E-learning: Supplementary or disruptive?

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Abstract

The rollout of the National Broadband Network in Australia will accelerate dramatic changes in pedagogy and access that have been underway since the advent of the Internet. Among the most important of these are the move away from bricks-and-mortar campuses towards global learning networks that share expertise and resources, the blurring of the virtual and the material and the rise of mobile learning (m-learning). When combined with the proliferation of MOOCs (Massive Open Online Courses), m-learning will result in access to education becoming a universal human right.

Introduction

The advent of the Internet around two decades ago provided universities with three monumental opportunities. Any one of these should have been sufficient to alter the way teaching was conducted but in combination should have revolutionised university education.

- First, educators now had the ability to extend their reach globally.
- Second, anyone with an Internet connection suddenly had unprecedented access to information.
- And third, with the development of Web 2.0 technologies, digital communication began to provide a medium, and for many now the preferred medium, for interacting with friends and associates.

Despite this, it was only five years ago that I was lamenting how slow Australian universities had been to exploit educational technology in the service of learning and teaching. What I said at that time was:

> ?educational technology has yet to fulfill its promise to the extent witnessed in other sectors of the economy. The cottage craft of teaching and learning in universities has constrained IT?s use. Indeed, in many universities, technology is often viewed as a barrier, even antithetical, to ?genuine? education.?

How quickly things have moved since then. It seems that every day now, there is an announcement about some new online start-up, innovation or development in e-learning. Admittedly, the most exciting of these developments are occurring outside of Australia but since there are no geographic boundaries in cyberspace, Australian universities have no choice but to respond.

According to the National Center for Education Statistics (NCES), the number of U.S. students enrolled in at least one distance education course increased from 1 million to 12 million between 2002 and 2006, and the growth spurt shows no sign of abating. Research by the Sloan Consortium, for example, recently found that online college enrolments have continued to grow faster than the total population of college students. And respected market research firm, Ambient Insight, expects online enrolments in the U.S. to rise by a further 10 million in the next two years alone. By that time, the number of students taking all of their classes online will increase to 3.55 million while the number of students taking all of their courses in on-campus mode will actually decline.

It is difficult to obtain authoritative statistics on the rate of growth in Australia, but IBIS World recently estimated that the revenue from courses offered at least 80% online grew by 56% between 2008-9 and 2011-12 in Australia, while the number of online providers (i.e. those offering courses with more than 80% online content) grew by 40%, (from 764 to 1,082) over the same period.

More significant than the growth in uptake of online learning are changes that are now occurring in the nature and quality of e-learning itself. Until recently, the most common view of educational technology was that it was at best supplementary to conventional forms of instruction. The delivery of online courses mimicked the lecture-tutorial approach that has been the staple of university education for centuries. Lecture materials were provided, often in PDF form or, for the more advanced lecturers, as pod- or vodcasts. This material was then supplemented by online versions of tutorials, such as synchronous or asynchronous bulletin boards and chat rooms.

We are at last beginning to display more imagination in the application of educational technology as e-learning evolves into a genuine alternative to traditional teaching practices. As broadband further liberates us from the constraints of time and place, it will accelerate the movement of university education away from campuses, desktops and teacher-centred pedagogy towards learning networks, a merger between the virtual and the material, mobile learning, and a radically new, student-centred form of pedagogy.

Advances in Educational Technology

With the arrival in Australia of broadband, just about anything you could only do on a university campus will soon be available to you anywhere, anytime. Of course there will always be some learning activities, such as clinical placements and medical procedures that require students to be physically present somewhere at a specified time but the range of these activities will become narrower as the available bandwidth becomes broader. At this university, for example, certain aspects of emergency medicine are now taught by specialists from the medical school at the University of California (Irvine). Staff and students from UNE connect via telepresence technology to UCI?s robotic simulation ward where they direct UCI?s ward assistants to administer treatment in response to simulated medical emergencies. The responses of the robotic patient are observed by the students, vital signs are downloaded onto UNE laptops and displayed in real time on monitors adjacent to the telepresence screen. Meanwhile, staff and students at both universities work together to adjust interventions and debrief outcomes. Similarly, academic staff in chemistry and physics are designing practical classes whereby students can manipulate scientific equipment remotely and download their results onto PCs or i-Pads. With the aid of video cameras mounted around the laboratories, students watch the equipment come to life as they issue instructions from anywhere they can obtain a broadband Internet connection.

In place of the traditional campus, then, what we are witnessing is the emergence of nodes of activity or learning networks that are physically dispersed around the country and around the world. This movement into cyberspace will accelerate along with advances in hardware and software that are blending the virtual and the material. Virtual environments are being created that mimic the real world and provide us with a visceral sense of immersion. Some have even argued that the distinction between virtual and real will disappear altogether. This is because all surfaces, including the skin are potential interface points enabling users to issue and receive computer commands using their own body parts as touchpads.

We are also seeing rapid progress in augmented reality, where an overlay of data or interactivity is created on top of the real world around us. For example, the Google Android now allows you to point your phone at, say, a restaurant and bring up reviews and contact details of that restaurant, along with seating plans, similar restaurants in nearby locations, transport options, etc., etc. so that you are in a position instantly to augment your lived experience with new knowledge and perceptions.

