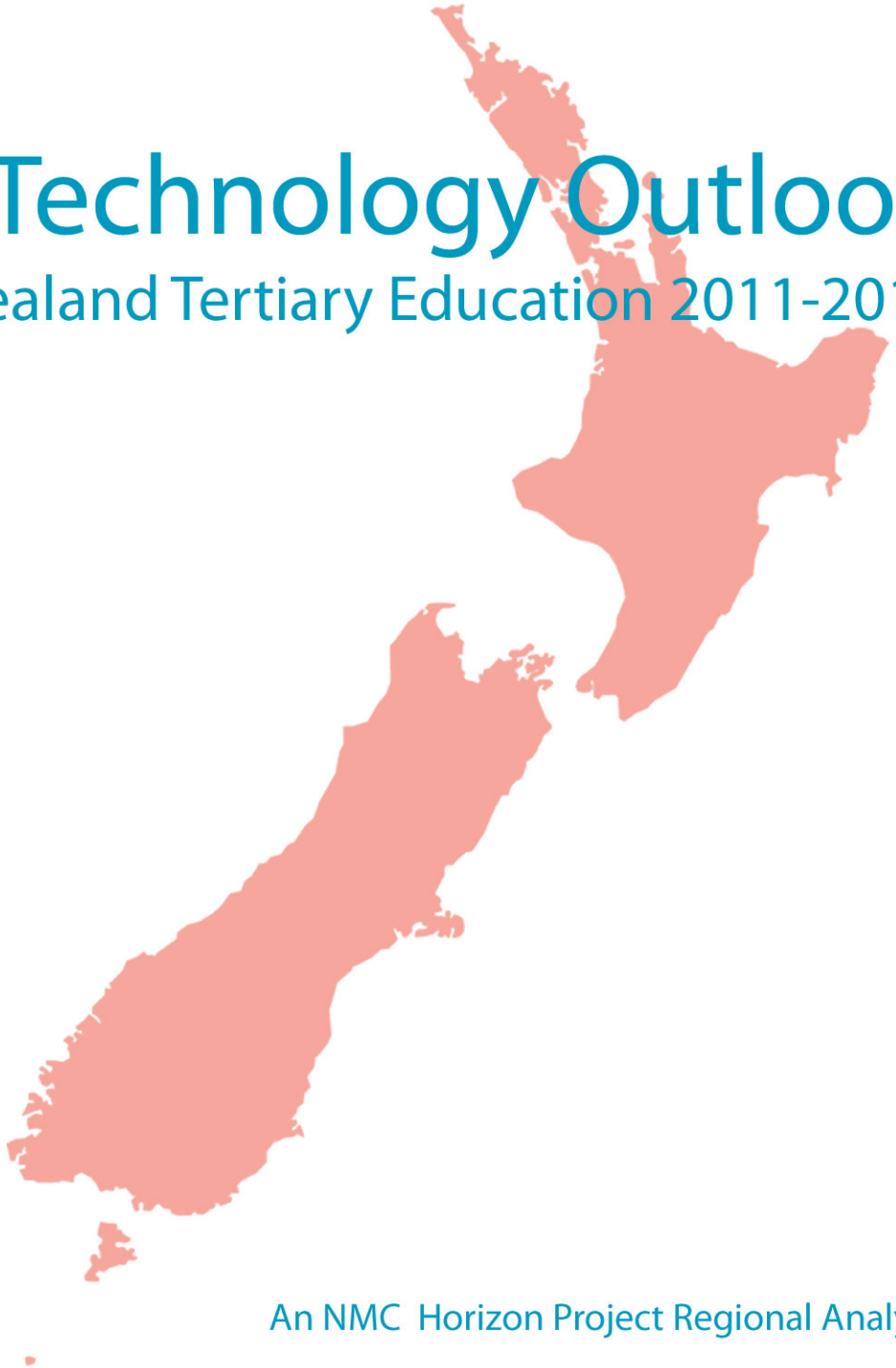
NMC Horizon Project

Technology Outlook

New Zealand Tertiary Education 2011-2016



An NMC Horizon Project Regional Analysis

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is a collaboration between

The NEW MEDIA CONSORTIUM

and

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Technology Outlook for New Zealand Tertiary Education 2011-2016

An NMC Horizon Report Regional Analysis

Executive Summary

The *Technology Outlook for New Zealand Tertiary Education 2011-2016* reflects a collaborative effort between the New Media Consortium (NMC), the New Zealand Ministry of Education, Ako Aotearoa, the Australasian Council on Open, Distance, and E-learning (ACODE), and the Distance Education Association of New Zealand (DEANZ). The research underpinning the report makes use of the NMC's Delphi-based process for bringing groups of experts to a consensus viewpoint, in this case around the impact of emerging technologies on teaching, learning, research, or information management in New Zealand tertiary education over the next five years. The same process underlies the well-known *NMC Horizon Report* series, which is the most visible product of an on-going research effort begun nearly a decade ago to systematically identify and describe emerging technologies likely to have a large impact on education around the globe.

This report is an important outcome of the Wellington 2010 Strategic Technology Summit, led by the NMC, ACODE, Ako Aotearoa, the Ministry of Education, and Massey University. These organisations came together in September 2010 to create an action plan to advance a better understanding of the place for information and communication technologies in New Zealand education, and to invoke a clearer sense of urgency in furthering national and sector-focused initiatives. A major call-to-action that arose from this summit was documented in the resulting communiqué, as follows:

More strategic forecasting is needed both within and across educational institutions. Strategic technology forecasting efforts are essential in understanding both the opportunities and the challenges related to leveraging emerging technologies. One such effort that has been formally proposed by the Distance Education Association of New Zealand (DEANZ) aims to lead social networking to kick off on-going production of future scenarios for tertiary education nationally.

