/index.php?title=Accessible_AR

This project, housed at the University of Canterbury's Human Interface Technology Lab in Christchurch, New Zealand, seeks to build augmented reality applications specifically for education, entertainment and engineering that run on common mobile devices.

Acrossair

http://www.acrossair.com/default.htm

Acrossair's public transit apps use augmented reality to locate public transportation near the user; Nearest Wiki and Nearest Places offer information useful to tourists and travellers.

CALMARS

http://www.hitlabnz.org/index.php?title=CALMARS

Based at the University of Canterbury's Human Interface Technology Lab in Christchurch, New Zealand, CALMARS is a project exploring the ways augmented reality can be used in new media applications and with context-aware mobile interfaces.

Interactive SAR

http://wearables.unisa.edu.au/projects/interactive-sar

A research project at the University of South Australia's Wearable Computer Lab (WCL) explores technology to support spatial augmented reality and seeks new applications for it.

Plane and Ship Finder

http://my.pinkfroot.com/page/5983902:Page:46

Created by Pinkfroot, these applications identify airplanes and ships (flight or vessel type, point of origin, destination, route, and more) when a user points a mobile device at one in motion.

For Further Reading

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

At the Dawn of the Augmented Reality Industry

http://site.layar.com/company/blog/video-bruce-sterlings-keynote-at-the-dawn-of-the-augmented-reality-industry

(Maarten Lens-FitzGerald, *Layar Launch Event via Vimeo.com,* 20 August 2009.) In this keynote address, author Bruce Sterling offers his thoughts on how augmented reality will affect technology and daily life (50-minute video).

Augmented Reality Technology Brings Learning to Life

http://www.gse.harvard.edu/blog/uk/2009/09/augmented-reality-technology-brings-learning-to-life.html

(Chris Dede, *Usable Knowledge,* September 2009.) Education technology professor Chris Dede discusses augmented reality as a tool for learning at the elementary level.

Blended Reality: Superstructing Reality, Superstructing Selves

http://www.iftf.org/node/2598

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

Collaborative Augmented Reality in Schools

http://ltee.org/uploads/cscl2009/paper236.pdf

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

Ubiquitous Contextual Information Access with Proactive Retrieval and Augmentation

http://eprints.pascal-network.org/archive/00005645

(Antti Ajanki et al., Helsinki University of Technology, 8 March 2010.) This paper describes a prototype platform for working with abstract information using augmented reality displays.

Delicious: Augmented Reality

http://delicious.com/tag/hz10anz+augmentedreality

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OPEN CONTENT

Time-to-Adoption Horizon: Two to Three Years

The movement toward open content reflects a growing shift in the way academics in many parts of the world are conceptualizing education to a view that is more about the process of learning than the information conveyed in their courses. Information is everywhere; the challenge is to make effective use of it. Open content embraces not only the sharing of information, but the sharing of instructional practice and experiences as well. Part of the appeal of open content is that it is also a response to both the rising costs of traditionally published resources and the lack of educational resources in some regions, and a cost-effective alternative to textbooks and other materials. As customizable educational content — and insights about how to teach and learn with it — is increasingly made available for free over the Internet, students are learning not only the material, but also skills related to finding, evaluating, interpreting, and repurposing the resources they are studying in partnership with their teachers.

Overview

Highlighted in the mid-term horizon last year, open content continues to be of considerable interest to many educators. Its focus on collective knowledge and on the sharing and reuse of learning and scholarly materials is particularly apt given the increasing adoption of electronic books and digital content. Open content has now come to the point that it is rapidly driving change in both the materials we use and the process of education. At its core, the notion of open content is to take advantage of the Internet as a global dissemination platform for collective knowledge and wisdom, and to design learning experiences that maximize the use of it.

Open content, as described here, has its roots in a number of seminal efforts, including the Open Content Project, MIT's Open Courseware Initiative (OCW), the Open Knowledge Foundation, and work by the William and Flora Hewlett Foundation and others. Many of these projects focused on creating collections of sharable resources and on devising licenses and metadata schemata. The groundswell of interest in open content described here is differentiated from early work by its primary focus on the use of open content and its place in the curriculum. The role of open content producers has evolved as well, away from the idea of authoritative repositories of content and towards the broader notion of content being both free and ubiquitous. Building on the trailblazing models of institutions like MIT, schools like Tufts University (and many others) now consider making their course materials available to the public a social responsibility.

