



Horizon Project

# 2015 NMC Technology Outlook

## Australian Tertiary Education

A Horizon Project Regional Report

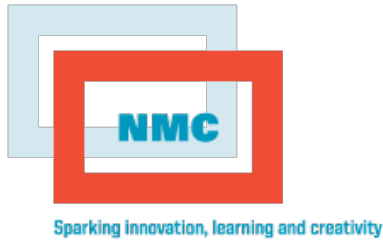




# 2015 NMC Technology Outlook for Australian Tertiary Education

*A Horizon Project Regional Report*

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*2015 NMC Technology Outlook for Australian Tertiary Education  
A Horizon Project Regional Report*

is a collaboration between

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and

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## Executive Summary

The *2015 NMC Technology Outlook for Australian Tertiary Education: A Horizon Project Regional Report* reflects a collaborative research effort between the New Media Consortium (NMC) and Open Universities Australia to inform Australian campus leaders and decision-makers about important developments in technologies supporting teaching, learning, and creative inquiry in tertiary education across the continent.

All of 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, or creative inquiry in Australian 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 more than 13 years ago to systematically identify and describe emerging technologies likely to have a large impact on education around the globe.

The *2015 NMC Technology Outlook for Australian Tertiary Education* was produced to explore important developments in technology and forecast their potential impact expressly in an Australian context. In the effort that took place from January through March 2015, a carefully selected panel of experts was asked to consider hundreds of relevant articles, news, blog posts, research, and project examples as part of the preparation that ultimately pinpointed the most notable technology topics, trends, and challenges for Australian tertiary education over the next five years.

Known as the 2015 Horizon Project Australia Expert Panel, that group of thought leaders consists of knowledgeable individuals, all highly regarded in their fields. Collectively the panel represents a range of diverse perspectives across the tertiary education 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 [aus.wiki.nmc.org](http://aus.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 expert panel identified the top ten key trends, the top ten significant challenges, and twelve important developments in educational technology. Each of the twelve developments in educational technology are profiled, on a single page that describes and defines the technology, and are ranked as very important for Australian tertiary education over the next year, two to three years, and four to five years. Every page opens with a carefully crafted definition of the highlighted technology, outlines its educational relevance, points to several real-life examples of its current use, and ends with a short list of additional readings for those who wish to learn more. Preceding those discussions are sections that detail the expert panel's top ranked trends and challenges, and illuminate why they are seen as highly influential factors in the adoption of technology in Australian universities over the next five years.

The three key sections of this report constitute a reference and straightforward technology-planning guide for educators, campus leaders, administrators, policy-makers, and technologists. It is our hope that this research will help to inform the choices that institutions are making about technology to improve, support, or extend teaching, learning, and creative inquiry in Australian tertiary education. Educators and administrators worldwide look to the NMC Horizon Project and both its global and regional reports as key strategic technology planning references, and it is for that purpose that the *2015 NMC Technology Outlook for Australian Tertiary Education* is presented.

## Introduction

The NMC Horizon Project and the 2015 Horizon Project Australia Expert Panel recognise that technology adoption in tertiary education is accelerated by trends in policy, leadership, and practice. Therefore, key trends frame the discussion of technology use in Australian universities. Similarly, a number of challenges are impeding the proliferation of digital tools, and the panel has identified a set of significant challenges that distinctly reflects the current obstacles facing Australian tertiary education over the coming five years. The top three trends and challenges from those longer lists are included in the related tables in this summary, and are organised by categories described in the next sections of this report.

As Table 1 below illustrates, the choices of the Australian experts overlap in interesting ways with those who contributed to the *NMC Horizon Report > 2015 Higher Education Edition*, which looked at technology uptake from a global perspective, and the *2014 NMC Technology Outlook > Australian Tertiary Education*, which provides perspective from last year's Australian expert panel — altogether a group of 143 acknowledged experts.

**Table 1: Top-Ranked Trends Across Three NMC Horizon Research Projects**

NMC Horizon Report 2015 Higher Education Edition	2015 Technology Outlook Australian Tertiary Education	2014 Technology Outlook Australian Tertiary Education
Rethinking Learning Spaces	Increasing Use of Hybrid/Blended Learning	Rise of Data-Driven Learning and Assessment
Increasing Use of Hybrid/Blended Learning	Redesigning Learning Spaces	Increasing Preference for Personal Technology
Growing Focus on Measuring Learning	Growing Focus on Measuring Learning	Evolution of Online Learning

The 2015 Australian panel's highest ranked trends overlap with the global panel's selections in two areas — redesigning learning spaces and increasing use of hybrid and blended learning. All over Australia, institutions such as the University of South Australia are designing learning environments that better accommodate more progressive pedagogies. Student-centred, active approaches call for more flexible classroom settings. Both panels are also observing the rise of online learning used in tandem with face-to-face experiences. Lecture capture is enabling students to get instruction at home via video, which allows time for hands-on projects and substantive discussions during class.

All three panels agree that there is a growing emphasis on measuring learning through methods involving digital assessment and learning analytics. In order to revise teaching approaches to more effectively meet student needs, often in real time, instructors need evidence and specific data about how well their students are grasping the material. This trend is further validated by the presence of adaptive learning technologies on the list of important developments in technology deemed influential by the expert panel.

Horizon Project panels in general have agreed that trends like these are clear drivers of technology adoption; the 2015 Australian panel especially saw such a linkage. At the same time, these panels of experts also agree that technology adoption is often hindered by both local and systemic challenges, which are grounded in everyday realities that make it difficult to learn about, much less adopt, new tools and approaches.



**Table 2: Top-Ranked Challenges Across Three NMC Horizon Research Projects**

NMC Horizon Report 2015 Higher Education Edition	2015 Technology Outlook Australian Tertiary Education	2014 Technology Outlook Australian Tertiary Education
Integrating Technology in Teacher Education	Personalising Learning	Integrating Technology in Teacher Education
Improving Digital Literacy	Rethinking the Roles of Educators	Blending Formal and Informal Learning
Creating Authentic Learning Opportunities	Creating Authentic Learning Opportunities	Scaling Teaching Innovations

As noted in Table 2, above, both the 2015 Australian and global panels agreed that creating authentic learning opportunities is a pressing challenge, and will rely on the integration of more hands-on and immersive learning in university courses. In order for students to be more prepared for the workforce, simulations and projects that encourage entrepreneurial thinking are needed in tertiary education curriculum.

The 2015 Australian experts ranked personalising learning and rethinking the roles of educator as the top two challenges impeding technology uptake — regarded by the other two panels but deemed less significant. Pursuing personalised learning in Australia means promoting more student-led approaches where learners choose their pathways in the ways in which they demonstrate their skill and knowledge acquisition. The shift to the digital arena for universities also means that students are relying more on virtual environments and Internet resources for learning. Adaptive learning technologies, identified as an important development in technology by the panel, are being piloted to help guide students online and present to them relevant and tailored content.

Resetting expectations for the roles of professors and other faculty is also chief among the concerns of the 2015 Australian panel. Integrating more personalised learning opportunities and student-led approaches challenge traditional perceptions of teachers. There is a need for educators to promote effective technology use as a way to help students independently pursue their ideas and develop projects and media. The goal is for professors and instructors to act as coaches and mentors, rather than lecturers.

