NMC Horizon Project

Technology Outlook

UK Tertiary Education 2011-2016

An NMC Horizon Project Regional Analysis

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The Technology Outlook for UK Tertiary Education 2011-2016
is a collaboration between

The NEW MEDIA CONSORTIUM

and

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Executive Summary

The *Technology Outlook for UK Tertiary Education 2011-2016* reflects a collaborative effort between the New Media Consortium (NMC) and the JISC Innovation Support Centres, CETIS and UKOLN. 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 UK tertiary education over the next five years. The same process underlies the NMC's well-known *Horizon Report* series, which is the most visible product of an ongoing 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.

In an effort that ran from January through August 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 33 experts that ultimately pinpointed the most notable emerging technology topics, trends, and challenges for tertiary education in the United Kingdom over the next five years. That group of experts, known as the Horizon.JISC Advisory Board, is comprised of an international 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 http://jisc.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.

Short List Topics Across Three NMC Horizon Projects

Technology Outlook for UK Tertiary Education 2011-2016	NMC Horizon Report 2011 Global Edition	2010 NMC Horizon Report Australia-New Zealand Edition
Time-to-Adoption Horizon: One Year or Less		
Cloud Computing Mobiles Open Content Tablet Computing	Cloud Computing Collaborative Environments Electronic Books Mobiles	Cloud Computing Electronic Books Mobiles Social Networking
Time-to-Adoption Horizon: Two to Three Years		
Game-Based Learning Learning Analytics New Scholarship Semantic Applications	Augmented Reality Game-Based Learning Open Content Visual Data Analysis	Augmented Reality Game-Based Learning Open Content Virtual Worlds
Time-to-Adoption Horizon: Four to Five Years		
Augmented Reality Collective Intelligence Smart Objects Telepresence	Brain-Computer Interfaces Gesture-Based Computing Learning Analytics Semantic Applications	Gesture-Based Computing Semantic Web Telepresence Visual Data Analysis

The twelve "technologies to watch" presented in the body of this report (commonly termed the "Short List") uniquely reflect the state of tertiary education in the UK. As the table above illustrates, however, they also overlap in interesting ways with *The NMC Horizon Report: 2011 Global Edition*, released earlier this year, as well as *The NMC Horizon Report: 2010 Australia-New Zealand Edition*. All three advisory boards — a group of 108 acknowledged experts — agree that mobiles 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 2-3 years, reflecting a worldwide consensus among experts regarding the utility and importance of all three of these potentially disruptive technologies.

Experts all over the globe see augmented reality as important, but the UK group saw it further away from mainstream use than the experts who served on the Global and Australia-New Zealand advisory boards. Open content approaches are thought to be two years closer to mainstream use in the UK compared to other parts of the world — a view supported by the number of open access projects, open institutions, and open courses in the UK. The 55 experts behind the Australia-New Zealand and the UK reports agree that telepresence is important, but is still four to five years away. Interestingly, new scholarship, collective intelligence, and smart objects are topics of unique interest in the UK that did not appear on the Short List for either of the other two recent reports.

Tablet computing is a new topic this year; it includes elements of electronic books, which was positioned on the near-term horizon just a few months ago in the global report and the Australia-New Zealand edition. This reflects a shift away from single purpose devices, to tablets — multi-tasking devices that encompass e-readers among other applications — seen as their imminent replacements. Embedded in the mobiles category in previous *NMC Horizon Reports*, tablet computing has emerged as a topic distinct from smart phones and tablet PCs.

Top Trends Across Three NMC Horizon Projects

Technology Outlook for UK Tertiary Education 2011-2016	NMC Horizon Report 2011 Global Edition	2010 NMC Horizon Report Australia-New Zealand 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 in sense-making, coaching, and credentialing.	As the availability and use of electronic books continue to grow, the traditional publishing (and textbook) market is undergoing a profound and lasting change.
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. This highly-ranked trend, also noted last year, continues to permeate all aspects of daily life.	Social and open forms of peer review and scholarship are gradually gaining acceptance.
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.	The availability of educational content for mobile devices is increasing as more providers develop for these platforms.