This philosophy of open content and open education acknowledges that information is not the only useful and distributable commodity among educators. Understanding, insight, and experience can also be collected and shared. An outgrowth of that perspective is the emergence of open-content textbooks that can be "remixed" — that is, customized, modified, or combined with other materials — and the resulting new combinations can be shared in turn. A number of publishers are finding ways to support authors and consumers of such materials. The publishing company Flat World Knowledge is one that provides access to textbooks authored for open use, making it very easy for faculty to individually tailor a text for use in their own class and then share that custom text with the larger community. Flat World Knowledge operates as any publisher does, reviewing book submissions and using a traditional editing process before release; however, electronic copies of the textbooks are free. Students only pay for print copies if desired, and authors receive royalties for these purchases whether the book has been customized or not.

At the centre of many discussions of open content are the challenges of sharing, repurposing, and reusing scholarly works; related to those discussions are concerns about intellectual property, copyright, and student-to-student collaboration. Solid work in this area has been done by groups such as Creative Commons and Creative Commons Australia, the Academic Commons, Science Commons, and others to address many of the concerns commonly voiced. Many believe that reward structures that support the sharing of work in progress, ongoing research, highly collaborative projects, and a broad view of what constitutes scholarly publication are key challenges that institutions need to solve. Also to be addressed are reputation systems, peer review processes, and models for citation of the new forms of content that are likely outgrowths of open content initiatives.

While a number of highly structured projects exist to provide access to open content, in general, the open content community is diffuse and distributed. Learning to find useful resources within a given discipline, assess the quality of content available, and repurpose them in support of a learning or research objective are valuable skills for any emerging scholar, and many adherents of open content list that aspect among the reasons they support the use of shareable materials. Nonetheless, broad use of open learning materials remains at least two years away, and the larger promise of open content — in which teaching and learning experiences and insights are shared as easily as information — will take even longer to realize. For the present, the creation of learning materials is still more a process of design driven by individual tastes and opinions than a collaborative process involving the contributions and views of many.

Relevance for Teaching, Learning, or Creative Enquiry

Open content shifts the learning equation in a number of interesting ways; the most important is that its use promotes a set of skills that are critical in maintaining currency in any discipline — the ability to find, evaluate, and put new information to use. Almost as important is that the same set of materials, once placed online and made sharable via the appropriate licensing, can inform a wide variety of learning modalities, not the least of which is learning for the sheer joy of discovery. A broader view of open content that includes learning activities, assessment methods, and teaching strategies hints at more far-reaching effects; beyond enabling self-directed study and custom course materials, open content has the potential to empower students and teachers to create individualized learning experiences drawn from a host of resources.

As more faculty and administrators become aware of and experience open content, its comparative benefits and challenges vis-à-vis traditional learning resources become better understood. Open resources are generally, though not always, electronic. They are easier to update than print materials. Because they are digital in nature, open learning materials can incorporate activities to support multiple modes of study — reading, listening, interacting — though they can be challenging to create as a result. As new courses are developed, faculty have a responsibility to carefully consider the best supporting materials and activities to offer to students, and a thorough understanding of what is available through open channels will assist with this.

Open content will influence course development and planning on several levels, although we will not see widespread evidence of this for several more years. Few teachers will reuse material as-is; most will wish to customize the open content they find to suit their local context. In many cases, the benefits of adapting open materials obviously outweigh the cost of creating new ones, but this is not the only factor under consideration; there is a strong impulse to design from scratch and rely on familiar resources. The process of course development, too, does not always lend itself to the use of open content. Often, courses are developed collaboratively, and workflow patterns may not easily accommodate the time and energy needed to adequately search for and review available open content. Selecting and adapting open resources are skills that must be cultivated, just as designing a new course is cultivated, and both should contribute to a complete picture of teaching proficiency.