In short, advances in virtual reality are further undermining the notion that students need to assemble in one place at one time in order to be informed, engaged or even entertained. As a consequence, the question for universities could soon become: What is the role of bricks and mortar in a world where students can now live and move and have their being in a network cloud? Soon there will be no compelling reason to think of universities as *places* at all, but if they do persist in that form, it will not be because they provide the best or most efficient means of educating people.

The worldwide proliferation of mobile devices and applications also has major implications for education. Consider some of the latest dizzying statistics:

- There are now 3 billion more smartphones in the world than there are people;
- On current estimates, 1 billion smartphones will be sold in 2014 alone, which is twice the number of PCs that will be sold in that year;
- By 2016 there will be around 10 billion mobile Internet devices globally, with 50 times the amount of smartphone traffic in that year than there is today.
- Ericsson estimates that by 2015, 80% of people accessing the Internet will be doing so from mobile devices. (In Japan today, over 75% of Internet users already use a mobile device to connect, and in the U.S., 2/3 of Americans connect to the web via a smartphone, tablet or other portable device.)
- Users are now downloading 1 billion Android apps every month and over 18 billion apps have so far been downloaded in the Apple marketplace. A recent study by Distimo predicts that by 2016, every person in the world will have an average of 7 mobile apps each.
- Ambient Insight has forecast the compound annual growth rate for worldwide mobile learning products and services at 26.3% for the period 2011-2016, with revenues rising from $US212.38 million in 2011 to $US682.13 million by 2016.

It may be, then, that the migration from campus to desktop that is currently occurring may merely be a wayside station on the road to m-learning. If so, the big winners will be what we euphemistically call ?non-traditional? students: the poor, the isolated, those with disabilities and people from developing countries. This is because the cost of mobile Internet-enabled devices is in rapid decline and their power needs are minimal, which is giving even people off the grid access to the Internet.

Ten years ago, the fastest growing market for mobile phones was India, which grew from 10 million phones in 2000 to 850 million in the decade following. But India has since been displaced by the African continent as the world?s fastest growing market for mobiles, which are also the most common method of connecting to the Internet in Africa. The democratisation of education will happen not just through technological advances, of course, but the veritable flood of free courseware that is now finding its way onto the Internet virtually guarantees it.

The idea of open courseware got going in 2001 when MIT started uploading its course materials to the net. Within 12 months MIT had 50 of its courses freely available and since then it has distributed around two-and-a-half thousand of its courses and is receiving close to 20 million site visits every year. MIT estimates that in the 10 or so years since it opened up its courseware, it has reached around 125 million people worldwide. This combination of Internet-enabled mobile devices and open courseware quite literally places higher education into the hands of people who would previously have been too poor, marginalised, or remote to participate.

There are numerous other sources of free educational resources, of course, including iTunes U, which amassed more than 350,000 downloadable files in its first five years of operation. And then there is Wikipedia, which was launched in the same year as MIT?s open courseware initiative and now contains more than 15 million articles (only 20% of which are in English), all of which are continually updated and corrected by subscribers themselves.

The enormous appeal of Wikipedia demonstrates another profound shift in the way that universities of the future will teach ? the movement away from *acquisition* of knowledge as the fundamental purpose of education to incorporate its *creation* and *re*-creationby students themselves. This is unfamiliar territory for academics of my generation who were raised on the idea that only professional educators are qualified to teach. But Facebook, Wikipedia and blogging have radically undermined this assumption because all consist of information that is created by, not just communicated to, participants. The acts of teaching and learning are blurring as a consequence. Schooled on Google and Wikipedia, students today want to inquire, not rely on the professor. They want a conversation, not a lecture.

The most recent development in open courseware is of course the MOOC, which is an acronym for ? Massive Online Open Courses? in which huge numbers of students enrol in online courses, network with one another online and undertake online quizzes and self-directed learning. The term MOOC was first coined in 2008 but entered common parlance only towards the end of 2011 when Stanford University professor, Sebastian Thrun, offered to enrol students in his online robotics course free of charge and 160,000 people took up the offer. Buoyed by the success of his experiment, Thrun and his colleagues launched a free online university called Udacity [5] in February of 2012 and within the first three months of operation had achieved over 100,000 enrolments.

Six days after Udacity, coursera.org [6] was launched by a star-studded line-up of U.S. universities including the University of Pennsylvania; the University of Michigan; and Princeton and Stanford Universities. These universities offer their courseware free of charge online, and there is facility for students to interact with one another and take quizzes to monitor their progress. By the end of April, coursera had amassed a staggering 1,000,000 enrolments.

Not to be outdone, two weeks after coursera was launched, MIT and Harvard University joined forces to launch edX [7] and on 1st August 2012, arguably the world?s finest public university UC (Berkeley) threw in its lot with edX. Like other MOOC providers, edX also offers free online courseware to students around the world; its stated goal is to exceed one billion student enrolments in the next decade.