While many of the technology topics featured in this report enjoy worldwide interest, the trends and challenges selected by the Horizon.JISC Advisory Board distinctly reflect the current attitude, innovation, and obstacles of the local environment. For example, challenges to university presses in the UK identified by the advisory board convey the unique ways they are funded there. 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 16; the top three from those longer lists are included in the two tables presented here.

Both the Horizon.JISC and *The NMC Horizon Report: 2011 Global Edition* advisory boards agreed that the role of educators is changing. These 76 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.

The NMC Horizon Report: 2010 Australia-New Zealand Edition, published just a few months after the introduction of the first iPad, placed an emphasis on electronic books and the growing availability of educational resources created specifically for mobile platforms. An aspect of this focus also appears in the UK context, but the growing interest in tablets has redefined the devices used to read ebooks and other mobile content.

Top Challenges Across Three NMC Horizon Projects

Technology Outlook for UK Tertiary Education 2011-2016	NMC Horizon Report 2011 Global Edition	2010 NMC Horizon Report Australia-New Zealand Edition
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.	Even where technology for learning is strongly promoted, there remains a clear need for professional development opportunities around emerging technology.
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.	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.
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.	The need for formal instruction in key new skills, including information literacy, visual literacy, and technological literacy, poses a continuing challenge to educational programs.

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. Economic pressures, for example, continue to dominate conversations about the challenges likely to impact the acceptance of technology in higher education worldwide, and the UK is no different. Britons are feeling tremendous economic pressure on their higher education system — a subtext that permeated all of the discussions for this report.

All three advisory boards noted the increasing importance of digital media literacy to every discipline and profession; in *The NMC Horizon Report: 2010 Australia-New Zealand Edition*, the need for comprehensive professional development to help faculty gain these skills was listed as the number one challenge. Similarly, all three groups of experts noted the lag between ways of documenting and evaluating scholarship and teaching, as well as the use of new technologies in support of the work that tertiary educators do. New notions and tools for assessments are needed with new technologies to support those assessment processes.

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 in the *Technology Trends in UK Tertiary Education 2011-2016* will be officially released at an invited preconference session at the 2011 Association for Learning Technology conference held at the University of Leeds on September 5, 2011, and hosted by the NMC and JISC Innovation Support Centres.

Time-to-Adoption: One Year or Less

Cloud Computing

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

Relevance for teaching, learning, research, or information management

- Dynamic provisioning services offered by cloud providers like Amazon's S3 have transformed the ways we provision servers, 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

- The Bloomsbury Media Cloud is a joint effort of six University of London institutions to create a shared resource for collaboration on strategies to support teaching, learning and research: https://sites.google.com/site/bloomsburymediacloud/.
- The University of Oxford launched the pilot program Flexible Services for the Support of Research to provide a public-private hybrid cloud solution for large project development and on-demand storage: http://www.oerc.ox.ac.uk/research/current-research/flexible-services-for-the-support-of-research.
- The University Modernisation Fund and Universities and the Higher Education Funding Council for England have developed a new program, where universities and colleges across England will benefit from shared services in cloud computing infrastructure and applications: http://www.hefce.ac.uk/news/hefce/2011/cloud.htm.

For Further Reading

Building Up Cloud in Europe
http://www.eurocloud.org.uk/_m1721/from-the-blogs/Building-up-cloud-in-Europe

(EuroCloud UK Blog, eurocloud.org.uk, 5 July 2011.) EuroCloud UK, the UK-based SaaS and cloud computing community, illuminates how politicians and government officials are finally recognizing the value of the cloud.

Cloud Migrations Trigger Organizational Challenges
http://www.informationweek.com/news/cloud-computing/229203436

(Vanessa Alvarez, *InformationWeek.com*, 9 February 2010.) This article discusses how cloud computing can work if organizations are well structured in advance to take advantage of its affordances.

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.