A key issue in Australia is the impact of the Copyright Agency Limited (CAL) on practices and policies applying to open content. While institutions and academics are empowered to use commercial material for teaching purposes, they may do so only if access is restricted to enrolled students, and only for the duration of the enrolled term. As a result, such material can never be incorporated into open access offerings. This restriction has been in place for sufficiently long a time that it is likely that most courses contain proprietary content, prohibiting broad access to already-developed materials.

Going forward, course developers must take care to locate sharable resources to replace those that are governed under the CAL licensing structure. Open content tends to be distributed in nature and can be difficult to locate, though this is changing as the interest in open access grows. Many sources of open content can easily be found in Creative Commons, Teachers Without Borders, and other online communities, while portals like Folksemantic offer a single point of entry to many open content offerings. Learning communities associated with services like Diigo or Twine can point educators in the right direction via the social networking equivalent of “word of mouth.”

Communities of practice and learning groups provide another avenue for continuing education and support to both practitioners and independent learners. OpenLearn, a project of the Open University in the U.K., offers anyone the opportunity to join a

study group while working through open course content. OpenLearn practices a method known as "supported open learning," in which students work through content at their own pace with help and guidance from a tutor.

A sampling of applications of open content across disciplines includes the following:

- **Curriculum Development.** WikiEducator is a community resource supported by the Open Education Resource Foundation, an independent non-profit for the development of free educational content based at Otago Polytechnic. As well as open content, WikiEducator provides resources for teachers wishing to develop courses using the content.
- **Information Sciences.** Koha is an open-content library management system originating in New Zealand. Today, it is used by hundreds of libraries worldwide and sustained by over forty active developers.
- **Literature.** *Looking for Whitman* is an open-access, multi-institutional experiment, dedicated to the study of the life and works of Walt Whitman.

Open Content in Practice

The following links provide examples of open content in educational settings.

CK-12 Flexbooks

http://www.ck12.org/flexr

CK-12 provides open content textbooks for K-12. The not-for-profit organization aims to lower the costs of textbooks by providing electronic versions through their website and the iBookstore.

Remixing Çatalhöyük

http://wiki.creativecommons.org/Case_Studies/Remixing_Çatalhöyük

Developed using data and interpretations from recent archaeological research at a 9,000-year-old settlement in central Turkey, this open resource includes tools to make it easy for teachers and students to use and remix content about the settlement.

Thinkfinity

http://www.thinkfinity.org

Thinkfinity is a free source of lesson plans and educational resources for K-12. Sponsored by Verizon and developed with a number of content providers, Thinkfinity includes a community of practice, resources for home learning, and a professional development program.

UTSeScholarship

http://utsescholarship.lib.uts.edu.au

The UTSeScholarship program at the University of Technology Sydney is an integrated open content program consisting of UTSePress, UTSiResearch and UTSeData. UTSePress is a major publisher of open access scholarly journals in Australia and New Zealand.

Wikipublisher

http://www.wikipublisher.org/wiki/Wikipublisher

Wikipublisher is an open source project originating in New Zealand that allows wikis and web content to be easily formatted for print publication.

For Further Reading

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

Around the World, Varied Approaches to Open Online Learning

http://chronicle.com/article/Countries-Offer-Different/48775

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

Creative Commons Launches Public Domain Mark

http://creativecommons.org/press-releases/entry/23755

(Diane Peters, Creative Commons, 11 October 2010.) In October 2010, Creative Commons established the Public Domain Mark, a way to brand open source content so there is no question as to whether it can be reused or remixed.

Open Societies Need Open Systems

http://news.bbc.co.uk/2/hi/technology/8493006.stm

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

The Open University's Patrick McAndrew: Open Education and Policy

http://creativecommons.org/weblog/entry/23521

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

Students Find Free Online Lectures Better Than What They're Paying For
http://chronicle.com/article/Students-Find-Free-Online/48776

(Jeffery R. Young, *The Chronicle of Higher Education,* 11 October 2009.) Not only traditional students, but learners whose primary language is not native, advanced high-school students, and working professionals all take advantage of free educational resources.