Fuelled by the key trends and impeded by significant challenges selected by the panel, the 12 “technologies to watch” presented in the body of this report reflect our experts’ opinions as to which of the nearly 60 technologies considered will be most important to Australian tertiary education over the five years following the publication of the report. All three of these projects’ expert panels strongly agree that the Bring Your Own Device movement, along with the flipped classroom, will likely tip into mainstream use within the next year — developments in technology that span education across the world.

There are also several other overlaps, indicating Australia’s close alignment with prevalent global trends. The three panels believe that mobile learning, in some form, will soon be in widespread practice, as Australian educators are increasingly encouraging students to use their own devices for learning or making sure educational resources are formatted for mobile consumption. All of the panels were in consensus that learning analytics is poised for mainstream adoption — coinciding with the trend toward measuring learning. However, compared to the 2014 Australian expert panel, the 2015 panel believes that learning analytics has gained traction in being

leveraged in practice at more local universities. Both 2015 panels also agree that adaptive learning technologies are on the far-term horizon, demonstrating a growing interest in tailoring online content to suit individual student needs.

**Table 3: Comparison of “Final 12” Topics Across Three NMC Horizon Research Projects**

NMC Horizon Report 2015 Higher Education Edition	2015 Technology Outlook Australian Tertiary Education	2014 Technology Outlook Australian Tertiary Education
<b>Time-to-Adoption Horizon: One Year or Less</b>		
Bring Your Own Device Flipped Classroom Learning Analytics Mobile Apps	Bring Your Own Device Cloud Computing Flipped Classroom Learning Analytics	Bring Your Own Device Flipped Classroom Mobile Learning Online Learning
<b>Time-to-Adoption Horizon: Two to Three Years</b>		
Collaborative Environments Games and Gamification Makerspaces Wearable Technology	Badges/Microcredit Mobile Learning Open Licensing Wearable Technology	Badges/Microcredit Games and Gamification Learning Analytics Open Content
<b>Time-to-Adoption Horizon: Four to Five Years</b>		
Adaptive Learning Technologies Flexible Displays The Internet of Things Wireless Power	Adaptive Learning Technologies Augmented Reality Quantified Self Telepresence	The Internet of Things Machine Learning Natural User Interfaces Wearable Technology

Both the 2014 and 2015 Australian panels deemed badges and microcredit as positioned in the mid-term horizon, indicating that the area is not rapidly advancing but moving at a steady, more incremental pace. Both Australian National University and Curtin University currently use badges to incentivise students in online learning platforms for informal training sessions. The 2015 panel believes that wearable technology has also progressed since last year’s Australian project, placing it at two to three years away from mainstream use. University of Southern Australia and Swinburne University of Technology have been instrumental in researching wearable technology applications and developing their own devices.

A number of unique choices distinguished the perspectives expressed by the 2015 Australian panel from their counterparts. For example, they perceive open licensing as an important development in technology on the mid-term horizon. Institutions including Open Universities of Australia are removing the barriers for world-class educational resources by making them free or adaptable. Telepresence was also cited by the panel as a technology worth watching, as it helps make virtual conferencing and learning more lifelike. Similarly, augmented reality, also positioned on the far-term horizon, has the capacity to enhance interactions with mobile apps to make the content come alive.

The 2015 Australian panel proposed another far-term topic different than their peers — the quantified self. There is an increasing emphasis in Australia on not only tracking learning, but also monitoring physical and other daily activities. Being able to analyse behavioural data can lead to improvements in health and unveil important patterns.

These points and comparisons provide an important context for the main body of the report that follows.



## Key Trends Accelerating Technology Adoption

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 panel member researches, identifies, and ranks key trends that are currently affecting policy, leadership, and practice in Australian tertiary education, and uses these as a lens for the work of predicting the uptake of emerging technologies.

These ten trends, which the panel agreed are very likely to drive technology planning and decision-making over the next five years, were ranked in order of importance by the expert panel, with the first trend listed being deemed the most impactful. The trends were also framed by three time-related categories: short-term impact trends that are new and are poised to last only for the next one to two years and are bound to become pervasive in universities; mid-term impact trends that have been around for a few years already and will last for the next three to five years; and, long-term impact trends, which have been around for five years and will grow incrementally in Australian tertiary education over the next five or more years.

**1. Increasing Use of Hybrid/Blended Learning Designs.** Perceptions of online learning have been shifting in its favour as more learners and educators see it as a viable alternative to face-to-face learning. Drawing from best practices in online and face-to-face methods, blended learning is on the rise at Australian universities. Institutions including University of the Sunshine Coast, Griffith University, and the University of Western Sydney have developed blended learning strategies. Many faculty members are using lecture capture tools for students to watch online at home so that they can engage in substantial discussions during class. The flexibility, ease of access, and the integration of sophisticated multimedia and technologies are among the list of appeals.

**2. Redesigning Learning Spaces.** As Australian tertiary education continues to move away from traditional lecture-based programming to more hands-on scenarios, classrooms will start to resemble real-world work and social environments that facilitate organic interactions and cross-disciplinary problem solving. Wireless bandwidth is being upgraded in institutions to create “smart rooms” that support web conferencing and other methods of remote, collaborative communication. Large displays and screens are being installed to enable collaboration on digital projects and informal presentations. The University of South Australia developed learning spaces that motivate and promote innovative ways of thinking and deeper social connections.

**3. Growing Focus on Measuring Learning.** There is an increasing interest in using new sources of data for personalising learning experiences and ongoing formative assessment of learning. A key element of this trend is learning analytics, which is the application of web analytics, a science used by businesses to analyse commercial activities that leverages big data to identify spending trends and predict consumer behaviour. Education is embarking on a similar pursuit for learner profiling, a process of gathering and analysing large amounts of detail about individual student interactions. The goal is to build better pedagogies, empower students to take an active part in their learning, target at-risk student populations, and assess factors affecting student success.

**4. Rethinking How Institutions Work.** There is a focused movement to reinvent the traditional classroom paradigm and rearrange the entire university experience — a trend that is largely being driven by the influence of innovative learning approaches. Expert panellists see this trend teetering in the mid- to long-term impact range. Methods such as project- and challenge-based learning call for university structures that enable students to move from one learning activity to another more organically, better integrating different fields with each other. The multidisciplinary nature of contemporary approaches has brought attention to innovative designs of learning structures that link each course and subject matter to others.

**5. Shift from Students as Consumers to Students as Creators.** A shift is taking place in the focus of pedagogical practice in Australian universities as students across a wide variety of disciplines are learning by making and creating rather than from the simple consumption of content. Creativity, as illustrated by the growth of user-generated videos, maker communities, and crowd-funded projects in recent years, is increasingly the means for active, hands-on learning. Immersing students in activities that enable them to create their own understanding of a concept has far greater learning value than when passively or "engagingly" consuming.

**6. Employment as the Definition of Successful Education.** A majority of expert panellists view this trend as having a mid-term impact as students are increasingly concerned about the effect of their education on their future. Part-time work/study programmes minimise the cost of education and student debt, while maximising the ability to market oneself to future employers. The ability to stretch oneself, to explore areas where success is not guaranteed, is increasingly seen as a risky strategy that might compromise a transcript and reduce the chance of future employment — but may also open up students to new worlds.