Time-to-Adoption: One Year or Less

Mobiles

Mobiles as a category have proven more interesting and more capable with each passing year, and continue to surprise both researchers and consumers. According to a report from mobile manufacturer Ericsson, by 2015 80% of people accessing the Internet worldwide will be doing so from a mobile device. At the 2011 Mobile World Congress, Google CEO Eric Schmidt reaffirmed the prediction by revealing that for every baby born, 30 Android phones are activated. It is no arbitrary decision that the statistical point of comparison is between new lives and mobiles; the next generation of students will inevitably be armed with smarter mobiles at younger ages. Perhaps even more important for education is that Gartner Research projects Internet-capable mobile devices will outnumber PCs by 2013. In Japan, over 75% of Internet users already use a mobile as their first choice for access. This shift in the means of connecting to the Internet is being enabled by the convergence of three trends: the growing number of Internet-capable mobile devices, increasingly flexible web content, and continued development of the networks that support connectivity.

Relevance for teaching, learning, research, or information management

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

Mobiles in Practice

- 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.
- The Mobile Campus Assistance project, led by the University of Bristol, provides students with information on campus events and resources through their mobile phones: http://mobilecampus.ilrt.bris.ac.uk/final-progress-report/.
- MoLeNET is a UK-based network that provides collaboration platforms to support mobiles in education. The program offers technical support, pedagogical advice, and continuing professional development among other features: http://www.molenet.org.uk.

For Further Reading

428 Million Mobile Communication Devices Sold Worldwide in First Quarter 2011
http://www.gartner.com/it/page.jsp?id=1689814

(Christy Petty and Holly Stevens, Gartner, 19 May 2011.) Gartner reports a 19% increase on the sales of mobiles for the first quarter of 2011 compared to the same period in 2010. Apple, Samsung, and HTC led the pack with the highest results because of the ability to easily download apps on their devices.

Information Security in Education/Security Policies for Mobile Devices
http://en.wikibooks.org/wiki/Information_Security_in_Education/Security_Policies_for_Mobile_Devices

(WikiBooks, wikibooks.org, last modified 30 April 2010.) This wikibook entry details considerations for cell phone use in schools, outlines what to consider when you are writing a plan for a school, and offers links to various policies as examples.

Time-to-Adoption: One Year or Less

Open Content

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 pedagogies 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. It presents 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.

Relevance for teaching, learning, research, or information management

- The use of open content promotes a set of skills that are critical in maintaining currency in any area of study — the ability to find, evaluate, and put new information to use.
- The same set of materials, once placed online and made sharable via the appropriate licensing, can inform a wide variety of learning modalities, not the least of which is learning for the sheer joy of discovery.
- Sharable materials reduce teacher workloads as they do not need to be recreated from scratch.

Open Content in Practice

- OpenSpires is a University of Oxford resource providing high quality Creative Commons education resources, including lectures and interviews: http://openspires.nsms.ox.ac.uk/.
- The Open University's Learning Space offers 600 free online courses with assignments and tools that help students assess their progress: http://openlearn.open.ac.uk/.
- OpenEd Solutions provides schools with opportunities to integrate open resources in the classroom to stimulate more innovation and collaboration: http://openedsolutions.com/.
- Peer 2 Peer University (P2PU) is a free and open emerging education platform where learners gather to study and discuss specific topics and assess each others' work: http://p2pu.org/en/.

For Further Reading

Managing and Learning in Massive(ly) Open Online Courses
http://www.slideshare.net/gsiemens/teaching-learning-in-open-courses

(George Siemens, eLearnspace, 21 October 2010.) This slide deck from educator George Siemens provides a good overview of how open content can be successfully used and implemented in coursework.

Open Content in Practice
http://thejournal.com/articles/2011/03/02/open-content-in-practice.aspx

(Bridget McCrea, *The Journal*, 2 March 2011.) This article provides an in-depth look at one of the most acclaimed open content-driven institutions — The Open High School of Utah.

The Open Internet and its Enemies
http://www.bbc.co.uk/news/technology-14217363

(Bill Thompson, BBC News, 23 July 2011.) Technology writer Bill Thompson's essay explores what "open" really means. While advocating for open content, he examines the challenges we face in having access to an impeded flow of information.