***Delicious:* Open Content**
http://delicious.com/tag/hz10anz+opencontent

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GESTURE-BASED COMPUTING

Time-to-Adoption Horizon: Four to Five Years

For nearly forty years, the keyboard and mouse have been the primary means to interact with computers. The Nintendo Wii in 2006 and the Apple iPhone in 2007 signalled the beginning of widespread consumer interest in — and acceptance of — interfaces based on natural human gestures. Now, new devices are appearing on the market that take advantage of motions that are easy and intuitive to make, allowing us an unprecedented level of control over the devices around us. Cameras and sensors pick up the movements of our bodies without the need of remotes or handheld tracking tools. The full realization of the potential of gesture-based computing is still several years away, especially for education; but we are daily moving closer to a time when our gestures will speak for us, even to our machines.

Overview

It is already common to interact with a new class of devices entirely by using natural gestures. The Microsoft Surface, the iPhone, iPad, and iPod Touch, the Nintendo Wii, the Kinect system for Xbox, and other gesture-based systems accept input in the form of taps, swipes, and other ways of touching, hand and arm motions, or body movement. These are the first in a growing array of alternative input devices that allow computers to recognize and interpret natural physical gestures as a means of control. We are seeing a gradual shift towards interfaces that adapt to — or are built for — humans and human movements.

As the underlying technologies evolve, a variety of approaches to gesture-based input are being explored. The screens of the iPhone, the iPad, and the Surface, for instance, react to pressure, motion, and the number of fingers touching the devices. The smaller devices additionally can react to manipulation — shaking, rotating, tilting, or moving the device in space. The Wii and similar gaming systems use a combination of a handheld, accelerometer-based controller and a stationary infrared sensor to determine position, acceleration, and direction. The technology to detect gestural movement and to display its results is improving very rapidly, increasing the opportunities for this kind of interaction. Two new gaming systems — the Sony PlayStation 3 Motion Controller and the Microsoft Kinect system — take a step closer to stripping the gesture-based interface of anything beyond the gesture and the machine, at least in terms of how it is experienced by the user.

Gesture-based interfaces are increasingly built into things we can already use; Logitech and Apple have brought gesture-based mice to market, and Microsoft is developing several similar models. Smart phones, remote controls, and touch-screen computers all accept gesture input. As more of these devices are developed and released, our options for controlling a host of electronic devices are expanding. We can make music louder or softer by moving a hand, or skip a track with the flick of a finger. Apple's Remote application for the iPhone turns the mobile device into a remote control for the Apple TV; users can search, play, pause, rewind, and so on, just by gliding a finger over the iPhone's surface. Instead of learning where to point and click and what commands to type, we are beginning to be able to expect our computers to respond to natural movements that make sense to us.

Currently, the most common applications of gesture-based computing are for computer games, file and media browsing, and simulation and training. A number of simple mobile applications use gestures. The iPhone application Mover lets users "flick" photos and files from one phone to another; Shut Up from Nokia silences the phone when the user turns it upside down; nAlertme, an anti-theft tool, sounds an alarm if the phone isn't shaken in a specific, preset way when it is switched on. Some companies are exploring further possibilities; for instance, Softkinetic develops platforms that support gesture-based technology, as well as designing custom applications for clients, including interactive marketing and consumer electronics as well as games and entertainment.

Because it is changing not only the physical and mechanical aspects of interacting with computers, but also our very notions of what it means to work with a computer, gesture-based computing is a transformative and potentially disruptive technology. The sense of distance between the user and the machine decreases and the sensation of power and control over it increases when the machine responds to movements that feel intuitive and natural. Unlike a keyboard and mouse, gestural interfaces can often be used by more than one

person at a time, making it possible to engage in truly collaborative activities and games. Our perception of the kinds of activities that computers are good for is also altered by gestural interaction — for instance, activities that require sweeping movements, such as many sports or exercises, are suited to gestural interfaces, as are many augmented reality interfaces.