**7. Proliferation of Open Educational Resources (OER).** Defined by the Hewlett Foundation in 2002, OER are "teaching, learning, and research resources that reside in the public domain or have been released under an intellectual property license that permits their free use and re-purposing by others." Often mistaken to mean "free of charge," advocates of openness have worked towards a common vision that defines it more broadly, including ownership and usage rights. Most of Australia's top institutions are providers of open content and have created a wealth of materials now available on demand to anyone. At La Trobe University, for example, the Faculty of Health Sciences have successfully piloted a programme to develop and distribute OER and research practices using Wikiversity and the Wikimedia Foundation Projects.

**8. Advancing Cultures of Change and Innovation.** In order to breed innovation and adapt to economic needs, universities must be structured in ways that allow for flexibility, and spur creativity and entrepreneurial thinking. There is a growing consensus among thought leaders that Australian tertiary education leadership and curricula could benefit from agile startup models. Educators are working to develop new approaches and programmes that stimulate top-down change and can be implemented across a broad range of institutional settings.

**9. Shift to Deeper Learning Approaches.** Project-based, problem-based, inquiry-based, and challenge-based learning foster more active learning experiences, both inside and outside the classroom. Expert panellists were divided between categorising this trend as having a mid-term or long-term impact. As technologies such as tablets and smartphones are more readily accepted in universities, educators are leveraging these tools to connect the curriculum with real-life applications. The hope is that if learners can connect the course material with their own lives and their surrounding communities, then they will become more excited to learn and immerse themselves in the subject matter.

**10. Increasing Cross-Institution Collaboration.** More and more, institutions are joining consortia — associations of two or more organisations — to combine resources or to align themselves strategically with innovation in tertiary education. The expert panel agreed that this trend has mid-term impact implications in Australian tertiary education. Today's global environment is allowing universities to unite across international borders and work toward common goals concerning technology, research, or shared values. Support behind technology-enabled learning in classrooms has reinforced the trend toward open communities and university consortia, as educators and administrators recognise collective action as a sustainable method of supporting upgrades in technological infrastructure and IT services.

## Significant Challenges Impeding Technology Adoption

Along with the trends discussed in the preceding section, the expert panel noted a number of significant challenges faced in Australian tertiary education that are impeding the uptake of emerging technologies. Because not all challenges are of the same scope, the discussions were framed by three categories defined by the nature of the challenge. The NMC Horizon Project defines solvable challenges as those that we both understand and know how to solve; difficult challenges are ones that are more or less well understood, but for which solutions remain elusive. Wicked challenges, the most difficult, are categorised as complex to even define, and thus require additional data and insights before solutions will be possible.

The expert panel ranked challenges in order of significance, with the first challenge listed being deemed the most prominent.

**1. Personalising Learning.** Categorised by the expert panel as somewhere between solvable and difficult, implementing personalised learning includes embracing a wide variety of approaches to support self-directed and group-based learning that can be designed around each learner's goals. Universities are being challenged to incorporate personalised learning environments and networks, adaptive learning tools, and more. There are two paths of development for personalised learning: the first is organised by and for the learner, which includes apps, social media, and related software. University goals and interests are driving the other path, primarily in the form of adaptive learning. In this pathway, adaptive learning is enabled by intervention-focused machine intelligence that interprets data about how a student is learning and responds by changing the learning environment based on their needs.

**2. Rethinking the Roles of Educators.** Professors and instructors are increasingly expected to be adept at a variety of technology-based and other approaches for content delivery, learner support, and assessment; to collaborate with other teachers both inside and outside their universities; to routinely use digital strategies in their work with students; to act as guides and mentors in promoting student-centred learning; and to organise their own work and comply with administrative documentation and reporting requirements. As this trend gathers steam, many universities across the world are redesigning the primary responsibilities of faculty.

**3. Creating Authentic Learning Opportunities.** Authentic learning, especially that which brings real-life experiences into the classroom, is still all too uncommon in universities. However, a majority of expert panellists believe that this challenge is solvable. Authentic learning is seen as an important pedagogical strategy, with great potential to increase the engagement of students who are seeking some connection between the world as they know it exists outside of school, and their experiences in school that are meant to prepare them for that world. Use of learning strategies that incorporate authentic experiences, technology, and tools that are already familiar to students, and interactions from community members are examples of approaches that are increasingly being used to bring authentic learning into the classroom.

**4. Transitioning to New Business Models for Tertiary Education.** Some Australian thought leaders are questioning the traditional social contract that has defined a place for tertiary education in society and established the parameters for funding, as well as provided a context for student experiences. The panel defined this challenge as a wicked one, exacerbated by technology constantly redefining expectations for many typical classroom activities. The dilemma for Australian universities is predicting the type of changes that are needed for future educational experiences to be relevant in students' lives and creating viable business models for educational organisations that support these new experiences.

**5. Improving Students' Digital Literacy.** With the proliferation of the Internet, mobile devices, and other technologies that are now pervasive in education, the traditional view of literacy as the ability to read and write has expanded to encompass understanding digital tools and information. This new category of competence is affecting how education institutions address literacy issues in their curriculum objectives and teacher development programmes. Lack of consensus on what comprises digital literacy is impeding many universities and colleges from formulating adequate policies and programmes that address this challenge.

**6. Scaling Teaching Innovations.** Our organisations are not adept at moving teaching innovations into mainstream practice. Innovation springs from the freedom to connect ideas in new ways. Universities generally allow us to connect ideas only in prescribed ways — a challenge largely deemed as wicked by the expert panel. Current organisational promotion structures rarely reward innovation and improvements in teaching and learning. A pervasive aversion to change limits the diffusion of new ideas, and too often discourages experimentation.

**7. Integrating Technology in Faculty Education.** Faculty training still does not acknowledge the fact that digital media literacy continues its rise in importance as a key skill in every discipline and profession. Despite the widespread agreement on the importance of digital competence, training in the supporting skills and techniques is rare in teacher education and non-existent in the preparation of teachers. As teachers begin to realise that they are limiting their students by not helping them to develop and use digital competence skills across the curriculum, the lack of formal training is being offset through professional development or informal learning, making this challenge considered solvable by the expert panel.

**8. Keeping Formal Education Relevant.** As online learning and free educational content become more pervasive, stakeholders and administrators must seriously consider what universities can provide that cannot be replicated by other sources. There are, however, valuable skills and attitudes that can only be acquired in tertiary education settings. Soft skills, such as face-to-face communication and collaboration, for instance, are essential practices for solving problems in a world that is increasingly interconnected. Similarly, work ethic and the ability to persevere through even the toughest challenges, both social and academic, are reinforced in formal education environments. The idea is to rethink the value of education as a means of reinforcing skills learners will need to seek credible information, work effectively in teams, and achieve their goals.

**9. Competing Models of Education.** Categorised by the expert panel as a difficult challenge, new models of education are bringing unprecedented competition to the traditional models of tertiary education where students typically receive instruction by faculty or teaching assistants per credit hour over four years, on-campus. Institutions are looking for ways to provide a high quality of service and more learning opportunities at lower costs. A range of adult learning programmes are creating innovative models that emphasise human interaction and multidimensional learning by cultivating 21st century skills such as intercultural communication and social entrepreneurship. As these new platforms arise, there is a growing need to frankly evaluate the models and determine how to best support collaboration, interaction, and assessment at scale.