Effectiveness of e-Learning

Among the most common objections to e-learning continues to be that it is a very poor substitute for face-to-face teaching. Given the technological advances described earlier, however, this objection rather begs the question of whether the distinction between ?face-to-face? and ?online? has any real meaning in a post-NBN world. But even before the improvements that broadband will bring, there was solid evidence in support of e-learning methods.

Prior to the development of Web 2.0 technologies like MySpace and Facebook, there had been two major meta-analyses of the effectiveness of online education (Bernard et al 2004 [8]; Cavanaugh et al 2004 [9]). Meta-analysis is a technique for combining the statistical results of multiple research studies to obtain a composite estimate of the size of the effect. In this way, different studies using different online techniques and different measures of learning can be combined into a single study and a global measure of the effectiveness of online learning calculated.

The result of each experiment is first expressed as an *effect size*, which is the difference between the mean score for online learning and the mean score for face-to-face classes divided by the pooled standard deviation. Individual effect sizes are then combined into a single, overall index. Importantly, meta-analysis is only ever performed on studies that satisfy the most rigorous methodological standards, normally involving random allocation of students to classroom and online conditions.

Results of these pre-Web 2.0 meta-analyses suggested that there was no significant difference in learning outcome between distance education and face-to-face education. Findings of a more recent meta-analysis of job-related courses comparing Web-based and classroom-based learning (Sitzmann et al 2006 [10]) were even more positive. This study found online learning to be superior to classroom-based instruction in declarative knowledge (or knowing *that*) outcomes, with the two being equivalent in procedural knowledge (or knowing *how*) outcomes.

A more recent meta-analysis conducted by the United States Department of Education (Means et al 2010 [11]) combined effect sizes from 46 separate studies conducted since the advent of Web 2.0 technologies. The number of students in the various studies ranged from 16 to 1,857, with student ages ranging from an average of 13 to 44 years. Importantly also, the subject matter captured by the meta-analysis was very diverse, extending from medicine, to education, law enforcement, introductory science, problem-solving skills, computer science, optometry, veterinary science, and multi-media studies.

The overall finding of the meta-analysis was that classes with online learning (whether taught completely online or blended) actually produced better learning outcomes than classes with solely face-to-face instruction. Admittedly, the effect size was only moderate (+0.24) but it was sizeable enough to dispel the myth that face-to-face instruction is always the optimal form of teaching. This same meta-analysis compared three conditions:

- face-to-face only,
- online only, and
- blended or a combination of face-to-face with online learning.

Comparisons of these conditions revealed that the third actually produced the most powerful effects ($g+$ = +0.35 vs face-to-face; compared with $g+$ = +0.14 for online only), with the difference between online only and blended also being statistically significant. In short, then, as the technology has improved so has the relative advantage of online learning over face-to-face instruction and as broadband erodes the very distinction between online and face-to-face, the debate itself will be consigned to history.

Conclusion

Up to this point, I have written as if universities will continue to be the main providers of higher education and gatekeepers to the professions, but it would be a mistake for universities to take this privileged position for granted in the post-NBN world. In her confronting introduction to a U.S. Department of Education (2006) report on the future of higher education, Education Secretary Margaret Spellings wrote that:

?What we have learned over the last year makes clear that American higher education has become what, in the business world, would be called a mature enterprise: increasingly risk-averse, at times self-satisfied, and unduly expensive. It is an enterprise that has yet to address the fundamental issues of how academic programs and institutions must be transformed to serve the changing educational needs of a knowledge economy? .History is littered with examples of industries that, at their peril, failed to respond ? or even to notice ? changes in the world around them, from railroads to steel manufacturers. Without serious self-examination and reform, institutions of higher education risk falling into the same trap, seeing their market share substantially reduced and their services increasingly characterised by obsolescence? (Spellings 2006 [12], p.xii).

Until the invention of the Internet, universities did not have to be innovative because they have effectively had a monopoly. But competition from virtual institutions like ed-X, Udacity and coursera is changing all that. In his research on the implementation of new ideas, Harvard Professor Clayton Christensen found that disruptive innovations rarely come out of established enterprises. Even when a truly new way of doing things does occur to someone in a traditional organisation, established systems and standards take over and the idea is usually quashed. A new idea that is not dismissed entirely is almost inevitably modified to fit the way things are traditionally done, losing its innovation impact in the process. Let us hope Christensen is wrong. Universities must surely be among the very finest institutions that society has created. Let us hope that Australian universities embrace the opportunity that the NBN provides before it becomes a threat to them.

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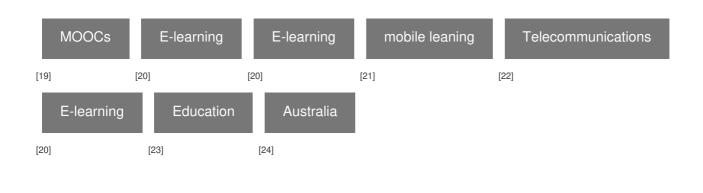
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MOOCs	E-learning	E-learning	mobile leaning	Telecommunications
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