Time-to-Adoption: One Year or Less

Tablet Computing

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

Relevance for teaching, learning, 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

- Northumbria Law School is launching a pilot project this fall semester, exploring the use of iPads in legal education: http://www.northumbria.ac.uk/sd/academic/law/news/ipad.
- The biological sciences department at the University of Leeds embarked on an e-learning project, where one professor is monitoring how using iPads impacts his students' academic performance and engagement: http://www.fbs.leeds.ac.uk/lt/bulletin/index.php?id=2022.

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 Ziomek, *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.

Educators Evaluate Learning Benefits of iPad
http://www.edweek.org/dd/articles/2011/06/15/03mobile.h04.html

(Ian Quillen, Education Week, 15 June 2011). This article explores the use of iPads as learning tools, and delves into the ongoing discourse about whether they are more viable for one-to-one solutions or as part of a group of shared classroom devices.

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.

Game-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 developed a free and open 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.

10 Gaming Trends that are Transforming Higher Ed
http://www.onlinecolleges.net/2011/07/31/10-gaming-trends-that-are-transforming-higher-ed/

(OnlineColleges.net, 31 July 2011.) Homegrown virtual classrooms and role-playing are among the top ten developments in higher education influenced by video games.

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.

Time-to-Adoption: Two to Three Years

Learning Analytics

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

Relevance for teaching, learning, research, or information management

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

Learning Analytics in Practice

- The Agtivity project, led by JISC and the University of Manchester, is collecting data from those using the Advanced Video Conferencing services as a catalyst to improve the tools: http://www.jisc.ac.uk/whatwedo/programmes/inf11/activitydata/AGtivity.aspx.
- Led by JISC and the University of Cambridge, the Exposing Virtual Learning Environment (VLE) Activity Data project is generating reports on how to improve VLEs based on data analysis and visualization:

  http://www.jisc.ac.uk/whatwedo/programmes/inf11/activitydata/exposingvle.aspx.
- One of the prerequisites for creating learning analytics platforms is data visualization. Future Everything developed the innovative Open Data Cities project around participatory visualization of complex datasets: http://futureeverything.org/ideas-overview/open-data-cities/.

For Further Reading

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

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

Evolving a Learning Analytics Platform
http://grockit.com/blog/main/files/2010/02/2011_LAK_paper.pdf

(Ari Bader-Natal and Thomas Lotze, *grockit.com*, 27 February 2011.) This paper presents a discussion of how learning analytics can evolve into robust data collecting systems that ultimately benefit both students and teachers.

Learning and Knowledge Analytics
http://www.learninganalytics.net/

(George Siemens (TEKRI, Athabasca University), on Drown, www.learninganalytics.net/, January 2011.) A blog by several prominent educators and researchers is built as an open course for educators to learn more abut learning analytics.

Time-to-Adoption: Two to Three Years

New Scholarship

Increasingly, scholars are beginning to employ methods unavailable to their counterparts of several years ago, including prepublication releases of their work, distribution through non-traditional channels, dynamic visualization of data and results, and new ways to conduct peer reviews using online collaboration. New forms of scholarship, including creative models of publication and non-traditional scholarly products, are evolving along with the changing process. Some of these forms are very common — blogs and video clips, for instance — but academia has been slow to recognize and accept them. Proponents of these new forms argue that they serve a different purpose than traditional writing and research — a purpose that improves, rather than runs counter to, other kinds of scholarly work. Blogging scholars report that the forum for airing ideas and receiving comments from their colleagues helps them to hone their thinking and explore avenues they might otherwise have overlooked.

Relevance for teaching, learning, research, or information management

- New scholarship creates more opportunities for educators and learners to collaborate on research across disciplines and industries, through online communication tools and virtual learning environments.
- The emergence of scholarly blogging, podcasts, and videos enables faculty members to publish research and new ideas more frequently without the lengthy review periods that accompany traditional published research.
- As scholars look to new forms of online communication, they gain insight into the unique affordances of these channels, which itself has become a research focus for many new members of the academy.

New Scholarship in Practice

- Beyond Impact is an Open Society Foundations project that explores new definitions of research "impact," and how researchers, funders, and developers can collaborate to assess findings more reliably: http://beyond-impact.org/.
- Mendeley is part free and open reference manager and part academic social network, facilitating better ways for research organization and collaboration: http://www.mendeley.com/.

