



Evolution of Education – How societal readiness and technological improvement is improving online higher education access and quality worldwide

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Evolution of Education How societal readiness and technological improvement is improving online higher education access and quality worldwide

Michelle Nic Raghnaill, 25/09/2014

The recent use and rapid uptake of online education on a large scale has shown how access to education can be improved. This paper analyses the historical drivers for widely accessible effective online tertiary education. It looks broadly at the history of tertiary education, then considers a set of social and technical issues surrounding online education, in particular massive open online courses. The benefits for Australia's society, education system and economy are likely to be substantial.

Key words: Evolution, phase transition, accessibility, standardisation, growth nations, composability, inter-dependence, inter-operability, training, workforce, pedagogy, status, business models, massive open online course (MOOC), higher education, online education, tertiary education

Overview

- Technology continually evolves through adaption of available technological components and processes leading to developments and emerging technologies that fuel social progress.
- Massive open online courses (MOOCs) have been cited as an emerging form of online technology platform that is driving a rapidly evolving technology revolution in tertiary education. Open access to free tertiary level courses and the possibility of enrolling massive numbers of students has been reported as radically altering tertiary education as we know it. The ability of one single innovation (such as MOOCs) to completely transform a complex system (such as tertiary education) should always be questioned. MOOCs offer courses and not degree programs, and they would not be possible without the prior existence of reputable universities to provide high quality education through their educational expertise. Their involvement is a prerequisite for the value of the information available online.
- The evolution of online education technology such as MOOCs is due to gradual improvement of social and technical readiness over long periods of time: the development and diffusion of information and communications technology (ICT), specifically the optimal internet bandwidth to transfer course information and the near ubiquitous access to computer devices and software; population-wide skills in using online technology, and demand for personalised anytime/anyplace education.
- A number of eminent Australian universities have incorporated online learning technology platforms into higher education curriculums. Optimal education outcomes can be achieved through the combination of online and traditional education. Administrator and instructor training may be required.
- A purely online format of tertiary education is unlikely to be adopted on a large scale in preference to attending a physical university. Gaining access to information and becoming accredited are only some of the many significant factors associated with attending university –social and networking prospects of university life are equally important. In addition, government aid (i.e. grants), upon which many rely to attain a university education, are not applicable to purely online tertiary education.
- Online education platforms such as MOOCs have the potential to remove traditional higher education barriers such as lack of access (disability), age restrictions and low income.
- The large amount of experimental data retrieved from online education platforms has been shown to greatly improve higher education quality, specifically through the transmission and pacing of information.

- Research suggests that to be cost effective, current higher educational frameworks may require redesign to realise the full potential of integrating online education technology platforms into university life. Public institutions can effectively implement online education as a substantial revenue resource in a cost-effective manner using alternative business models.
- The presence of physical infrastructure in order to access tertiary level education is becoming less necessary. This trend began with increased access to online education through the Open University, and continues with online tertiary education platforms such as massive open online courses (MOOCs). Growth nations such as India, projected to require 1500 new educational institutions in the near future, are therefore highly likely to embrace this form of learning, which in various ways may affect the export of tertiary education from Australian universities.

How has tertiary education changed in Australia over the last century? How has technology evolved tertiary education?

Social and technical drivers have changed the Australian tertiary education system over the last century.

There are many ways to educate and generally there is a technology threshold involved. In the past, student learning was revolutionised when the introduction of photocopiers made individual books for each student unnecessary. More recently, tablet computers have greatly changed the method of student learning with the ability to store and access learning material on portable lightweight devices. Knock-on effects also include the reduced cost of e-texts and off-site virtual lab participation.¹

The close of the 20th century saw a change in the structure of tertiary education in Australia. Apprenticeships declined, and the higher education system changed from three-tiers (TAFEs, institutes of technology and universities) to two, with the merging of institutes of technology and universities in the 1980s–1990s. Changes implemented during the ‘Dawkins revolution’ of John Dawkins, Education Minister in the third Hawke ministry from 1987 to 1991, aimed to improve the quality of higher education and social equity. However, Dawkins has since stated that the implementation of reforms did not have the intended effects (Ashenden 2012). Student numbers increased dramatically but the reforms also resulted in the introduction of an inappropriate culture of corporate managerialism within universities.

The removal of caps from government-funded places for tertiary level students is a more recently cited ‘education revolution’ promoted by the Rudd/Gillard government. With increased enrolment in tertiary education, by 4% overall in 2012, there is concern that enrolment growth may outstrip resources (Rosenberg 2012).