The *Technology Outlook for New Zealand Tertiary Education 2011-2016* was produced to complement the DEANZ effort by exploring emerging technologies and forecasting their potential impact expressly in a New Zealand context. In an effort that ran from October through November 2011, the team behind this report considered a wide range of relevant articles, news, blog posts, research, and project examples as part of the preparation for a carefully selected group of 38 experts that ultimately pinpointed the most notable emerging technology topics, trends, and challenges for tertiary education in New Zealand over the next five years.

That group of experts, known as the 2011 Horizon.NZ Advisory Board, is comprised of a body of knowledgeable individuals, all highly regarded in their fields; collectively the advisory board represents a range of diverse perspectives across the learning sector. The project has been conducted under an open data philosophy, and all the interim projects, secondary research, discussions, and ranking instrumentation can be viewed at *newzealand.wiki.nmc.org*. The precise research methodology employed in producing the report is detailed in a special section found at the end of this report.

The 12 "technologies to watch" presented in the body of this report (commonly termed the "Short List") uniquely reflect the state of tertiary education in New Zealand. As the table below illustrates, however, they also overlap in interesting ways with the *NMC Horizon Report: 2011 Global Edition* as well as *Technology Outlook for UK Tertiary Education 2011-2016*. All three advisory boards — a group of 114 acknowledged experts — agree that mobiles, in forms such as tablets and mobile apps, will likely tip into mainstream use in educational settings in the coming year. These advisory boards also placed cloud computing in the near-term, and agreed that game-based learning would see mainstream adoption within two-three years, reflecting a worldwide consensus among experts regarding the utility of all three of these potentially disruptive technologies.

Experts all over the globe see augmented reality as important, but both the New Zealand and UK groups saw it further away from mainstream use than the experts who served on the global advisory board. There are some other interesting overlaps between New Zealand and the other two reports, including the position of smart objects in the far-term horizon — also agreed on by the UK advisory board. The 81 experts from both the New Zealand and global advisory boards also placed collaborative environments in the near-term horizon and gesture-based computing in the far-term horizon. Interestingly, digital identity, electronic publishing, and personal learning environments are topics of unique interest in New Zealand that did not appear in either of the other two recent reports.

"Short List" Topics Across Three NMC Horizon Projects

Technology Outlook for NZ Tertiary Education 2011-2016	Technology Outlook for UK Tertiary Education 2011-2016	NMC Horizon Report 2011 Global Edition
Time-to-Adoption Horizon: One Year or Less		
Cloud Computing	Cloud Computing	Cloud Computing
Collaborative Environments	Mobiles	Collaborative Environments
Mobile Apps	Open Content	Electronic Books
Tablet Computing	Tablet Computing	Mobiles
Time-to-Adoption Horizon: Two to Three Years		
Digital Identity	Game-Based Learning	Augmented Reality
Electronic Publishing	Learning Analytics	Game-Based Learning
Game-Based Learning	New Scholarship	Open Content
Personal Learning Environments	Semantic Applications	Visual Data Analysis
Time-to-Adoption Horizon: Four to Five Years		
Augmented Reality	Augmented Reality	Brain-Computer Interfaces
Gesture-Based Computing	Collective Intelligence	Gesture-Based Computing
Next-Generation Batteries	Smart Objects	Learning Analytics
Smart Objects	Telepresence	Semantic Applications

Next-generation batteries is a new topic this year, as proposed by the 2011 Horizon.NZ Advisory Board; this emerging technology represents the convergence of low-power consumption processors, LED lights, and other high-efficiency technologies with improved chemical processes. The result is batteries with long lives that do not need to be replaced and require minimal charging. The significance of this technology in New Zealand is that it creates more potential for teachers and students to use their devices with a greater sense of freedom, whenever and wherever they want, without needing to plug-in or recharge as often.

Just as the nuances of the technologies and their associated adoption horizons featured in this report are unique to New Zealand, the trends and challenges selected by the 2011 Horizon.NZ Advisory Board distinctly reflect the current attitude, innovation, and obstacles of the local environment. For example, the advisory board agreed that navigating through the rapidly growing technologies and online resources while still ensuring quality information and applications is a challenge that impacts curriculum design as well as the role of the tertiary educator in New Zealand. As such, the experts spent a fair amount of time researching and discussing relevant trends and challenges in the context of British tertiary education. A full discussion of trends and challenges begins on page 17; the top three from those longer lists are included in the two tables presented here.

All three advisory boards agree that the role of educators is changing. These experts found that the Internet has brought fundamental change to how we approach learning, and even how we define relationships; the obvious consequence is that the role of educators must adapt and evolve to accommodate this change. All three advisory boards noted that people increasingly want to learn, work, and play wherever — and whenever — they want. This trend is pushing universities to

be increasingly entrepreneurial and innovative, especially those seeking the best and brightest students.

Top Trends Across Three NMC Horizon Projects

Technology Outlook for NZ Tertiary Education 2011-2016	Technology Outlook for UK Tertiary Education 2011-2016	NMC Horizon Report 2011 Global Edition
The abundance of resources and relationships made easily accessible via the Internet is increasingly challenging us to revisit our roles as educators.	The abundance of resources and relationships made easily accessible via the Internet is increasingly challenging us to revisit our roles as educators.	The abundance of resources and relationships made easily accessible via the Internet is increasingly challenging us to revisit our roles as educators.
The growing availability of bandwidth will dramatically change user behaviours in teaching, learning and research over the next five years.	What were previously thought of as new and disruptive forms of scholarship are now becoming the norm for scholarly communication.	People expect to be able to work, learn, and study whenever and wherever they want.
People expect to be able to work, learn, and study whenever and wherever they want.	The technologies we use are increasingly cloud-based, and our notions of IT support are decentralized.	The world of work is increasingly collaborative, giving rise to reflection about the way student projects are structured.