Relevance for Teaching, Learning, or Creative Enquiry

The kinaesthetic nature of gesture-based computing will very likely lead to new kinds of teaching or training simulations that look, feel, and operate almost exactly like their real-world counterparts. The ease and intuitiveness of a gestural interface makes the experience seem very natural, and even fun, making them relevant for learning at any age or level of study. Already, medical students benefit from simulations that teach the use of specific tools through gesture-based interfaces, and it is easy to see how such interfaces could be applied in the visual arts and other fields where fine motor skills come into play. Gestural interfaces allow users to easily perform precise manipulations that can be difficult with a mouse, as the prototypical video editing system Tamper makes plain (see the demonstration video at http://www.youtube.com/user/oblongtamper). When combined with haptic (touch or motion-based) feedback and augmented reality, the overall effect is very compelling.

Gesture-based computing opens up unparalleled avenues of accessibility and interaction for learners. Larger multi-touch displays support collaborative work, allowing multiple users to interact with content simultaneously. In schools where the Microsoft Surface has been installed in study areas, staff report that students naturally gravitate to the devices when they want to work together to study collaboratively. Gestural interfaces go beyond multi-touch displays, of course.

Imagine an interface that allows students to determine or change the DNA of a fruit fly by piecing it together by hand, page through a fragile text from the Middle Ages, or practice surgical operations using the same movements a surgeon would — with gestural interfaces, discovery-based learning opportunities like these are likely to be common scenarios. Although these examples are hypothetical, research in the field of gesture-based computing is expanding rapidly and early results show that applications like these are not far-fetched.

Pranav Mistry, while at the MIT Media Lab, developed a gesture-based system called SixthSense that uses visual markers and gesture recognition to allow interaction with all sorts of real-time information and data in extremely intuitive ways. The platform was recently released as open source, which is likely to stimulate a raft of new ideas. Another gesture-based system by Mgestyk uses a 3-dimensional camera to capture user movements. The system has been demonstrated with Microsoft Flight Simulator, and allows players to fly a simulated plane simply by moving their hands — without any joystick or remote. It is not difficult to picture similar applications, a little further down the road, that could be used to simulate many kinds of experiences.

A sampling of applications of gesture-based computing across disciplines includes the following:

- **Kinesiology.** Dutch company Silverfit uses a gesture-based system to deliver fitness games designed for the elderly. Used in elder care organizations, the games provide gentle exercise and "activity of daily life" practice.
- **Medicine.** Digital Lightbox by BrainLAB is a multi-touch screen that allows doctors and surgeons to view and manipulate data from MRI, CT, x-ray, and other scan images. The system integrates with hospital data sources to enable health professionals to collaborate throughout the cycle of treatment.
- **Sign Language.** Researchers at Georgia Tech University have developed gesture-based games designed to help deaf children learn sign language. Deaf children of hearing parents often lack opportunities to pick up language serendipitously in the way hearing children do; the game provides an opportunity for incidental learning. The iPhone application Sign 4 Me allows easy manipulation of the point of view so that a sign can be viewed from any angle.

Gesture-Based Computing in Practice

The following links provide examples of gesture-based computing in educational settings.

Digital Foam

http://wearables.unisa.edu.au/projects/digital-foam

Researchers at The University of South Australia's Wearable Computer Lab (WCL) are developing a thin, flexible material that

responds to touch (and multi-touch) and can be wrapped around objects of any shape.

Gesture-Based Computing on the Cheap
http://web.mit.edu/newsoffice/2010/gesture-computing-0520.html

MIT researchers have developed a gestural system that requires only a computer webcam and an inexpensive pair of multicoloured Lycra gloves.

The Hybridiser
http://vimeo.com/6580702

This innovative project at the Auckland Museum uses touch-screen interfaces to allow visitors to create custom virtual orchids in lifelike detail. Such screens can provide an immersive, interactive experience that directly engages the visitor.

Kinect for XBox 360
http://www.xbox.com:80/en-US/kinect

Microsoft's Kinect system works with the XBox 360 platform to deliver immersive, gesture-based gaming and interactive experiences.

SixthSense
http://www.pranavmistry.com/projects/sixthsense

MIT student Pranav Mistry created a wearable gesture-based computing system to interact with everyday objects and people. This site describes the project and links to demonstration videos.