**10. Teaching Complex Thinking.** It is essential for learners to understand the networked world in which they are growing up and also the difference between human and artificial intelligence, learn how to use abstraction and decomposition when tackling complex tasks, and deploy heuristic reasoning to complex problems. Mastering modes of complex thinking does not make an impact in isolation; communication skills must also be mastered for complex thinking to be applied meaningfully. Indeed, the most effective leaders are outstanding communicators with a high level of social intelligence; their capacity to connect people with other people, using technologies to collaborate and leveraging data to support their ideas, requires an ability to understand the bigger picture and to make appeals that are based on logic, data, and instinct.

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

### Bring Your Own Device

Bring Your Own Device (BYOD), also referred to as BYOT (Bring Your Own Technology), refers to the practice of people bringing their own laptops, tablets, smartphones, or other mobile devices with them to the learning or work environment. Intel coined the term in 2009, when the company observed that an increasing number of its employees were using their own devices and connecting them to the corporate network. Since implementing BYOD policies, the company has reported up to 5 million hours of annual productivity gains, a statistic that is compelling many other companies to consider BYOD. In schools, the BYOD movement addresses the same reality; many students are entering the classroom with their own devices, which they use to connect to the school's network. While BYOD policies have been shown to reduce overall technology spending, they are gaining traction more so because they reflect the contemporary lifestyle and way of working. The University of Queensland and the University of Western Australia are among the growing list of tertiary education institutions across the continent that actively promote BYOD policies. Although administrators and educators have cited IT security concerns, technology gap issues, and platform neutrality as challenges to the uptake of this technology, a growing number of models in practice are paving the way for BYOD to enter the mainstream.

### Relevance for Teaching, Learning, or Creative Inquiry

- Because BYOD allows students access to the same devices at school and at home, it can extend learning opportunities to times and places outside of the classroom.
- BYOD policies allow students to work with technology with which they are already comfortable and familiar.
- BYOD programmes eliminate the support and other demands placed on universities that accompany paying for and maintaining institution-provided devices.

### Bring Your Own Device in Practice

- Form meets function in the BYOD seminar rooms at the University of Sydney, which are equipped with wireless Internet, device charging stations, and lightweight furniture designed for easy rearranging: [go.nmc.org/byodroom](http://go.nmc.org/byodroom).
- The Master of Nursing Science programme at the University of Melbourne piloted iiNurse, a learning platform with interactive quizzes and dynamic digital textbooks available on students' mobile devices: [go.nmc.org/iinurse](http://go.nmc.org/iinurse).
- The University of Western Australia created collaborative teaching "pods" for medical students, combining a wet laboratory with a BYOD work space where lecturers can communicate with multiple pods simultaneously: [go.nmc.org/byodpods](http://go.nmc.org/byodpods).

### For Further Reading

*Riding the Wave of BYOD: Developing a Framework for Creative Pedagogies*

[go.nmc.org/byodcreate](http://go.nmc.org/byodcreate)

(Thomas Cochrane et al., *Research in Learning Technology*, 28 August 2014.) Teachers are encouraged to view BYOD capabilities as an opportunity to discard their focus on content delivery and reconstruct their curricula to enhance student creativity and collaboration.

*The Very Idea of e-Exams: Student (Pre)conceptions (PDF)*

[go.nmc.org/byodexams](http://go.nmc.org/byodexams)

(Mathew Hillier, *Rhetoric and Reality: Critical Perspectives on Educational Technology. Proceedings Ascilite Dunedin*, 23 November 2014.) A survey was conducted prior to implementing a BYOD policy for computerised examinations to identify university students' top concerns, which were found to vary according to area of study and prior exposure to computerised testing.



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

Cloud computing refers to expandable, on-demand services and tools that are served to the user via the Internet from specialised data centres and consume almost no local processing or storage resources. Cloud computing resources support collaboration, file storage, virtualisation, and access to computing cycles, and the number of available applications that rely on cloud technologies has grown to the point that few education institutions do not make some use of the cloud, whether as a matter of policy or not. Over the past few years, cloud computing has been firmly established as an efficient way for businesses to protect data, develop applications, deliver software and online platforms, and to collaborate. A recent report from Infosys revealed that 86% of surveyed enterprises in Australia have used cloud in their production environment for more than a year; while this is only 50% in the United States. Australian education institutions are deploying similar cloud-based strategies to boost collaboration, productivity, and mobility in teaching and learning.

**Relevance for Teaching, Learning, or Creative Inquiry**

- At the university level, flexible options for computing, bandwidth, and storage offered by providers can be reconfigured on the fly, and in most cases are considerably cheaper than the capital and operational costs of dedicated data centres.
- At the user level, secure cloud resources are less expensive than licensed products, and they increase access to storage, tools, media, and educational materials for learners.
- Cloud-based services support collaborative learning competencies, encouraging students to work simultaneously on a document in the same room or across continents.

**Cloud Computing in Practice**

- Central Queensland University's cloud-based virtual anatomy lab enables distance students learn from wherever they are: [go.nmc.org/virtlab](http://go.nmc.org/virtlab).
- Deakin University introduced DeakinSync, an online student hub with a suite of tools that assist students in managing course loads and connecting socially: [go.nmc.org/deakinsync](http://go.nmc.org/deakinsync).
- The Smart Farm Innovation Centre at the University of New England, a cloud-enabled facility located in the middle of a working farm, will allow students and visitors to remotely access live streams of farm activities and lectures: [go.nmc.org/smartfarm](http://go.nmc.org/smartfarm).

**For Further Reading**

*Schools Big and Small, Public and Private, Have Their Eyes on the Cloud*

[go.nmc.org/cloudbased](http://go.nmc.org/cloudbased)

(Simon Green, *Education Technology Solutions*, 16 October 2014.) This article advocates for institutional advancement in cloud-based services to meet the changing needs of digital-native student populations, reduce costs, and eliminate redundancies.

*A Study on Strategic Provisioning of Cloud Computing Services*

[go.nmc.org/cloudmetrics](http://go.nmc.org/cloudmetrics)

(Md Whaiduzzaman et al., *The Scientific World Journal*, 15 June 2014.) In response to an ever-growing marketplace of cloud service providers, the authors have identified service and pricing metrics to assist others in choosing cloud platforms to meet their objectives.

*Mobile Cloud Learning for Higher Education: A Case Study of Moodle in the Cloud*

[go.nmc.org/mobilecloud](http://go.nmc.org/mobilecloud)

(Minjuan Wang et al., *The International Review of Research in Open and Distributed Learning*, April 2014.) Educational advantages reside at the intersection of mobile learning and cloud computing, including lower costs, greater connectivity, learner mobility, and a reduction in device memory requirements and processing power usage.



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

### Flipped Classroom

The flipped classroom refers to a model of learning that rearranges how time is spent both in and out of class to shift the ownership of learning from the educators to the students. In the flipped classroom model, valuable class time is devoted to more active, project-based learning where students work together to solve local or global challenges — or other real-world applications — to gain a deeper understanding of the subject. Rather than the instructor using class time to dispense information, that work is done by each student after class, and could take the form of watching video lectures, listening to podcasts, perusing enhanced e-book content, or collaborating with peers in online communities. Students access the online tools and resources any time they need them. Faculty can then devote more time to interacting with each individual. After class, students manage the content they use, the pace and style of learning, and the ways in which they demonstrate their knowledge; the instructor adapts instructional and collaborative approaches to suit their learning needs and personal learning journeys. The goal is for students to learn more authentically by doing. The flipped classroom model is part of a larger pedagogical movement that overlaps with blended learning, inquiry-based learning, and other instructional approaches and tools that are meant to be flexible, active, and more engaging for students.