While trends influence the uptake of technology positively, challenges are grounded in everyday realities that often make it difficult to learn about, much less adopt new technologies. Digital media literacy, for example, continues to dominate conversations about the challenges likely to impact the acceptance of technology in tertiary education worldwide, and New Zealand is no different. New Zealand is placing a tremendous emphasis on the need to equip its teachers, students, administrators, and researchers with the skills for understanding and creating digital content, tools, and applications — a subtext that permeated all of the discussions for this report.

Top Challenges Across Three NMC Horizon Projects

Technology Outlook for NZ Tertiary Education 2011-2016	Technology Outlook for UK Tertiary Education 2011-2016	NMC Horizon Report 2011 Global Edition
Digital media literacy continues its rise in importance as a key skill in every discipline and profession.	Economic pressures and new models of education are bringing unprecedented competition to the traditional models of tertiary education.	Digital media literacy continues its rise in importance as a key skill in every discipline and profession.
Economic pressures and new models of education are bringing unprecedented competition to the traditional models of tertiary education.	Digital media literacy continues its rise in importance as a key skill in every discipline and profession.	Appropriate metrics of evaluation lag behind the emergence of new scholarly forms of authoring, publishing, and researching.
Most academics are not using new and compelling technologies for learning and teaching, nor for organising their own research.	New modes of scholarship are presenting significant challenges to libraries and university collections, how scholarship is documented, and the business models to support these activities.	Economic pressures and new models of education are presenting unprecedented competition to traditional models of the university.

All three advisory boards noted the increasing economic pressures that are creating setbacks in the education system. Financial issues are indeed an issue felt all over the world that impact the adoption of technologies and hinder students' access to them. While the global advisory board and UK advisory board focused on challenges of measuring learning and implementing new modes of scholarship respectively, the 2011 Horizon.NZ Advisory Board noted a major challenge of academics not using new technologies or techniques themselves. For students to learn how to effectively use technology, the educators must find ways to embrace and creatively integrate it into their own work.

This report is intended as a reference and guide for educators, researchers, administrators, policymakers, and technologists to more easily make strategic technology choices in the areas of teaching, learning, research, or information management. Educators and administrators worldwide look to the *NMC Horizon Report* series to make budgeting decisions when investing in new tools and designing new curriculum.

The results of the research detailed in the *Technology Outlook for NZ Tertiary Education 2011-2016* will be officially released at a series of high-level workshops in New Zealand, hosted by the NMC, the New Zealand Ministry of Education, Ako Aotearoa, ACODE, and DEANZ.

Time-to-Adoption: One Year or Less

Cloud Computing

Since cloud computing first appeared on the near-term horizon in the *NMC Horizon Report: 2009 Global Edition,* its use for supporting collaboration, file storage, and access to computing cycles, and the number of available applications that rely on cloud technologies have grown tremendously. Cloud computing has become the unifying factor among content and applications on the many devices people use in everyday life. Whether connecting at home, work, school, on the road, or in social spaces, nearly everyone who uses computers relies on cloud computing to access their information and applications. This ability to access services and files from any location and on any device is driving development of cloud computing applications in the consumer space. In the academic sector, this technology makes educational resources and communication and collaboration tools more resilient and ubiquitous. As cloud computing garners widespread adoption, providers are establishing standards for privacy and security while staying ahead of evolving institutional needs.

Relevance for Teaching, Learning, Research, or Information Management

- Dynamic provisioning services offered by cloud providers like Amazon's S3 have transformed how we add storage and processing power, and scale resources.
- Cloud computing is being used in computer science programs to simulate virtually any computer, from historical machines to super computers.
- Cloud-based services include a wide range of increasingly powerful tools for almost any platform a user might choose, or any task a user might need to do.

Cloud Computing in Practice

- New Zealand Computing Society launched "Cloud Computing Code of Practice," in partnership with international cloud providers, to identify standards and accountability surrounding cloud computing: http://www.nzcs.org.nz/news/archives/2829-Cloud_Computing_Industry_Code_of_Practice_Signaled.
- Northwestern University is using the cloud to host a virtual laboratory in which students can run experiments online with real equipment and tools: http://www.ilabcentral.org/.
- The University of Melbourne's CLOUDS Laboratory is a software and research development group that is developing the next generation of cloud computing systems and applications: http://www.eng.unimelb.edu.au/research/centres/cloud/.

For Further Reading

Cloud Computing and the Power to Choose
http://www.educause.edu/EDUCAUSE+Review/EDUCAUSEReviewMagazineVolume45/CloudComputingandthePowertoCho/205498

(Rob Bristow, Ted Dodds, Richard Northam, and Leo Plugge. *EDUCAUSE Review*, May/June 2010.) This article discusses how cloud computing helps scale learning resources, citing that over 75% of New Zealand universities have moved their email service to the cloud.

Europe Turns to the Cloud
http://www.nytimes.com/2011/07/25/technology/europe-turns-to-the-cloud.html

(Kevin J. O'Brien, *The New York Times*, 24 July 2011.) *The New York Times* explores how cloud computing is gaining momentum in Europe, citing that cloud services will rise 4.3% this year, in spite of challenging data protection laws.