For Further Reading

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

A Future Full of Touchscreens? It's All in the Software
http://venturebeat.com/2010/05/25/a-future-full-of-touchscreens-its-all-in-the-software

(Andrew Hsu, *VentureBeat.com,* 25 May 2010.) Software will be one of the main drivers of the technology behind touch screens, and innovators in this space will be the ones who entice consumers to use their products.

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

(Accessed 21 October 2010.) IDENT Technology has developed interfaces that use near field electrical sensing to allow mobiles to respond to grip and proximity sensing. A ringing mobile will put the call through if it is picked up and held but will send it to voice mail if it is picked up and quickly put down again.

Interactive Instrumental Performance and Gesture Sonification
http://scan.net.au/scan/journal/display.php?journal_id=122

(Kirsty Beilharz, *SCAN: Journal of Media Arts Culture, Macquarie University,* Vol 5 Number 3 December 2008.) This ongoing research by Kirsty Beilharz of University of Technology Sydney explores gestural interfaces for allowing artists and musicians to augment art installations and musical performances in real time.

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

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

Touching the Future: The Rise of Multitouch Interfaces
http://www.perada-magazine.eu/pdf/002864/002864.pdf

(Johannes Schöning, *PerAda Magazine,* 1 April 2010.) This short research synopsis discusses the technologies behind multi-touch and suggests ways it will be used, particularly for geospatial applications. An extensive list of references is provided.

***Delicious:* Gesture-Based Computing**
http://delicious.com/tag/hz10anz+gesturecomputing

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 "hz10anz" and "gesturecomputing" when you save them to *Delicious.*

VISUAL DATA ANALYSIS

Time-to-Adoption Horizon: Four to Five Years

New forms of analysis are making use of the visual centres in our brains and the ways of thinking described in Malcolm Gladwell's best seller, Blink, *to marshal the tremendous human capacity to discern and recognize patterns. Connections and insights that are not readily apparent in traditional tables of numbers, or in standard forms of quantitative study like correlations become obvious when portrayed visually using new techniques derived from the study of fluid dynamics and other complex systems. Visual data analysis has applications in science and engineering, and offers considerable promise for understanding complex social processes like learning that have proven difficult to explore with traditional methods.*

Overview

Over the past century, data collection, storage, transmission, and display has changed dramatically, and scholars have undergone a profound transformation in the way they approach data-related tasks. Data collection and compilation is no longer the tedious, manual process it once was, and tools to analyse, interpret, and display data are increasingly sophisticated, and their use routine in many disciplines. The options for illustrating trends, relationships, and cause and effect have exploded, and it is now a relatively simple matter for anyone to do the sorts of analyses that were once only the province of statisticians and engineers.

In advanced research settings, scientists and others studying massively complex systems generate mountains of data, and have developed a wide variety of new tools and techniques to allow those data to be interpreted holistically, and to expose meaningful patterns and structure, trends and exceptions, and more. Researchers that work with data sets from experiments or simulations, such as computational fluid dynamics, astrophysics, climate study, or medicine draw on techniques from the study of visualization, data mining, and statistics to create useful ways to investigate and understand what they have found.

The blending of these disciplines has given rise to the new field of visual data analysis, which is not only characterized by its focus on making use of the pattern matching skills that seem to be hard-wired into the human brain, but also in the way in which it facilitates the work of teams collaborating to tease out meaning from complex sets of information. While the most sophisticated tools are still mostly found in research settings, a variety of tools are emerging that make it possible for almost anyone with an analytical bent to easily interpret all sorts of data.

Self-organizing maps are an approach that mimics the way our brains organize multi-faceted relationships; they create a grid of "neuronal units" such that neighbouring units recognize similar data, reinforcing important patterns so that they can be seen. Cluster analysis is a set of mathematical techniques for partitioning a series of data objects into a smaller amount of groups, or clusters, so that the data objects within one cluster are more similar to each other than to those in other clusters. Visual, interactive principal components analysis is a technique once only available to statisticians that is now commonly used to identify hidden trends and data correlations in multidimensional data sets. Gapminder (http://www.gapminder.org/), for example, uses this approach in its analysis of multivariate datasets over time.