### Relevance for Teaching, Learning, or Creative Inquiry

- Flipped classroom concepts and providing students with a more diverse set of learning resources can support self-directed learning.
- More active learning is an important component of the flipped classroom: lectures can be watched with ensuing online discussions unfolding at home, while instructors can use class time for hands-on activities or trips outside of the building.
- The online component of the flipped classroom enables students to repeat vital learning activities, such as re-watching video lectures and running virtual experiments as often as needed, in order for them to fully grasp the subject matter.

### Flipped Classroom in Practice

- Law professors at Monash University are producing lecture videos for first-year students to shift class-time from content delivery to analysis and discussion: [go.nmc.org/lawflip](http://go.nmc.org/lawflip).
- Students at Curtin University use “GroupMap” as a virtual brainstorming space and to submit discussion questions prior to lectures: [go.nmc.org/groupmap](http://go.nmc.org/groupmap).
- The University of Adelaide is developing a “FlipKit” of tools and resources to aid first-year health sciences faculty in flipping their classrooms: [go.nmc.org/adeflip](http://go.nmc.org/adeflip).

### For Further Reading

*The Transition from Traditional Face-to-Face Teaching to Blended Learning (PDF)*

[go.nmc.org/mathflip](http://go.nmc.org/mathflip)

(Birgit Loch et al., *Rhetoric and Reality: Critical Perspectives on Educational Technology*. 23 November 2014.) This article reviews current research on blended and online learning outcomes for mathematics students in order to highlight gaps in the literature and provide guidance on future research in the field.

*Using the Flipped Classroom to Improve Student Engagement and to Prepare Graduates to Meet Maritime Industry Requirements: A Focus on Maritime Education*

[go.nmc.org/maritimeflip](http://go.nmc.org/maritimeflip)

(Allison J. James et al., *WMU Journal of Maritime Affairs*, 30 September 2014.) Applications of flipped classroom practices in maritime education can produce industry-ready graduates when students receive authentic field experience and exposure to working in team-based settings.

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

### Learning Analytics

Learning analytics is an educational application of “big data,” a science that was originally used by businesses to analyse commercial activities, identify spending trends, and predict consumer behaviour. The rise of the Internet drove research into big data and metrics as well as the proliferation of web tracking tools, enabling companies to build vast reserves of information they could study and apply to their marketing campaigns. Education is embarking on a similar pursuit into data science with the aim of improving student retention and providing a high quality, personalised experience for learners. Learning analytics research uses data analysis to inform decisions made on every tier of the educational system. Whereas analysts in business use consumer data to target potential customers and personalise advertising, learning analytics leverages student data to build better pedagogies, target at-risk student populations, and assess whether programs designed to improve retention have been effective and should be sustained — outcomes for legislators and administrators that have profound impact. For educators and researchers, learning analytics has been crucial to gaining insights about student interaction with online texts and courseware. Australian tertiary education institutions are leading the charge; the University of Technology, Sydney recently held the Australian Learning Analytics Summer Institute to determine ways to effectively incorporate learning analytics at the university level.

### Relevance for Teaching, Learning, or Creative Inquiry

- If used effectively, learning analytics can help surface early signals that indicate a student is struggling, allowing teachers and schools to address issues quickly.
- The science behind learning analytics in online environments can be used to create adaptive software that caters to a student’s individual learning curve in real time.
- When correctly applied and interpreted, learning analytics will enable teachers to more precisely identify students’ learning needs and tailor instruction appropriately.

### Learning Analytics in Practice

- Open Universities of Australia’s OUA Learning Analytics platform collects data from online student environments to derive insights and identify patterns of how they behave and collaborate. Real-time data is created for every LMS activity: [go.nmc.org/ouala](http://go.nmc.org/ouala).
- A pilot programme at James Cook University uses the Blackboard Analytics for Learn software to create reports on student engagement and learning so that staff can provide more timely and effective referrals to university support services: [go.nmc.org/jcupilot](http://go.nmc.org/jcupilot).
- The University of Western Sydney identified at-risk student populations using data analytics software to monitor students’ classroom performances: [go.nmc.org/risktrack](http://go.nmc.org/risktrack).

### For Further Reading

*Curricular Design Analysis: A Data-Driven Perspective*

[go.nmc.org/datadesign](http://go.nmc.org/datadesign)

(Gonzalo Mendez et al., *Journal of Learning Analytics*, 2014.) By applying simple statistical techniques to existing academic data, instructors and administrators can determine the coherence and efficacy of individual courses relative to curricular objectives.

*Embracing Big Data in Complex Educational Systems: The Learning Analytics Imperative and the Policy Challenge (PDF)*

[go.nmc.org/datapolicy](http://go.nmc.org/datapolicy)

(Leah P. Macfadyen et al., *Research & Practice in Assessment*, November 2014.) This article outlines strategies for tertiary education institutions to capture useful student data and utilise the information to increase engagement and understanding.

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

### Badges/Microcredit

Badges are seen as a way to grant certification for informal learning in the form of micro-credits. A key aspect of gamification is to build in easy-to-reach incentives, and badges are a simple way to bring that idea to learning. The concept behind badging draws on longstanding ways learning has been documented in other settings, such as the personal skills and achievement when a Boy or Girl Scout earns a merit badge. The approach is being used in learning environments like the Khan Academy, with promising results. People watch videos on specific subjects and earn new badges by doing so. Mozilla has published an open specification for badging — the Open Badge Initiative (OBI) — that enables providers and users alike to easily display their achievements on the web. Badges can be used as a way to incorporate some of the advantages of game mechanics as participants work through various levels or stages to achieve credentials. While badges are not by any means pervasive in education systems, they appeal to many educators because they are considered to be more authentic signs of knowledge comprehension and skill acquisition than standard tests, grades, or course credits.

### Relevance for Teaching, Learning, or Creative Inquiry

- Badges are very flexible and can provide institutional as well as peer- and self-documentation, and if OBI-compliant, even external validation.
- Badges can be used to gamify the learning process, incentivising learners to participate in projects and activities that publicly demonstrate their knowledge, and achieve recognition.
- For faculty, the awarding of badges can demonstrate continuing professional development that is achieved through online training academies or informal methods.

### Badges/Microcredit in Practice

- Australian National University's Insignia Project offers research students the opportunity to receive professional development badges for completing informal online trainings: [go.nmc.org/insignia](http://go.nmc.org/insignia).
- Curtin University has unveiled several learning platforms dedicated to career exploration, university preparedness, and leadership skills, where students can earn digital badges as they advance through the modules: [go.nmc.org/careerbadge](http://go.nmc.org/careerbadge).
- Deakin University offers free massive open online courses (MOOCs) through DeakinConnect. Participants can upload a public portfolio of learning achievements, along with giving and receiving peer accreditation digital badges: [go.nmc.org/deakinbadge](http://go.nmc.org/deakinbadge).