For Further Reading

Higher Education and the New Media Reality
http://campustechnology.com/articles/2011/07/28/higher-education-and-the-new-media-reality.aspx

(John K. Waters, *Campus Technology*, 28 July 2011.) This article charts the success of cultural anthropologist Michael Wesch in deploying non-traditional learning techniques.

Scholars Embrace Some, But Not All, Digital Media
http://chronicle.com/article/Scholars-Increasingly-Embrace/64982/

(Jennifer Howard, *The Chronicle of Higher Education*, 7 April 2010.) Faculty members are no longer turning to the library catalogues to obtain new information, but instead taking advantage of Google Scholar and digital journals.

Scholars Test Web Alternative To Peer Review
http://www.nytimes.com/2010/08/24/arts/24peer.html

(Patricia Cohen, *The New York Times*, 23 August 2010.) This *New York Times* article discusses how new media technology is changing how peer review is considered and used in academia.

Time-to-Adoption: Two to Three Years

Semantic Applications

Semantic-aware applications infer the meaning, or semantics, of information on the Internet to make connections and provide answers that would otherwise entail a great deal of time and effort. New applications use the context of information as well as the content to make determinations about relationships between bits of data; examples like TripIt, SemaPlorer, and Xobni organize information about travel plans, places, or email contacts and display it in convenient formats based on semantic connections. Semantic searching is being applied for scientific inquiries, allowing researchers to find relevant information without having to deal with apparently similar, but irrelevant, information. For instance, Noesis, a new semantic web search engine developed at the University of Alabama in Huntsville, is designed to filter out search hits that are off-topic. The search engine uses a discipline-specific semantic ontology to match search terms with relevant results, ensuring that a search on "tropical cyclones" will not turn up information on sports teams or roller coasters.

Relevance for teaching, learning, research, or information management

- Semantic portals that intelligently aggregate information from a variety of sources would facilitate research in many practical and useful ways.
- Fully-developed semantic search tools will be able to return results from a topical search with video, images, text, and other content aggregated and presented in ways that reveal their subtle relationships and similarities.
- As the amount of available information continues to grow at a geometric pace, semantic tools that can deliver context-sensitive information will become more key for scholarship, research and sense-making.

Semantic Applications in Practice

- The NeOn project is an open-source endeavour of 14 European partners to investigate the life cycle of the network ontologies that enable semantic applications: http://www.neon-project.org/nw/Welcome_to_the_NeOn_Project.
- Siri is a virtual personal assistant for mobiles that features voice recognition and allows users to request time- and location-sensitive resource recommendations: http://siri.com.
- TrueKnowledge is a UK-founded smart Internet search engine that combines natural language analysis with internal and external databases to answer specific questions instantly, rather than redirecting to a list of web pages: http://www.trueknowledge.com.

For Further Reading

Southampton Uni shows way to a truly open web
http://www.theregister.co.uk/2011/03/22/southampton_linked_data_semantic_web/

(Kevin Fiveash, *The Register*, 22 March 2011.) Southampton University is linking data in the UK, launching a site earlier this year that contained more than 21 non-confidential datasets.

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

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

Yves Raimond on the BBC's interlinked, semantic web of the future
http://www.guardian.co.uk/media/pda/2011/apr/06/bbc-yves-raimond

(*The Guardian*, 6 April 2011.) This article chronicles new improvements in line for the BBC technical infrastructure, including better navigation between program pages, the coverage and consistency of news feeds, and deploying external developers to build applications to delve into existing program data.

Time-to-Adoption: Four to Five Years

Augmented Reality

Augmented reality enhances the information we can perceive with our senses. Its first applications appeared in the late 1960s and 1970s, and by the 1990s, augmented reality was being put to use by a number of major companies for visualization, training, and other purposes. Now, the technologies that make augmented reality possible are powerful and compact enough to deliver augmented experiences to personal computers and mobile devices.