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

(*Cloudbook*, accessed 21 November 2011.) A number of short videos prepared by various professionals and researchers provide some perspectives on cloud computing.

Time-to-Adoption: One Year or Less

Collaborative Environments

Collaborative environments are online spaces — often cloud-based — where the focus is making it easy to collaborate and working in groups, no matter where the participants may be. As the typical educator's network of contacts has grown to include colleagues who might live and work across the country, or indeed anywhere on the globe, it has become common for people who are not physically located near each other to collaborate on projects. In classrooms as well, joint projects with students at other schools or in other countries are more and more commonplace as strategies to expose learners to a variety of perspectives. The essential attribute of the technologies in this set is that they make it easy for people to share interests and ideas and easily monitor collective progress. The largest example is Wikipedia, which, through the efforts of thousands of contributors, has become the world's de facto encyclopaedia. Google Apps is an online environment, built expressly to enable collaboration, which includes a set of productivity tools configured for teamwork. Educators are continuing to establish best practices to scaffold students from being consumers of such resources to active participants. The bar for widespread participation is very low because the software to support virtual collaboration is low cost or free, and available via a web browser.

Relevance for Teaching, Learning, Research, or Information Management

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

Collaborative Environments in Practice

- The international eLanguages project facilitates collaboration between teachers and classrooms around the world. Teachers can select or propose projects for their classes to take part in, exchange ideas with other teachers, and share resources: http://www.elanguages.org.
- Sakai is a virtual environment consisting of a global community of educators who are collaborating to design and create open software for teaching, learning, and research: http://sakaiproject.org/.

For Further Reading

Collaboration as an Intangible Asset

http://blogs.hbr.org/cs/2011/06/collaboration_as_an_intangible.html

(Robert J. Thomas, *Harvard Business Review*, 16 June 2011.) The author explores social network analysis as a way to discover patterns of interactions and collaboration, which has clear applications for educators evaluating student use of collaborative environments.

Collaborative Learning Environments Sourcebook

http://www.criticalmethods.org/collab/

(CriticalMethods.org, accessed 21 November 2011.) This site offers detailed guides and resources for everything from different types of collaboration tools to building communities of practice and e-portfolios.

Howard Rheingold on Collaboration

http://www.ted.com/talks/howard_rheingold_on_collaboration.html

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

Time-to-Adoption: One Year or Less

Mobile Apps

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

Relevance for Teaching, Learning, Research, or Information Management

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

Mobile Apps in Practice

- CampusM aggregates university services into one free mobile app so that students can easily access time and location-sensitive information. The University of Sheffield and Manchester Metropolitan Universities have integrated the app on their campuses: http://www.ombiel.com/campusm.html.
- Ohio State University's mobile app allows students to view their course grades and schedules in real-time: http://osu.edu/osumobile/.
- The University of Otago has an app that provides users with a map of the campus, making all the lecture halls and buildings easier to locate: http://itunes.apple.com/app/otago-maps/id309273113?mt=8.

For Further Reading

7 Things You Should Know about Mobile App Development

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

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

Campus Computing Survey: Mobile Apps Grow, Cloud Adoption Slow

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

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

Can the iPhone Save Higher Education?

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

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

Time-to-Adoption: One Year or Less

Tablet Computing

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

Relevance for Teaching, Learning, Research, or Information Management

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

Tablet Computing in Practice

- Abilene Christian University business students studying in Oxford are using iPads to deploy research plans, present product concepts, and conduct market research: http://www.acu.edu/news/2010/100611_iPadinOxford.html.
- First-year science students at the University of Adelaide are using iPads in place of the standard set of textbooks: http://www.adelaidenow.com.au/news/ipad-replaces-uni-textbooks-at-university-of-adelaide-science-faculty/story-fn5jhv6y-1225918213032.
- Northumbria Law School is launching a pilot project, exploring the use of iPads in legal education: http://www.northumbria.ac.uk/sd/academic/law/news/ipad.

For Further Reading

The B-School Case Study Gets a Digital Makeover
http://www.businessweek.com/business-schools/the-bschool-case-study-gets-a-digital-makeover-07252011.html

(Erin Zlomek, *Bloomberg Business Week*, 25 July 2011.) This article shows how traditional business school case studies are being transformed with the advent of tablets.

Math That Moves: Schools Embrace the iPad
http://www.nytimes.com/2011/01/05/education/05tablets.html?pagewanted=all

(Winnie Hu, *The New York Times*, 4 January 2011.) In a growing number of schools, iPads are being used to expand learning outside of the classroom and encourage teachers to communicate course materials online. This article weighs both the benefits and concerns of integrating tablets in school curriculum.

School's iPad Requirement 'Divisive'
http://www.stuff.co.nz/national/education/5304084/Schools-iPad-requirement-divisive

(Caralise Moore and Jessica Tasman-Jones, Stuff.co.nz, 19 July 2011.) As more and more colleges and universities make tablets a requirement, there is a growing challenge to ensure that students of all different incomes are able to access them.

Time-to-Adoption: Two to Three Years

Digital Identity

Digital identity management focuses on enabling users to create a single digital identity that can be used in any place where a login is required to access a website or service. It is not a single technology, but a group of related technologies and ideas. In the simplest terms, one's digital identity is a method that allows recognition any place where a login is needed. A variety of different systems are being developed, and though they have the same broad purpose of creating a sign-on system that is convenient and secure for an individual rather than a company or organisation, ideas about what precisely defines a user-centric identity system and how that would be implemented are still widely varied. Both Google and Facebook are positioning their systems to be the "home" of one's digital identity. Digital identity benefits academia because learners can quickly switch back and forth from various secure web resources and contribute posts under the same ID. Educators can then view the work students are doing and the content they are creating across the Internet because it is associated with each user.