¹ Online higher education technology now supports online laboratories. Georgia Institute of Technology is conducting pilot studies in online laboratories using modelling and simulation software (<http://www.dlpe.gatech.edu/dl/degrees/>).

Significant historical social and technological factors have also affected the adoption of global online education. Distance education has now been possible for almost a century, and from the early 1950s the Australian School of the Air pioneered education for students in remote locations. Incorporation of new technology has been a mainstay of its continuing success, from using pedal radios and high-frequency radios, to the current use of two-way broadband satellite networks (Government, A. 2007). Open University is a distance education provider established in 1993 in Australia; it has since moved from a televised to an online format, enrolling over 60,000 students in 2012 (www.open.edu.au).

What are the current factors in the adoption of tertiary education technology?

Most recently, worldwide access to online education such as massive open online courses (MOOCs) became possible because of a large number of incremental changes in technology and societal attitudes over time. A MOOC is an open access tertiary education course available via the web with unlimited participation. One benefit of MOOCs is their potential to remove traditional higher education barriers such as lack of access (disability), age restrictions and low income. MOOCs involve technological tools and educational processes that aid in the transfer of information, can be used in many aspects of university education and provide integrating capability. In the short time from 2011 to 2013 over 200 universities worldwide had produced MOOCs and enrolled more than 6.5 million students in over 800 free classes (Gallagher S, G.G. 2013). Courses of this sort would not have been possible without the near-ubiquitous availability of internet access and computing devices in the developed world.

Population surveys report a number of reasons for the rapid and substantial uptake of online learning (i.e. MOOCs) including the recent global financial crisis, an expanding adult student population, and technological readiness (Allen, I.E. and Seaman, J. 2010, *The Future of State Universities* 2011). Two of these factors, however, are not restricted to today – there have been substantial economic downturns over the last hundred years, as well as a steadily increasing global student population. Incentives for gaining higher levels of education are not recent: accreditation for gainful employment had long been a driver of tertiary education. But the expectation now is that 21st century adults will constantly improve their workplace skills at low cost and have more computational technology experience than previous generations. This is probably the key to the phase transition toward large-scale adoption of online learning. In 2010–11 79% of Australian households had internet access and 83% of Australians had access to a computer at home (Statistics, A.B.o. 2012). In addition, the optimal internet bandwidth (~2–3 Mbps, ADSL connection) for communicating presentations and real-time education online has improved incrementally over decades. The ubiquitous availability of software platforms such as Windows is also a key to making online courses available.

Composability and standardisation of widespread infrastructure such as optimal internet bandwidth, ubiquitous access to standardised software and computers, public online technology knowledge base and the demand for personalised anytime/anyplace education are all drivers of open access online tertiary education platforms such as MOOCs. The introduction of MOOCs has led to large-scale student enrolment and pedagogy, and highlights the potential to change the education process and improve the quality of education through technology.

What are the perceptions of revolutionary tertiary education platforms?

Social levers have previously been predicted to create radical transformation of tertiary education such as the Dawkins revolution and the Rudd/Gillard education. Specific technologies are often predicted to have the capacity to radically alter the future, and the domain of tertiary education is no exception.²

MOOCs have been cited as the driving force behind a rapidly evolving technology revolution in tertiary education. As the following quotations show, it has been predicted that open access to free tertiary level courses and the possibility to enrol massive numbers of students will radically alter tertiary education (Skills, D.f.B.I. 2013).

'A thousand year old industry on the cusp of profound change' Ernest & Young (Ernst & Young 2012)

'AN AVALANCHE IS COMING Higher education and the revolution ahead' (Barber M, D.K. and Rizvi S. 2013)

'I'm a believer in online technology in education. I think we have learned enough about this to understand that it will be transformative. It's going to change the world, and it's going to change the way we think about education.' John Hennessy, President of Stanford University (Perry T S 2012)

One must always question the capability of a single entity (such as MOOCs) to completely transform a complex system such as tertiary education. It should be noted that MOOCs would not be possible without the prior existence of reputable universities as it is the provision of high quality education provided by university expertise that confers trust, status and therefore value on the information available online.

The perception of MOOCs as revolutionary has shifted in the last year as education leaders now discuss the drawbacks of MOOCs in tertiary education. For instance, the automatic grading technology used in MOOCs was not created to support rigorous examination of large numbers of students. This therefore affects the accreditation possibilities of a MOOC (Drake S 2014).