These sorts of tools are now finding their way into common use in many other disciplines, where the analytical needs are not necessarily computational; visualization techniques have even begun to emerge for textual analysis and basic observation. Many are free or very inexpensive, bringing the ability to engage in rich visual interpretation to virtually anyone.

Online services such as Many Eyes, Wordle, Flowing Data, and Gapminder accept uploaded data and allow the user to configure the output to varying degrees. Many Eyes, for instance, allows people to learn how to create visualizations, to share and visualize their own data, and to create new visualizations from data contributed by others. Some, like Roambi, have mobile counterparts, making it easy to carry interactive, visual representations of data wherever one goes. Even quite public data, such as the posts made in Twitter, can be rendered visually to reveal creative insights. For instance, the New Political Interfaces project visualized political topics from 2009 as expressed on Twitter, charting which topics were — and were not — being discussed by politicians, news outlets, and other sources.

Relevance for Teaching, Learning, or Creative Enquiry

As stated previously, one of the most compelling aspects of visual data analysis is in the ways it augments the natural abilities humans have to seek and find patterns in what they see. By manipulating variables, or simply seeing them change over time (as Gapminder has done so famously), it is easy to discover whether or not patterns exist. Such tools have applicability in nearly every field.

As the tools, their capabilities, and their variety continue to expand, their use is already making its way out of scientific and engineering labs and into business and social research. Creative enquiry is benefiting from a wide range of new tools that are exposing trends and relationships among both qualitative and quantitative variables in real time, and making longitudinal relationships easier to find and interpret than ever. Textual analysis is an area that tools like Wordle have revealed as especially suited to visual techniques.

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

Visual data analysis may help expand our understanding of learning itself. Learning is one of the most complex of social processes, with a myriad of variables interacting in highly involved ways, making it an ideal focus for the search for patterns. Related to this is the opportunity to understand the variables influencing informal learning and the social networking processes at work in the formation of learning communities. The tools for such analyses exist today; what is needed are ways to balance privacy with the kinds of data capture that can inform such work.

A sampling of applications of visual data analysis across disciplines includes the following:

- **Engineering.** Massive amounts of data generated through research, system monitoring, plant operation, or other standard processes can be overwhelming, especially to students who are learning how to analyse and interpret such data. Visual data analysis provides a way for engineering students to come to grips with the complexities of the systems they are trying to master.
- **Medicine.** Created by the Commonwealth Scientific and Industrial Research Organisation (CISRO) Australia, MILXview is a rapid visualization tool for medical imagery that assists practitioners in quickly analysing and diagnosing cases.
- **Research.** The Visual Understanding Environment (VUE) created at Tufts University enables students and faculty to gather, sort, and make sense of large amounts of electronic content in their work. The visualizations can be annotated, and users can create and save paths through them to make guided walk-throughs.

Visual Data Analysis in Practice

The following links provide examples of visual data analysis in educational settings.

Christchurch Quake Map

http://www.christchurchquakemap.co.nz

This map visualizes the 2010 Christchurch earthquake and its aftershocks, stepping through them to show how the aftershocks grow and recede over time. As new quakes and aftershocks occur, they are added to the map.

Google Public Data Explorer

http://www.google.com/publicdata/home

Built using the technology that powers Gapminder, Google Public Data Explorer enables users to create custom visualizations comparing different variables using public data.

San Francisco Crimespotting

http://sanfrancisco.crimespotting.org

Crimespotting is an interactive map of crimes in San Francisco and Oakland that visualizes crime by location, type, date, and time, allowing users to grasp patterns and trends.

Truthy

http://truthy.indiana.edu

Truthy analyses Twitter posts to identify memes, aiding in the study of social epidemics and helping users to distinguish between actual organic memes and those planted by marketing campaigns.

VisualComplexity

http://www.visualcomplexity.com/vc

This project is intended to help further the field of visual data analysis by exploring and

collecting visualization tools, best practices, and examples.

For Further Reading

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

5 Tools for Online Journalism, Exploration and Visualization
http://www.readwriteweb.com/cloud/2010/10/10-tools-for-online-journalism.php

(Alex Williams, *ReadWriteWeb,* 2 October 2010.) This article describes five tools that can be used to visualize data.