Relevance for Teaching, Learning, Research, or Information Management

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

Digital Identity in Practice

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

For Further Reading

The Challenge of Creating Web Based Identity Standards
http://mashable.com/2011/11/14/google-consumer-authentication/

(John Fontana, *Mashable*, 14 November 2011.) The author discusses the battle between corporations, including Google, Facebook, and Yahoo, to own users' digital identities, as well as the security implications.

Digital Identity Development in Higher Education
http://edcabellon.com/leadership/digitalidentity/

(Ed Cabellon, *On the Go*, 29 August 2011.) This article addresses the importance of students carefully crafting their digital identities — online profiles are becoming critical in helping them build their reputations.

Using Espresso (Establishing Suggested Practices Regarding Single Sign On) to Streamline Access
http://www.niso.org/apps/group_public/download.php/7058/ESPReSSO_pres_NASIG_2011.pdf

(Andy Ingham, University of North Carolina – Chapel Hill, 4 June 2011.) This presentation outlines the goals of project Espresso to perfect user authentication when using single sign-on.

Time-to-Adoption: Two to Three Years

Electronic Publishing

Now that it is firmly established in the consumer sector, electronic publishing is beginning to demonstrate capabilities that challenge the boundaries between print and digital, still image and video, passive and interactive. Modern digital workflows support all manner of possible publication, from traditional print to digital, web, video, and even interactive content. Building in the full spectrum of potential publishing avenues — print, web, video, mobiles and tablets, and interactives — from the beginning is not only a way to streamline production overall, but also to increase the reach of the materials produced by leveraging the content over a wide range of media. Modern media companies have been at the vanguard of this conversion. Magazine writers, for example, will produce a piece so that it will work in the magazine, on the web, and in video — and the finished product may appear in any or all of those outlets.

Relevance for Teaching, Learning, Research, or Information Management

- Electronic publishing offers institutions unprecedented opportunities of scale and richness by reorganising the way images, audio and video content, and layers of textual data are conceptualized during the design process.
- Modifying publishing workflows brings educational institutions in line with industry-standard practices and allows them to reach entirely new audiences.
- Electronic publications change the way educators publish their scholarly work; they have the ability to publish online and adapt their material as often as they like, without being subject to the cost of additional print cycles.

Electronic Publishing in Practice

- Ako Aotearoa Southern Hub is evaluating the use of interactive e-textbooks on net tablets: http://akoaotearoa.ac.nz/ako-hub/ako-aotearoa-southern-hub/news/newly-approved-project-effective-use-interactive-e-textbooks-and-e-workbooks-net-tablets.
- The Australian National University E Press is exploring and enabling electronic modes of scholarly publishing in an effort to make the intellectual output of ANU's academic community more accessible: http://epress.anu.edu.au/titles/ahr.html.
- Single Edition is a new Adobe Program that allows users to create digital magazines and magazine apps for the iPad: http://blogs.adobe.com/digitalpublishing/2011/10/new-adobe-digital-publishing-suite-single-edition-announced.html.

For Further Reading

How Yale Press Took Over Art Publishing
http://www.yaledailynews.com/news/2011/apr/13/how-yale-press-took-over-art-publishing/

(Edmund Downie, *Yale Daily News*, 13 April 2011.) This article discusses the art of electronic publishing and how Yale Press has successfully transitioned into the digital age.

In E-Books, Publishers Have a New Rival: News Sites
http://www.nytimes.com/2011/09/19/business/media/in-e-books-publishing-houses-have-a-rival-in-news-sites.html

(Julie Bosman and Jeremy Peters, *The New York* Times, 18 September 2011.) Traditional publishing houses are finding new competitors as e-books are being produced by individuals and institutions, and the very definition of a "book" is changing.

Online Platforms Begin to Test the Market for University-Press E-Books
http://chronicle.com/blogs/wiredcampus/online-platforms-begin-to-test-the-market-for-university-press-e-books/33480

(Jennifer Howard, *The Chronicle of Higher Education*, 3 October 2011.) This article explores several e-book projects in their initial phases at universities, and discusses the implications of electronic publishing as it relates to contracts with publishing houses.

Time-to-Adoption: Two to Three Years

Game-Based Learning

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

Relevance for Teaching, Learning, Research, or Information Management

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

Gamed-Based Learning in Practice

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

For Further Reading

5 Teaching Tips for Professors — From Video Games

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

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

Games and Learning: Teaching as Designing

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

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

What Does Game-Based Learning Offer Higher Education?

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

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

Time-to-Adoption: Two to Three Years

Personal Learning Environments

Personal learning environments (PLEs) are described as systems for enabling self-directed and group-based learning, designed around each user's goals, with great capacity for flexibility and customization. PLEs are conceived as drawing on a variety of discrete tools, perhaps chosen by the learner, which can be connected or used in concert in a transparent way. Using a growing set of free and simple tools and applications, it is already quite easy to create customized, personal web-based environments, and craft them to explicitly support one's social, professional, learning and other activities. Online material, once found, can be saved, tagged, categorized, and repurposed without difficulty and without any special knowledge of how web pages are put together. While the concept of PLEs is still very new and fluid, it does seem to be clear that a PLE is not simply a technology but an approach or process that is individualized by design, and thus different from person to person. Widespread adoption of PLEs, once they actually exist, may require a shift in attitudes toward technology, teaching, and learning.