A key characteristic of augmented reality is its ability to respond to user input. This interactivity confers significant potential for learning and assessment; with it, students can construct new understanding based on interactions with virtual objects that bring underlying data to life. Dynamic processes, extensive datasets, and objects too large or too small to be manipulated can be brought into a student's personal space at a scale and in a form easy to understand and work with.

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

- ConnectED developed Second Sight, a new technology for Sony Playstation Portable, in which print textbooks trigger interactive audio visual content on the handheld device: http://www.connectededucation.com/index.php?option=com_content&view=article&id=132.
- The University of Exeter's Web Innovation Project incorporated campus geolocation and a mobile-friendly augmented reality navigational application built using Layr: http://as.exeter.ac.uk/divisions/exeterit/itinnovation/projects/webinnovationproject/.
- "Walking Through Time" is an iPhone app that uses GPS technology to bring to life historic UK maps, immersing users in a setting from the past: http://www.walkingthroughtime.co.uk/.

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 UK-based Capita IT Services visits explains why augmented reality is easier to use than other 3D technologies.

Blaise Aguera y Arcas Demos Augmented-Reality Maps
http://www.ted.com/talks/lang/eng/blaise_aguera.html

(Blaise Aguera, www.ted.com, February 2010.) The architect for Microsoft's Bing Maps talks about redefining the fluidity and navigation of virtual maps.

The Potential of Augmented Reality in Education
http://portal.sliderocket.com/AMIVA/SXSWkh

(Karen E. Hamilton, South By Southwest Interactive, March 2011.) This presentation includes insightful videos and builds the case for why augmented reality appeals to the new learner and how it can provide students with their own unique discovery paths.

Time-to-Adoption: Four to Five Years

Collective Intelligence

Collective intelligence is a term for the knowledge embedded within societies or large groups of individuals. It can be explicit, in the form of knowledge gathered and recorded by many people (for example, the Wikipedia is the result of collective intelligence); but perhaps more interesting, and more powerful, is the tacit intelligence that results from the data generated by the activities of many people over time. Discovering and harnessing the intelligence in such data — revealed through analyses of patterns, correlations, and flows — is enabling ever more accurate predictions about people's preferences and behaviours, and helping researchers and everyday users understand and map relationships, and gauge the relative significance of ideas and events.

Two new forms of information stores are being created in real time by thousands of people in the course of their daily activities, some explicitly collaborating to create collective knowledge stores like the Wikipedia and Freebase, some contributing implicitly through the patterns of their choices and actions. The data in these new information stores has come to be called collective intelligence, and both forms have already proven to be compelling applications of the network. Explicit knowledge stores refine knowledge through the contributions of thousands of authors; implicit stores allow the discovery of entirely new knowledge by capturing trillions of key clicks and decisions as people use the network in the course of their everyday lives.

Relevance for teaching, learning, research or information management

- Collective intelligence promotes peer-to-peer learning through knowledge networks that grow by the minute as people share the information they've gained in specific disciplines and fields.
- Knowledge networks encompass multiple points of view and allow for people to make instant updates to research and topics, unlike in printed textbooks by a single author.
- Implicit knowledge stores provide insight on the learning choices we make by tracking our online searches and activity, and ultimately direct us to the discovery of new information.

Collective Intelligence in Practice

- ChemSpider, developed by the Royal Society of Chemistry, is a free database for chemical structures, gathering curated research from across the web into a single search repository: http://www.chemspider.com.
- The Khan Academy is a vast but highly curated collection of videos that supplement school curriculum: http://www.khanacademy.org/.
- The Knowledge Web project is designed to explore ways to map human understanding and experience: http://www.k-web.org/.

For Further Reading

Learning Reimagined: Participatory, Peer, Global, Online
http://dmlcentral.net/blog/howard-rheingold/learning-reimagined-participatory-peer-global-online

(Howard Rheingold, *DMLCentral*, 22 July 2011.) This article addresses the implications of open educational resources to influence the pedagogy behind self-organizing peer learning groups.

Mahout my Hadoop and Embrace Collective Intelligence
http://blog.readingroom.com/2011/06/30/mahout-my-hadoop-and-embrace-collective-intelligence/

(Martin Buhr, *Reading Room UK*, 30 June 2011.) The author breaks down collective intelligence to four stages: recommendation, classification, prediction, and clustering.