MOOCs are likely to evolve again from being massive to private use on a smaller scale 'Two words are wrong in 'MOOC': massive and open' (Drake S 2014). In response to the massive number of enrolments (which is both a strength and a weakness), MOOCs may also evolve into small private online courses or 'SPOCs'. SPOCs combine online resources and technology with personal engagement between faculty and students to provide in-classroom teaching to a significantly smaller number of students than MOOCs. Early research indicates that by fostering a valuable classroom experience, SPOCs might improve higher education using online courses (Oremus W 2013, The Sloan Consortium 2013).

What are the impacts of open access online information on tertiary education?

Traditional western higher education (university, lecturer, individual student learning) involves student motivation, social experiences and the transmission and pacing of information. Technology now has the capacity to unbundle these elements via web access to video/audio content and

² See Sanchez D, SAF05 Working Paper, Technology Prediction

assessments. Different people learn at different speeds, and learning preferences and abilities are highly dependent on the information format (visual, text, or audio). Online access to course content allows the student to control lecture speed and format to optimise learning by using their dominant mode of learning. And because all students can have access to the same level of background knowledge, students can tailor lectures and have improved engagement in tutorials, thereby maximising understanding.

To date, few traditional universities have incorporated online courses such as MOOCs into their curriculums. Where they have, the courses generally supplement what they are already doing — like digitising lecture and course content (‘flipping the classroom’) This allows students to review lecture content in their own time by watching lectures from home. This increases the time available to debate and solve problems with peers and tutors in the classroom, skills much sought in the workplace. In addition to the benefits provided by flipping the classroom, MOOCs can facilitate university enrolment by acting as a bridge to higher education. Accessibility is a key component to the MOOCs system: low-cost online education can improve educational equality and allow access to those with disabilities, on low incomes, and with limited free time. The system also allows a global projection of university brands and the identification of the best students globally. MOOCs are not seen as a university replacement but as a way of improving the higher education and workforce skill sets of society (Gallagher S, G.G. 2013). Indeed, the highest levels of MOOC enrolments have been among students with a prior tertiary education (Coursera 2013).

Individually paced and personalised learning is key to high quality education. Because of MOOCs, this form of information delivery is no longer solely available to students with excellent instructors. Large-scale online education platforms allow unprecedented pedagogy experimentation and innovation in areas such as adaptive and personalised e-learning, teacher training and peer assessment. The vast amount of pedagogical data attained through online education also allows analysis of what helps learning and what hinders it on a global scale, which can be fed back into the system to improve it (The Future of State Universities 2011).

How can online technology aid in the attainment of a valuable tertiary education? How can online education alter the format of Australian universities? What are the implications of online education adoption?

The optimal use of technology is cited as having the potential to improve tertiary education (The Future of State Universities 2011). Institutions providing high quality online education must focus on what students learn and the technologies, environments and resources that encourage learning (GreeN, K.C. and Wagner, E. 2011).

Research for thousands of studies since the 1990s reports no significant difference in learning outcomes between distance learning and face-to-face instruction, regardless of discipline, student type or technology medium used and yet a growing body of evidence reports that the combination of online and traditional instruction is optimal for improving educational outcomes.

‘Asked to rate factors that contribute to quality in online education, whether an online program is offered by an accredited institution tops the list for faculty members (73 percent), and about 6 in 10 say that whether an online program is offered by an institution that also offers in-person instruction is a “very important” indicator of quality. Only 45 percent say it is very important that the online education is offered for credit, and about 3 in 10 say it is very important whether the offering institution is nonprofit. Technology administrators, by contrast, are far likelier to associate quality with academic credit, with 63 percent citing that as a “very important”

indicator of quality in online education.' (Means, B., Toyama, Y., Murphy, R., Bakia, M. and Jones, K. 2010)

Most faculty members are sceptical of MOOCs and want to be sure that campus faculties control decisions on how the courses are used, and that those who accredit courses review the quality.

'30 percent of faculty respondents say they have taught online. Of those who have never taught an online course, 30 percent say the main reason they haven't is because they've never been asked.' (Inside Higher Education 2013)

Accreditation, standards, investment protection and business models all have the capacity to increase the quality and therefore prestige of an education institution through online technology.

What are the possible economic effects of online higher education in Australia? How will online courses impact costing tertiary education?