Relevance for Teaching, Learning, Research, or Information Management

- PLEs may cater to students with differing learning styles; for instance, visual learners might be able to obtain material from a different source than auditory learners do.
- Students using PLEs may benefit from the practice of keeping track of, and curating, their own resource collections.
- Using PLEs can empower students to take greater control of their learning networks and connections with peers, experts, and others.

Personal Learning Environments in Practice

- Colorado Libraries has developed a series of lessons for information professionals, culminating in a capstone project to create an individual PLE: http://web20.coceforum.org/the-modules/capstone-your-ple/.
- Innovative Technologies for an Engaging Classroom is a pan-European project dedicated to designing the future classroom by bringing together policy-makers, researchers, technology suppliers, and teachers to develop scalable learning environments for students: http://itec.eun.org.
- MindTap works as a personal learning experience, building on concepts used in PLEs. This system offers adaptable learning paths and activities that instructors can choose from based on student needs: http://www.cengagesites.com/academic/?site=5232.

For Further Reading

5 Ways to Build Your 1.0 and 2.0 Personal Learning Network
http://theinnovativeeducator.blogspot.com/2010/08/5-ways-to-build-your-10-and-20-personal.html
(Lisa Nielsen, The Innovative Educator Blog, 1 August 2010.) This post discusses how to build a personal learning network and how this has evolved as online communities and technologies have developed more robust ways to share information and collaborate. The author offers ways to create a PLE through some exercises and examples.

The PLN Matures. The Progression of the 21st Century Personal Learning Network
http://theinnovativeeducator.blogspot.com/2010/08/pln-matures-progression-of-21st-century.html
(Lisa Nielsen. The Innovative Educator Blog, 18 August 2010.) This article discusses the ways in which PLEs have progressed into collaborative creation environments that are more interactive. The author also mentions how PLEs are beginning to use social media such as Twitter to further grow and enrich personal learning networks.

Time-to-Adoption: Four to Five Years

Augmented Reality

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

Relevance for Teaching, Learning, Research, or Information Management

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

Augmented Reality in Practice

- BuildAR is a Layar-based augmented reality platform that allows people — even without development experience — to create and host mobile augmented reality content online: http://www.buildar.com/.
- The Earthquake AR project was started in response to the recent earthquake in Christchurch, New Zealand. The University of Canterbury and HITLabNZ are exploring how mobile augmented reality can reveal data sets that would be helpful in the reconstruction of a demolished building: http://www.hitlabnz.org/index.php/research/augmented-reality?view=project&task=show&id=24
- The Powerhouse Museum developed an augmented reality application that captures the history of Sydney, Australia, by allowing visitors to use the camera on their mobiles to see the city as it appeared one hundred years ago: http://www.powerhousemuseum.com/layar/.

For Further Reading

Augmented Reality — Its Future in Education
http://www.publictechnology.net/sector/augmented-reality-its-future-education

(Steve Smith, publictechnology.net, 15 November 2010.) The director of learning at Capita IT Services explains why augmented reality is easier to use than other 3D technologies.

Augmented Reality for Chemists (video)
http://youtu.be/gZxK6j4JTHQ

(Art Olson, Chemical & Engineering News, 19 September 2011.) This video shows how augmented reality is built, using a webcam to track all the possible motions of a 3D model of a chemical.

Time-to-Adoption: Four to Five Years

Gesture-Based Computing

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

Relevance for Teaching, Learning, Research, or Information Management

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

Gesture-Based Computing in Practice

- At McGill University researchers are developing a haptic feedback system that allows people with visual impairments to get more feedback with fine degrees of touch: http://www.cim.mcgill.ca/~haptic/laterotactile/papers/VL-VH-EH-10.pdf.
- Developed at RWTH Aachen University, MudPad is a localized active haptic feedback interface that offers users more nuanced ways to interact with screens through touch: http://hci.rwth-aachen.de/mudpad.
- European-based company Extreme Reality is creating software to allow users to control computer programs, games, and mobile devices with their hand gestures and movements: http://www.news10.net/life/entertainment/game-guys/story.aspx?storyid=127197&catid=99

For Further Reading

7 Areas Beyond Gaming Where Kinect Could Play A Role
http://radar.oreilly.com/2010/12/dancing-with-kinects-future-in.html

(Alex Howard, O'Reilly Radar, 3 December 2010.) This article looks at how the gesture-based Kinect System from Microsoft can have broad use beyond its intended use as a gaming platform. Uses include applications in art, health and education.

Google Updates Its Search App For iPads
http://www.mobilemag.com/2011/11/21/google-updates-its-search-app-for-ipads/

(Andrew Grush, *Mobile Magazine*, 21 November 2011.) Google has updated its Google iOS/iPad app to be gesture-driven. Users can now easily return back to their search results, simply by swiping a finger across the screen.

A Touchscreen You Can Really Feel
http://www.kurzweilai.net/a-touchscreen-you-can-really-feel

(*Kurzweil News*, 17 November 2011.) This article discusses a new interface with tactile surfaces, developed by the Integrated Actuators Laboratory, where users can feel raised keys beneath their fingers, along with vibrations. The interface is being explored for use by the visually impaired.