Time-to-Adoption: Four to Five Years

Smart Objects

A smart object is simply any physical object that includes a unique identifier that can track information about the object. There are a number of technologies that support smart objects: radio-frequency identification (RFID) tags, quick response (QR) codes, near-field communications, and smartcards are some of the most common. Objects that carry information with them have long been used for monitoring of sensitive equipment or materials, point-of-sale purchases, passport tracking, inventory management, identification, and similar applications.

RFID tags and smartchips "know" about a certain kind of information, such as temperature, color, pressure, or humidity — or how much money is available in a user's account and how to transfer the correct amount to a retailer for a given purchase — or which book is being checked out at a library, who the patron is, and whether that patron has any currently overdue materials. Smart objects connect the physical world with the world of information and will power the "Internet of Things". They can be used to digitally manage physical objects, 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

- 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.
- Pill-shaped microcameras are used in medical diagnostics and teaching to traverse the human digestive tract and send back thousands of images to pinpoint sources of illness.
- 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.

Smart Objects in Practice

- QRpedia is a collaborative project that aims to connect tagged physical objects with online information from Wikipedia using QR codes: http://qrpedia.org/.
- Location systems use a variety of smart object technologies to quickly locate key staff or equipment in a building or on a campus. New systems even detect real time exposure levels to radiation or other potentially harmful environmental factors in laboratory, medical, or manufacturing situations.
- Tiny sensors that detect changes in motion, temperature, colour, pressure, humidity, direction, tilt, flex, and much more are common, and increasingly incorporated into everyday devices.

For Further Reading

Going Multilingual with QRpedia
http://midea.nmc.org/2011/06/qrpedia/

(Lori Byrd Phillips, MIDEA, 15 June 2011.) One museum professional explores the efficiency of using QR codes to seamlessly digitize and organize exhibits.

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.

Time-to-Adoption: Four to Five Years

Telepresence

Telepresence is a form of remote conferencing in which the participants appear to be physically present in the conference space. Body language cues like eye contact are easily transmitted and interpreted because of the fidelity, size, and position of the images. Several high-profile 3-dimensional demonstrations of the technology have taken place; for instance, CNN made extensive use of the technology three years ago during coverage of the 2008 US presidential election. Typically, 3D telepresence requires a specially configured space in which to capture a 360-degree image that can then be inserted into a virtual set, and viewed from any angle, but high-definition displays, seamless integration with software and data presentation, and full-surround audio make even 2D telepresence a very immersive experience.

Relevance for teaching, learning, research, or information management

- 2D Telepresence is often a consideration for distance learning, collaborative courses with students in other geographical areas, and guest lectures.
- The ability for physically disabled students to connect with educators and courses remotely allows them to receive equal learning opportunities as their peers from the comfort of their homes.
- New high definition forms of telepresence are easily adapted to researching locations that human beings cannot physically reach or safely explore.

Telepresence in Practice

- VisiDeck is collaborating with the University of Derby to take an architect's two-dimensional plans to create a virtual 3D world that clients can "walk" through: http://www.derby.ac.uk/news/games-technology-virtually-advances-architecture.
- Pathways to Space is an initiative at the Powerhouse Museum where secondary students are developing space robotics, and searching for life on Mars through video conferencing: http://www.powerhousemuseum.com/pathwaystospace/.

For Further Reading

Holograms Deliver 3-D, Without the Goofy
http://www.nytimes.com/2010/12/05/business/05novel.html

(Anne Eisenberg, *The New York Times*, 4 December 2010.) In recent years, holograms are being actively developed at research centres within universities and private industry. Holograms have the potential to not only provide realistic 3D imaging of complex objects, but also be a driving force in teleprescence.

Leukaemia Sufferer Stepan Supin Stays Home, Sends Robot to School
http://www.news.com.au/technology/leukaemia-sufferer-stepan-supin-stays-home-sends-robot-to-school/story-e6frfro0-1225992845324

(*Herald Sun*, 24 January 2011.) A telepresence robot allows a student with leukaemia to participate in the classroom and interact with teachers and other students while he is at home.