### For Further Reading

*Badges in the Carpe Diem MOOC*

[go.nmc.org/carpediem](http://go.nmc.org/carpediem)

(Kulari Lokuge Dona et al., *Rhetoric and Reality: Critical Perspectives on Educational Technology. Proceedings Ascilite Dunedin*, 23 November 2014.) A survey of Carpe Diem MOOC participants reflected a positive response to the digital badging available through the completion of courses, although further research is necessary to ascertain the relation of badges to learner motivation and achievement.

*Can Digital Badges and Nanodegrees Protect Job Seekers From a First-Round Knockout?*

[go.nmc.org/digicred](http://go.nmc.org/digicred)

(Steve Kolowich, *The Chronicle of Higher Education*, 25 November 2014.) While alternative credentials offer verifiable information about candidates' proficiencies, their value in job placement will depend upon industry acceptance and recruiting practices.

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

### Mobile Learning

We are in the midst of a complete shift in the devices we use. As smartphones and tablets become more and more capable and user interfaces more and more natural, old methods of computing seem place-bound and much less intuitive. People increasingly expect to be connected to the Internet and the rich tapestry of knowledge it contains wherever they go, and the majority of them use a mobile device to do so. We are Social reports that 65% of Australian adults own smartphones, and according to Vivid Wireless, there are 30.2 million mobile services in Australia to accommodate less than 23 million people. The unprecedented evolution of these devices and the apps that run on them has opened the door to myriad uses for education. Learning institutions all over the world are adopting apps into their curricula and modifying websites, educational materials, resources, and tools so they are optimised for mobile devices. The significance for teaching and learning is that these devices have the potential to facilitate almost any educational experience, allowing learners to organise virtual video meetings with peers all over the world, use specialised software and tools, and collaborate on shared documents or projects in the cloud, among many other things. Although there are still likely many uses that have not been realised yet, over the past several years mobile learning has moved quickly from concept to reality.

### Relevance for Teaching, Learning, or Creative Inquiry

- As a one-to-one solution, mobiles present an economic, flexible alternative to laptops and desktops due to the devices' lower cost, greater portability, and access to apps.
- Mobile apps with built-in social features enable learners to share their questions or findings with each other in real time. For example, productivity apps such as Evernote and Dropbox make it possible to exchange notes, assignments, drawings, and videos.
- Students can leverage the cameras, microphones, and other tools inherent in mobiles to do fieldwork or create rich media. This is especially convenient for work done outside of the classroom as students can record interviews, collect data for experiments, and more.

### Mobile Learning in Practice

- James Cook Uni Mobile, a free mobile app, provides easy access to maps, staff directories, and on-campus activities: [go.nmc.org/jcumobile](http://go.nmc.org/jcumobile).
- A multidisciplinary team at the University of Technology, Sydney received funding to investigate Australian mobile learning projects in order to identify best practices that improve educational outcomes: [go.nmc.org/utsmobile](http://go.nmc.org/utsmobile).
- Researchers at the University of Southern Queensland are developing a mobile learning evaluation framework to help educators assess the efficacy and viability of mobile learning initiatives across various disciplines: [go.nmc.org/usqmobile](http://go.nmc.org/usqmobile).

### For Further Reading

*Mobile Learning-System Usage: An Integrated Framework to Measure Students' Behavioural Intention*

[go.nmc.org/mobileframe](http://go.nmc.org/mobileframe)

(Saleh Alharbi et al., *Proceedings Science and Information Conference 2014*, 27 August 2014.) To measure success of mobile learning initiatives, researchers created a model that incorporates lecturers' attitudes, with a host of student social and performance variables.

*Mobile Pedagogical Framework: A Socio-Cultural Model for Mobile Learning*

[go.nmc.org/schuckmobile](http://go.nmc.org/schuckmobile)

(Sandy Schuck, *Conversations on Knowledge for Teaching 2015*, 11 February 2015.) This framework is designed to help educators navigate the challenges of incorporating mobile technologies with a focus on increasing curriculum mastery.

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

### Open Licensing

As new forms of publication and scholarship begin to take hold, the academic world is examining standard forms of licensing and rights management and finding them lacking. While current copyright and intellectual property laws focus on restricting use of materials, authors are beginning to explore new models that centre on enabling use while still protecting the academic value of a publication. Some rights are still reserved, but some are proactively licensed at publication time to encourage re-use. These approaches make it clear which rights are licensed for various uses, removing the barrier of copyright and smoothing the way for others to access and use one's work. One such approach is that taken by Creative Commons, an organization that supplies easy-to-understand, "some rights reserved" licenses for creative work. Authors simply review the list of rights they can grant or restrict, make their choice, and receive a link to a written license that spells out how their work may be used. Copyleft is another alternative license; often used in open source software development, and it describes how a work can be used and also governs how derivative works are to be licensed as well. Models like these are beginning to gain acceptance among artists, photographers, and musicians; scholarly papers and reports are increasingly released under alternative licenses.

### Relevance for Teaching, Learning, or Creative Inquiry

- In many cases, openly licensed materials can be easily updated and reposted to reflect the latest knowledge and discoveries.
- Many of the top universities and learning-focused organisations in Australia are proponents and users of open licenses and have made materials available on demand to anyone.
- The use of open licenses promotes a set of skills for faculty that are critical in maintaining currency in any area of study — the ability to find, evaluate, and put new information to use, along with publishing their own resources to be freely adapted.

### Open Licensing in Practice

- Charles Sturt University is developing case studies and policy recommendations to promote use of OER in Australian universities: [go.nmc.org/csuopen](http://go.nmc.org/csuopen).
- Swinburne University of Technology's "Open Education Licensing Project" will research copyright and licensing issues related to online open education practices. The findings will be compiled into a toolkit for Australian universities: [go.nmc.org/oelproject](http://go.nmc.org/oelproject).
- The University of Sydney has adopted an open access policy for its scholarly research output, and has created the Sydney e-Scholarship Repository to allow self-archiving of academic works: [go.nmc.org/opensydney](http://go.nmc.org/opensydney).

### For Further Reading

*Creative Users, Social Networking, and New Models of Publishing*

[go.nmc.org/openpub](http://go.nmc.org/openpub)

(Xiang Ren, *Journal of Cultural Science*, 2014.) As the publishing world continues to evolve in the digital era, the author argues that the new paradigm must include principles supporting open knowledge transfer.

*Will Academic Publishing Become More Pluralistic Thanks to Open Access?*

[go.nmc.org/openjourn](http://go.nmc.org/openjourn)

(Witold Kieñć, *Open Science*, 28 November 2014.) Open access publishing helps journals to reach international audiences and allows newer journals to amass subscribers, particularly when publishing outside of the dominant markets in North America and Western Europe.

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

Wearable technology refers to computer-based devices that can be worn by users, taking the form of an accessory such as jewellery, eyewear, or even actual items of clothing such as shoes or a jacket. The benefit of wearable technology is that it can conveniently integrate tools that track sleep, movement, location, and social media interactions, or, in the case of Oculus Rift and similar gear, it can enable virtual reality. There are even new classes of devices that are seamlessly integrated with a user's everyday life and movements. Over the past year, Google Glass has been one of the most heavily discussed wearables, enabling users to see information about their surroundings displayed in front of them. Smart watches from Apple, Samsung, Sony, and Pebble are already allowing users to check emails and perform other productive tasks through a tiny interface. Thanks to the quantified self movement, today's wearables not only track where a person goes, what they do, and how much time they spend doing it, but now what their aspirations are and when those can be accomplished.