Time-to-Adoption: Four to Five Years

Next-Generation Batteries

Two long-term trends are converging to make it possible for the first time to imagine batteries that charge incredibly quickly, last for days, and can be recharged thousands of times with no loss of efficiency. The first of these trends is in the development of low-power-consumption processors, LED lights, and other high-efficiency technologies. Coupled with a recurring cycle of advances in lithium battery technology, this is resulting in devices that require less power and have significantly longer-lasting, high-efficiency batteries. Among these are advances that are improving the safety of lithium technology while increasing the capacity of the batteries using it, such as solid state and polymer batteries. While the impact of such a technology on learning is currently challenging to measure, it is easy to imagine that as users feel less of a need to be tethered to power supplies, they will be using their devices more — anywhere they want.

Relevance for Teaching, Learning, Research, or Information Management

- Long-lasting batteries will enable more kinds of portable sensors, recorders, and other devices to be placed in remote locations for all manners of field studies.
- Low-power devices allow simple networks to form on demand, with very little impact on battery life. A current example is the ability of phones to communicate with heart-rate monitors that can do their job powered only by a small "button" battery.
- The ability to recharge a device in minutes will mean that loaner equipment can be placed back into service very rapidly, which reduces costs.

Next-Generation Batteries in Practice

- The new iPad is expected to feature a thinner, lighter battery in its next release. *Mashable* reports that the new batteries will be smaller, thinner, and last longer: http://mashable.com/2011/09/07/ipad-thinner-lighter-battery/.
- The iPhone 4S includes a unique, low-power Bluetooth chip that enables it to communicate with a wide range of "Bluetooth Smart" devices. The chip requires so little power that it can run for years on a button-size watch battery: http://www.sltrib.com/sltrib/lifestyle/52804888-80/bluetooth-devices-smart-chip.html.csp.

For Further Reading

National Labs Leading Charge on Building Better Batteries
http://energy.gov/articles/national-labs-leading-charge-building-better-batteries

(Charles Rousseaux, Energy.gov, 26 September 2011.) Scientists at Oak Ridge National Laboratory incorporated a form of the compound titanium dioxide into lithium batteries and found significant improvements. Concurrently, Berkley Lab researchers designed a new anode made of millions of repeating units, giving the battery greater capacity.

Polymer Batteries for Next-Generation Electronics
http://www.physorg.com/news/2011-09-polymer-batteries-next-generation-electronics.html

(University of Leeds, Physorg.com, 9 September 2011.) A new polymer gel developed by University of Leeds scientists could replace the liquid electrolytes currently used in rechargeable lithium battery cells for laptops, digital cameras, mobile phones, and more.

Silicon Nanoparticles Will Power Next-Generation Batteries
http://news.medill.northwestern.edu/chicago/news.aspx?id=163903

(Marita Vera, *Medill Reports Chicago*, 28 April 2010.) Silicon has the highest energy density of any element and is cheap, so replacing graphite with silicon nanoparticles increases the amount of energy that can be packed into a battery. This article explores the challenges with silicon batteries — short life cycles.

Time-to-Adoption: Four to Five Years

Smart Objects

A smart object has four key attributes: it is small, and thus easy to attach to almost anything; it has a unique identifier; it has a small store of data or information; and it has a way to communicate that information to an external device on demand. Objects that carry information with them have long been used for the monitoring of sensitive equipment or materials, point-of-sale purchases, passport tracking, inventory management, identification, and similar applications. Smart objects are the next generation of those technologies — they "know" about a certain kind of information, such as cost, age, temperature, colour, pressure, or humidity — and can pass that information along easily and instantly.

Smart objects connect the physical world with the world of information; it is that linkage that will enable the "Internet of Things" described by Vint Cerf. They can be used to digitally manage physical objects, monitor their status, track them throughout their lifespan, alert someone when they are in danger of being damaged or spoiled — or even to annotate them with descriptions, instructions, warranties, tutorials, photographs, connections to other objects, and any other kind of contextual information imaginable.

Relevance for Teaching, Learning, Research, or Information Management

- Attached to scientific samples, smart objects can alert scientists and researchers to conditions that may impair the quality or utility of the samples, such as heat or excess humidity.
- Pill-shaped micro cameras are used in medical diagnostics and teaching to traverse the human digestive tract and send back thousands of images to pinpoint sources of illness.
- QR codes bridge the gap between physical and digital content as people can "scan" printed materials with their mobiles and be immediately directed to the corresponding place on the web.

Smart Objects in Practice

- Amarino, developed by MIT, is a toolkit to connect Android-driven mobile devices with Arduino microcontrollers via Bluetooth, that allows users to control the lights in a room, display text messages on a wall, and detect exposure levels to radiation or other potentially harmful environmental factors through their smartphones: http://www.amarino-toolkit.net/.
- In an effort to increase security, Otago Museum is installing a radio tracking system to monitor all of its objects. Each artefact will be tagged, and RFID readers will track the items as they move around the museum space: http://www.odt.co.nz/news/dunedin/143086/plans-made-radio-tracking-system.

For Further Reading

Internetting Every Thing, Everywhere, All the Time
http://edition.cnn.com/2008/TECH/11/02/digitalbiz.rfid/

(Cherise Fong, *CNN*, November 2008.) This article describes the "Internet of Things" and illustrates some current examples of smart object technology.

A New Laboratory Radio Frequency Identification (RFID) System for Behavioural Tracking of Marine Organisms
http://www.mdpi.com/1424-8220/11/10/9532/

(Jacopo Aguzzi, Valerio Sbragaglia, et al., MDPI Publishing, 10 October 2011.) This paper discusses the recent findings of how an RFID system is being used to track marine animals' behaviour via automated video imaging.