Vu Introduces Telepresence System for Remote Offices, SMBs
http://www.informationweek.com/news/smb/network/227900432

(Daniel P. Dern, *InformationWeek*, 21 October 2010.) Vu is offering a new technology that brings down the price of videoconferencing technology in the workplace or in schools. The system brings hi-definition video and better than telephone audio quality.

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 five trends have been identified as key drivers of technology adoptions in the UK 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 global report was again ranked very highly, indicating its continued influence, specifically in the UK. 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) **What were previously thought of as new and disruptive forms of scholarship are now becoming the norm for scholarly communication.** Blogs, open textbooks, electronic journals, and forms of expression embodied in new media formats have challenged notions of scholarly writing and communication for several years. Yet these techniques are increasingly common and are readily accepted as informal outlets for scholarly work. A more gradual trend toward official acceptance is moving slowly, but its stirrings are visible in the adoption of electronic content, experiments with crowd-sourcing, and open, online peer review of scholarly work. This trend is related to the challenge of developing metrics for evaluating such work, noted in the *2010 Horizon Report,* as well as again in 2011.

3) **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.

4) **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 Doc, 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.

5) **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.

6) **People expect to be able to work, learn, and study whenever and wherever they want to.** 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.

7) **Increasingly, students want to use their own technology for learning.** As new technologies are developed at a more rapid and at a higher quality, there 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.

8) **Computers as we know them are in the process of a massive reinvention.** The computer is smaller, lighter, and better connected than ever before, without the need for wires or bulky peripherals. In many cases, smart phones and other mobile devices are sufficient for basic computing needs, and only specialized tasks require a keyboard, large monitor, and a mouse. Mobiles are connected to an ecosystem of applications supported by cloud computing technologies that can be downloaded and used instantly, for pennies. As the capabilities and interfaces of small computing devices improve, our ideas about when — or whether — a traditional computer is necessary are changing as well.

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 the UK in the coming years are listed here, in the order of importance assigned them by the advisory board.

1) **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.

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

3) **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.** While the university library has traditionally housed collections of scholarly resources, social networks and new publishing paradigms, including open content initiatives, are challenging the library's role as curator. Students and educators are increasingly able to access important, historic research in web browsers on devices of their choosing. As such, libraries are under tremendous pressure to evolve new ways of supporting and curating scholarship.

4) **Most academics aren't using new and compelling technologies for learning and teaching, nor for organizing 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 organizational technology. Many caution that as this unfolds, the focus should not be on the technologies themselves, but on the pedagogies that make them useful.

5) **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.

6) **Commercial providers are delivering ever more credible educational content, providing a wide range of customizable offerings at quality levels that may dampen interest in traditional sources of scholarly work, such as university presses, and even open educational resources (OERs).** Increasingly, publishers are either buying learning resource websites or creating their own virtual warehouses of digital textbooks and other educational content. iTunes University is a prime example of this, offering thousands of course materials for free from distinguished institutions and professors. This trend creates a related challenge for university presses that have traditionally been the publishers of much of the work of their faculties; there is a growing fear that they will become obsolete. Both OERs and university presses are at a critical juncture for different reasons, yet each is aggressively confronted with the need to adapt, evolve, or even reconstruct their roles in education over the next five years.

7) **The growth of economic, social, health, and welfare inequalities means challenges for education in the UK.** While new learning technologies are released nearly every day, all students do not have equal access to them. Economically disadvantaged Institutions cannot afford the same technologies as world-class universities. The main issue, however, is that dropout rates and decreased student engagement is not universally being associated with this lack of equilibrium. Educators, researchers, and developers need to collaborate on creating solutions to address what is often called the "digital divide."

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

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

Methodology

The process used to research and create the *Technology Trends in UK 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 *Technology Trends in UK Tertiary Education 2011-2016* can be found at http://jisc.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 engaged in the central focus of the research — the research questions that are at the core of the NMC Horizon Project. These questions were 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.

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, research, and/or information management. 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 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 http://jisc.wiki.nmc.org.

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