**Relevance for Teaching, Learning, or Creative Inquiry**

- Effective wearable devices become an extension of the person wearing them, allowing them to comfortably engage in everyday activities, such as checking and responding to emails and other tasks that help instructors and students to stay productive on-the-go.
- The next wave of wearable technology, implantable devices, can be embedded under a person's skin to detect and even dispense treatment for health issues.
- Wearable devices such as Oculus Rift provide a virtual reality-enhanced experience for users, making simulation activities more realistic and immersive.

**Wearable Technology in Practice**

- An Apple Watch pilot programme at TAFE Queensland will use the SAMR model to assess the utility of integrating the technology into the classroom: [go.nmc.org/watchpilot](http://go.nmc.org/watchpilot).
- Engineers at the University of New South Wales are researching measures to safeguard data transmissions from wearable healthcare devices that medical patients can use to monitor their health in their homes: [go.nmc.org/safedata](http://go.nmc.org/safedata).
- Student teams from Swinburne University of Technology and several European universities have partnered with scientists at CERN to develop wearables that provide solutions to issues affecting the elderly and autistic populations: [go.nmc.org/cernwear](http://go.nmc.org/cernwear).
- The Wearable Computer Lab at the University of Southern Australia conducts research on various projects involving human-computer interaction, ranging from touch-responsive digital foam to e-suits with electronics imbedded in textiles: [go.nmc.org/wearlab](http://go.nmc.org/wearlab).

**For Further Reading**

*Imagining the Classroom of 2016, Empowered by Wearable Technology*

[go.nmc.org/classwear](http://go.nmc.org/classwear)

(Rick Delgado, *EmergingEdTech*, 20 April 2014.) This article anticipates that wearables will be a natural extension of BYOD, and envisions practical and creative education applications for wearables, including improvements to student safety and professor-student communications.

*Why Wearables Are the New Gateways to Human Knowledge*

[go.nmc.org/newgate](http://go.nmc.org/newgate)

(Toni Fuhrman, *Campus Technology*, 16 October 2014.) Two Americans in the higher education field consider wearables to be a disruptive technology that will require new institutional strategies, and share their predictions for the future of wearable technologies on campus.



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

### Adaptive Learning Technologies

Adaptive learning technologies refer to software and online platforms that adjust to individual students' needs as they learn. According to a paper commissioned by the Bill and Melinda Gates Foundation and authored by Education Growth Advisors, adaptive learning is a "sophisticated, data-driven, and in some cases, nonlinear approach to instruction and remediation, adjusting to a learner's interactions and demonstrated performance level, and subsequently anticipating what types of content and resources learners need at a specific point in time to make progress." In this sense, contemporary educational tools are now capable of learning the way people learn; enabled by machine learning technologies, they can adapt to each student's progress and adjust content in real time or provide customised exercises when they need it. In tertiary education, many faculty envision these adaptive platforms as new, patient tutors that can provide personalised instruction on a large scale. There are two levels to adaptive learning technologies — the first platform reacts to individual user data and adapts instructional material accordingly, while the second leverages aggregated data across a large sample of users for insights into the design and adaptation of curricula.

### Relevance for Teaching, Learning, or Creative Inquiry

- Adaptive learning dashboards are often viewable by students so they can gain a better understanding of what habits and activities are helping them learn more effectively.
- Adaptive learning technologies link specific concepts and skills from a course to how students are interacting with the material; a student, for example, may spend a disproportionate amount of time reading a single passage, signaling the algorithm to serve up more resources for them to better comprehend the concept.
- If applied effectively, adaptive learning can foster more personalised learning for students while providing institutions with key insights about the efficacy of their instruction.

### Adaptive Learning Technologies in Practice

- A pilot programme at the University of Queensland will develop adaptive mathematics e-tutorials to meet the unique needs of agricultural students, many of whom study remotely: [go.nmc.org/agmath](http://go.nmc.org/agmath).
- Professors at the Royal Melbourne Institute of Technology receive real-time feedback from students through Bluepulse, an adaptive learning platform, and use the data to identify student knowledge gaps and adjust their curricula accordingly: [go.nmc.org/bluepulse](http://go.nmc.org/bluepulse).
- Researchers at the University of Adelaide are investigating the impact of an online adaptive learning programme in a large undergraduate psychology course setting: [go.nmc.org/altpsych](http://go.nmc.org/altpsych).

### For Further Reading

*Adaptive Learning Technology: What It Is, Why It Matters*

[go.nmc.org/altech](http://go.nmc.org/altech)

(Brian Fleming, *Eduventures*, 1 April 2014.) Adaptive learning technologies can increase student success through personalised learning and analytics, but present challenges for institutions that must navigate relationships with third-party vendors.

*Development of an Application with Process Feedback to Enhance Student-Centred Learning (PDF)*

[go.nmc.org/altapp](http://go.nmc.org/altapp)

(Sudhakaran Edathil et al., *Rhetoric and Reality: Critical Perspectives on Educational Technology. Proceedings Ascilite Dunedin*, 23-26 November 2014.) Students at University of Tasmania improved their subject matter comprehension through the use of an adaptive learning tool that provides real-time feedback and opportunities for self-assessment.

## 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, or Creative Inquiry

- Augmented reality constructs provide contextual, in situ learning experiences that foster exploration of real world data in virtual surroundings and simulations.
- Games that are based in the real world and augmented with networked data give educators powerful new ways to show relationships and connections in computer science.
- Students doing outdoor fieldwork access AR applications to overlay maps and information about their surroundings, or to enter field observations and data that are automatically geocoded as the records are created.

### Augmented Reality in Practice

- The Immerse Studio at the University of the Sunshine Coast projects extreme-HD video in a 270-degree panorama for use in simulation learning scenarios across various disciplines: [go.nmc.org/immerse](http://go.nmc.org/immerse).
- Monash University announced pilot funding for research and collaborative access to CAVE2, their room-sized 2D/3D hybrid virtual reality environment that allows researchers to step inside their data sets, providing an immersive perspective: [go.nmc.org/monashcave](http://go.nmc.org/monashcave).
- A student at Flinders University developed AusRainAR, a mobile app that uses augmented reality technology to display rain radar data on the screen of a mobile device when it is pointed toward the sky: [go.nmc.org/ausrain](http://go.nmc.org/ausrain).

### For Further Reading

*Augmented Reality in Education – Cases, Places, and Potentials*

[go.nmc.org/aredu](http://go.nmc.org/aredu)

(Matt Bower et al., *Educational Media International*, 4 March 2014.) This paper predicts a proliferation of increasingly sophisticated augmented reality applications, asserts the didactic value of the technology, and offers guidance for future educational research.

*Tiny Mollusc on Beach Could Hold Key to Augmented Reality*

[go.nmc.org/ardisplay](http://go.nmc.org/ardisplay)

(Tom Bawden, *The Independent*, 26 February 2015.) Scientists have identified optical structures in a mollusc that filter and absorb light in a manner that could prove useful in the development of augmented reality displays on glass or windows.