Key Trends

The technologies featured in the NMC Horizon Project 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 perspective, each advisory board researches, identifies, and ranks key trends that are currently affecting the practice of teaching, learning, research, and information management, and uses these as a lens for its later work. These trends are surfaced through an extensive review of current articles, interviews, papers, and new research. Once identified, the list of trends is ranked according to how significant an impact they are likely to have on education in the next five years. The following trends have been identified as key drivers of technology adoptions in New Zealand for the period 2011 through 2016; they are listed here in the order each was ranked by the advisory board.

1) The abundance of resources and relationships made easily accessible via the Internet is increasingly challenging us to revisit our roles as educators. This multi-year trend from the *NMC Horizon Report* series was again ranked very highly, indicating its continued influence, specifically in New Zealand. Institutions must consider the unique value that each adds to a world in which information is everywhere. In such a world, sense-making and the ability to assess the credibility of information are paramount. Mentoring and preparing students for the world in which they will live — the central role of the university when it achieved its modern form in the 14th century — is again at the forefront.

2) The growing availability of bandwidth will dramatically change user behaviours in teaching, learning and research over the next five years. The advent of cloud computing has alleviated the burden of storing software, email services, and other applications locally. Major resources are now accessible via web browser in just one click, no longer bogging down computer speed. Students and educators can now connect and collaborate with more ease, transfer files and information quicker, and store more new content.

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

4) Recognition and acceptance by tertiary educators of the potential of new technologies is increasing. On many levels, what used to be considered emerging tools and new teaching and learning approaches have now reached mainstream adoption among educators. Maximizing online opportunities is one of the most notably accepted concepts. More than ever, teachers and administrators are embracing new technologies because there is now so much well-documented research on the positive outcomes they generate. Collaborations between other educational institutions have yielded lists of best practices and other tangibles that prove the worth of technology in learning. Communities and networks of practice are supporting educators as they experiment with new ideas and share their results.

5) Increasingly, students want to use their own technology for learning. As new technologies are developed at a more rapid pace and at a higher quality, there is a wide variety of different devices, gadgets, and tools from which to choose. Utilizing a specific device has become something very personal — an extension of someone's personality and learning style — for

example, the iPhone vs. the Android. There is comfort in giving a presentation or performing research with tools that are more familiar and productive at the individual level. And, with handheld technology becoming mass produced and more affordable, students are more likely to have access to more advanced equipment in their personal lives than at school.

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

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

Significant Challenges

Along with current trends, the advisory board notes important challenges faced by the tertiary sector, especially those that are likely to continue to affect education over the five-year time period covered by this report. Like the trends, these are drawn from a careful analysis of current events, papers, articles, and similar sources, as well as from the personal experience of the advisory board members in their roles as leaders in education and technology. Those challenges ranked as most significant in terms of their impact on teaching, learning, research or information management in New Zealand in the coming years are listed here, in the order of importance assigned them by the advisory board.

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

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

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

4) Organisations are challenged to ensure quality while engaging in the use of rapidly changing, ever-evolving technologies. As new information and new technologies are readily available, at the fingertips of learners, educational institutions must find ways to intervene and remain a part of the relationship between the technology and the student. These organisations must make wise, up-to-date decisions when investing in and implementing technologies. To do so, they must conduct extensive research and regard technologies and their potential applications from all angles. Collaborations between institutions in the exploration of emerging technology provide them with opportunities to exchange ideas, success stories, obstacles, and develop best practices.

5) The growing choice that emerging technologies make possible — and how people navigate through this choice — is an on-going challenge. When there are so many options for both educators and students on which technologies to use, it is easy to lose sight of how they will impact the teaching and learning process. In online learning environments in particular, there are a plethora of available communication, collaboration, and information management platforms. Individually, each tool or application may be effective, but when used all together, they can create a complex user interface where the focus is on the technologies rather than the learning. Navigating through the potential technologies and understanding how they will interact with each other to create a simple, easy-to-use environment is a pressing issue that must be solved at the conceptual — not implementation — level.

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

7) The role of the tertiary educator is changing. As the focus in tertiary education shifts from teacher-centred, lecture-based classrooms to open educational resources (OERs), educators must adapt to the role of online facilitator. Because these OERs are loaded with pre-developed materials, teachers must sift through the resources and identify what is credible and revise the materials often as new information arises. In this sense, they will be online resource managers, but they also must develop creative ways to digitally interact with students in regards to those resources — otherwise they risk becoming dispensers of course materials rather than scholarly guides and instructional designers.

Methodology

The process used to research and create the *Technology Outlook for New Zealand Tertiary Education 2011-2016: An NMC Horizon Report Analysis* is very much rooted in the methods used throughout the NMC 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, challenges, and trends, and then examines each of them in progressively more detail, reducing the set until the final listing of technologies, trends, and challenges is selected.

Much of the process takes place online, where it is captured and placed in the NMC 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 the *Technology Outlook for New Zealand Tertiary Education 2011-2016* can be found at newzealand.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 the *NMC Horizon Report* series, 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 NMC Horizon Project Advisory Boards; in any given year, a third of advisory board members are new, ensuring a flow of fresh perspectives each year.

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 is the potential relevance of the topic to teaching, learning, research, or information management. 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, the advisory board engages in the central focus of the research — the research questions that are at the core of the NMC Horizon Project. These questions 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 Listing will be most important to teaching, learning, research, or information management 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, research or information management?
    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 educational institutions approach our core missions of teaching, research, and service?
4. What do you see as the key challenges related to teaching, learning, research or information management that educational 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.

For additional detail on the project methodology or to review the instrumentation, the ranking, and the interim products behind the report, please visit the project wiki at newzealand.wiki.nmc.org.

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