Data Visualization Usages During the Australian Federal Election
http://www.yellowfinbi.com/YFCommunityNews.i4?newsId=98610

(Lachlan James, *Yellowfinbi,* 26 August 2010.) This article explains how visualizations were used to display the results of recent Australian elections.

Information Aesthetics
http://infosthetics.com

(Andrew Vande Moere, Accessed 17 October 2010.) *Information Aesthetics* is a collection of data visualizations — both hand-drawn information design and machine-visualized datasets — curated by a Senior Lecturer at the University of Sydney and K. U. Leuven University in Belgium.

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

This report describes fundamental research in visualization and analysis that is enabling knowledge discovery from computational science applications at extreme scale.

Visualizing
http://www.visualizing.org

(Accessed 10 October 2010.) *Visualizing* is a community of practice for designers, teachers, students, researchers, and others interested in visual data analysis. The community is invited to showcase work and best practices, post sharable academic resources, and engage in dialogue about the field.

Visualizing Climate Change Impact with Ubiquitous Spatial Technologies
http://www.csdila.unimelb.edu.au/publication/conferences/Visualizing_Climate_Change_Impact_with_Ubiquitous.pdf

(Bennett, R.M., et al., *Proceedings of Joint International Conference on Theory Data Handling and Modelling in Geospatial Information Science,* 26-28 May 2010.) This research paper looks at the use of technologies such as Google Earth to visualize changes in weather patterns and climate, with an eye to informing decision making related to climate change.

***Delicious:* Visual Data Analysis**
http://delicious.com/tag/hz10anz+visualization

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METHODOLOGY

The process used to research and create the *2010 Horizon Report: Australia-New Zealand Edition* is very much rooted in the methods used throughout the Horizon Project. All editions of the *Horizon Report* are produced using a carefully constructed process that is informed by both primary and secondary research. Dozens of technologies, meaningful trends, and critical 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 considers a broad set of important emerging technologies, trends, and challenges, 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, where it is captured and placed in the Horizon Project wiki. This wiki is intended to be a completely transparent window onto the work of the project, and contains the entire record of the research for each of the various editions.

The section of the wiki used for this edition can be found at http://anz.wiki.nmc.org.

The procedure for selecting the topics that will be in the report includes a modified Delphi process now refined over 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, hundreds of internationally recognized practitioners and experts have participated in the Horizon Project Advisory Boards; for any given edition, a third of the Advisory Board members will be new to the project, ensuring a flow of fresh perspectives each time the process is used.

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 pertains 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 in this edition is its potential relevance to teaching, learning, or creative enquiry. A carefully selected set of RSS feeds from dozens of relevant publications ensures that background resources stay current as the project progresses. They are used to inform the thinking of the participants throughout the process.

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

1. *Which of the key technologies catalogued in the Horizon Project Listing will be most important to teaching, learning, or creative enquiry within the next five years?*
2. *What key technologies are missing from our list? Consider these related questions:*
   a. *What would you list among the established technologies that some educational institutions are using today that arguably all institutions should be using broadly to support or enhance teaching, learning, or creative enquiry?*
   b. *What technologies that have a solid user base in consumer, entertainment, or other industries should educational institutions be actively looking for ways to apply?*
   c. *What are the key emerging technologies you see developing to the point that learning-focused institutions should begin to take notice during the next four to five years?*
3. *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?*
4. *What do you see as the key challenge(s) related to teaching, learning, or creative expression that learning-focused institutions will face during the next five years?*

One of the Advisory Board's most important tasks is to answer these questions as systematically and broadly as possible, so as to ensure that the range of relevant topics is considered. Once this work is done, a process that moves quickly over just a few days, the Advisory Board moves to a unique

consensus-building process based on 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 comprehensive list of technologies originally considered for any report, the twelve that emerge at the top of the initial ranking process — four per adoption horizon — are further researched and expanded. Once this "short list" is identified, the group, working with both NMC staff and practitioners in the field, begins to explore the ways in which these twelve important technologies might be used for teaching, learning, and creative enquiry. A significant amount of time is 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://anz.wiki.nmc.org.

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ISBN 978-0-9825334-8-2