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

### Quantified Self

Quantified self describes the phenomenon of consumers being able to closely track data that is relevant to their everyday lives through the use of technology. The emergence of wearable devices on the market such as watches, wristbands, and necklaces that are designed to automatically collect data are helping people manage their fitness, sleep cycles, and eating habits. Mobile apps also share a central role in this idea by providing easy-to-read dashboards for consumers to view and analyse their personal metrics. Empowered by these insights, many individuals now rely on these technologies to improve their lifestyle and health. Today's apps not only track where a person goes, what they do, and how much time they spend doing it, but now what their aspirations are and when those can be accomplished. Novel devices, too, are enabling people to track their lives automatically, such as the Memoto, a camera worn around the neck that is designed to capture an image every half minute. As more people rely on their mobile devices to monitor their daily activities, data is becoming a larger part of everyday life.

### Relevance for Teaching, Learning, or Creative Inquiry

- The quantified self provides individuals with greater self-awareness of their behaviours through self-tracking, as well as new ways to think about how to use the data collected. A growing number of communities have formed around the idea of using technology to aid in self-improvement.
- Students already spend time in formal classroom settings gathering data about themselves or research topics they have been assigned. Quantified self-enabled wearables tap into this interest to make the data collection process much easier.
- Universities across Australia are advancing the quantified self movement by conducting research on different methods of self-tracking.

### Quantified Self in Practice

- A PhD candidate at the University of Melbourne is exploring the utility of digital monitoring tools and apps for patients' management of diabetes: [go.nmc.org/qsdiab](http://go.nmc.org/qsdiab).
- Researchers from Southern Cross University, along with other institutions, are investigating the sociological and ethical implications of digital technology use in school health and physical education: [go.nmc.org/qsethics](http://go.nmc.org/qsethics).
- The University of Tasmania's Technology for Healthy Living course teaches students to improve health outcomes through self-monitoring technologies. Participating students receive a free Fitbit tracker: [go.nmc.org/qshealth](http://go.nmc.org/qshealth).

### For Further Reading

*The Law and Ethics of 'Self-Quantified' Health Information: An Australian Perspective*

[go.nmc.org/qsLaw](http://go.nmc.org/qsLaw)

(Angela Daly, *International Data Privacy Law*, 24 February 2015.) This article explores how Australian medical device regulations and privacy laws can apply to sensitive data gathered and stored in personal health monitors and apps.

*The Quantified Self Movement and Big Data*

[go.nmc.org/qsdata](http://go.nmc.org/qsdata)

(Claire Porter, *Australian Broadcasting Corporation*, 29 April 2014.) The self-monitoring of health can produce data sets useful to both patient and physician, but concerns about consumer privacy will complicate the creation of any national policies on data input and retention in the healthcare system.

## 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. Both 2D and 3D telepresence have been employed as a means of making it seem as though a user is in a location when they physically are not. This is a technique intended to make collaboration feel more seamless and replicate the benefits of face-to-face communication. 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, or Creative Inquiry

- 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 remotely from the comfort of their own homes with educators and courses allows them to receive equal learning opportunities as their peers.
- New high definition forms of telepresence are easily adapted to researching locations that human beings cannot physically reach or safely explore.

### Telepresence in Practice

- Apple co-founder Steve Wozniak accepted an appointment as adjunct professor at the University of Technology, Sydney, where he will assist students and consult on research projects via telepresence: [go.nmc.org/utswoz](http://go.nmc.org/utswoz).
- The New Academic Street project at the Royal Melbourne Institute of Technology will include a facility for large-scale projections and telepresence: [go.nmc.org/newacad](http://go.nmc.org/newacad).
- Planned upgrades to Southern Cross University's communications systems include HD telepresence to facilitate knowledge exchange across their multiple campuses: [go.nmc.org/telescu](http://go.nmc.org/telescu).

### For Further Reading

*Is the Future of Education Teacher-Robots Bumping into Walls?*

[go.nmc.org/telebot](http://go.nmc.org/telebot)

(Nichole Dobo, *The Hechinger Report*, 9 March 2015.) A network of American charter schools has introduced robots with telepresence screens into the classroom to provide online course instructors with a type of physical presence in the building.

*Michigan State Tests Telepresence Robots for Online Students*

[go.nmc.org/msubot](http://go.nmc.org/msubot)

(Leila Meyer, *Campus Technology*, 24 February 2015.) By freeing online students from a fixed viewpoint in the classroom, Michigan State University's telepresence robots empower those students to interact and participate equally with those physically present.

*Physical Telepresence*

[go.nmc.org/phystel](http://go.nmc.org/phystel)

(Daniel Leithinger et al., MIT Media Lab Tangible Media Group, 2014.) In this paper, researchers at the MIT Media Lab investigate a new approach to physical telepresence and explore interaction methods for manipulating remote physical objects.

## Methodology

The process used to research and create the *2015 NMC Technology Outlook for Australian Tertiary Education: A Horizon Project Regional Report* is very much rooted in the methods used throughout the NMC Horizon Project. All publications of the NMC Horizon Project 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 panel of experts that first considers a broad set of important developments in technology, challenges, and trends, and then examines each of them in progressively more detail, reducing the set until the final listing of trends, challenges, and important developments in educational technology is selected.

Much of the process takes place online, where it is captured and placed in the NMC Horizon Project wiki. This wiki, which has grown into a resource of hundreds of pages, 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 *2015 NMC Technology Outlook for Australian Tertiary Education* can be found at [aus.wiki.nmc.org](http://aus.wiki.nmc.org).

The procedures for selecting the topics that are in this report include a modified Delphi process now refined over years of producing the *NMC Horizon Report* series, and it began with the assembly of the expert panel. The panel as a whole was intended to represent a wide range of backgrounds and interests, yet with each member bringing a particularly relevant expertise. To date, hundreds of internationally recognised practitioners and thought leaders have participated in the NMC Horizon Project Expert Panels; in any given year, a third of expert panel members are new, ensuring a flow of fresh perspectives each year.

Once the expert panel 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. Panel 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, or creative inquiry. 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 expert panel 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 panel:

1. *Which of these important developments in technology will be most important to Australian tertiary education within the next five years?*
2. *What important developments in technology are missing from our list? Consider these related questions:*
  - a. *What would you list among the established technologies that some Australian universities and educational programmes are using today that arguably ALL Australian universities and educational programmes should be using broadly to support or enhance teaching, learning, or creative inquiry?*

- b. *What developments in technology that have a solid user base in consumer, entertainment, or other industries should Australian universities and educational programmes be actively looking for ways to apply?*
    - c. *What are the emerging technologies you see developing to the point that Australian universities and educational programmes should begin to take notice during the next four to five years?*
  3. *What key trends do you expect to accelerate the uptake of emerging technology across Australian tertiary education?*
  4. *What do you see as the significant challenges impeding emerging technology uptake across Australian tertiary education?*

One of the expert panel'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 expert panel moves to a unique consensus-building process based on an iterative Delphi-based methodology.

The responses to the research questions are systematically ranked and placed into adoption horizons by each panel 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, which can be found at [aus.wiki.nmc.org](http://aus.wiki.nmc.org).





## 2015 Horizon Project Australia Expert Panel

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