The introduction of online tertiary education such as MOOCs has highlighted the possible methods of costing education and accreditation. MOOCs are allowing the exploration and innovation of higher education business models and accreditation formats.

Significant private investment (over US\$30 million) into MOOC platforms has led to the formation of EdX (Harvard & MIT) and Coursera (Stanford) (Gallagher S, G.G. 2013). These companies offering MOOCs gain through payments for invigilated tests, course materials such as books, global brand projection, and helping employers find employees with the right skills. Essentially, Coursera and EdX MOOCs were made possible by significant industry capital investment and by using the customer base and brand recognition provided by existing universities.

In 2013, Coursera was funded through US\$85 million venture capital (US\$1 million from certification) and enrolled 5.2 million users (Coursera Accessed 2014, Kolowich S Accessed 2014). The contract between Coursera and participating universities contains a 'brainstorming' list of ways to generate revenue, including certification fees, introducing students to potential employers and recruiters (with student consent), tutoring, sponsorships and tuition fees (Young J Accessed 2014). Increased accreditation authenticity is underway through biometric signature tracking. As anti-plagiarism technology is in its infancy for MOOCs, there is not yet sufficient data on the efficiency of such techniques (Cooper and Sahami 2013).³

EdX received US\$30 million from MIT and Harvard which made online tertiary education courses available to 1.2 million users in 2012. They provide certificates of achievement verified through personal identification. EdX is currently testing new methods of certifying education by investigating the potential to provide businesses with tests to assess prospective employee knowledge (EdX 2014).

³ Coursera pilot studies are currently underway in the US - 'courseware' consists of everything but the instructor and interactive discussion, certification and support. This is what is meant by 'wrapping' around a MOOC. Coursera is testing the impact of adapting the current MOOC format to courseware (<http://mfeldstein.com/mooc-as-courseware-courseras-big-announcement-in-context/>).

LinkedIn is partnering with education technology companies including Coursera and EdX to offer MOOC certifications for online classes. The new 'Direct-to-Profile Certifications' pilot program will allow users to display online courses they have completed on their LinkedIn profile by clicking a link in an email from the course provider (Hepler L 2013).

As these business models evolve, their economic impact on tertiary education will become apparent.

Online tertiary education business models – What are the costs of traditional classroom learning compared to online learning? What are the projected potential cost-benefits if both systems are re-designed in optimal ways?

'By and large, colleges and universities have not yet begun to realize the promise of technology to improve the quality of student learning and reduce the costs of instruction.' (Twigg, C.A. 2003)

Online education can be cost-effective. Open University, with its reputation for high quality materials and low cost tutors, enrolled 253,075 students in 2009–10 (University, O. 2010). Globally, online higher education reported that mega-universities enrolled 2.8 million students at ~\$US350 per student in 2006. Mega-universities include Payame Noor University in Iran (117,000 students) and Anadolu University in Turkey (578,000 students) (Meyer, K.A. 2006).

A report investigating the capacity of the US government to fund online education networks looked at appropriations to public higher education, projected revenues per state, projected high school and young adult growth and the percentage of family income required to fund tuition. It concluded that the current funding structure may not be conducive to implementing online education courses under current business model conditions. This was attributed to state tax structures, willingness to fund higher education and public willingness to tax itself (Meyer, K.A. 2008). The current model for higher education institutes directly relates cost to access. Efficiencies are required to allow institutions to fund the infrastructure necessary to increase enrolment (The Future of State Universities 2011).⁴

Online tertiary education provides the opportunity to attract new students from under-served markets through branding of online courses to provide new revenue, the creation of opportunities through global partnerships and increased access to both student and academic talent (Ernst & Young 2012)(Green and Wagner 2011).

Increased competition in the global higher education market is highly likely. Physical infrastructure, such as universities, is no longer essential for free online tertiary education. Therefore growth nations such as India, projected to require 1500 new educational institutions in the near future, are highly likely to embrace this form of learning. China's tertiary education participation rate increased threefold from 8% to 25.9% from 2000 to 2010, and is projected to double in the next 10–15 years

⁴ How does this compare to the Australian tertiary education system? Higher education revenue in Australia was over \$24 billion per year in 2012 (almost 2% of GDP). Public funding of higher education exceeded \$12 billion in 2011–12, and \$6.2 billion of current student debt is not expected to be repaid (Norton, A. 2013). Is there a trade-off between greater productivity and a higher tax base?

(Ernst & Young 2012). Australia has the potential to embrace online tertiary education technology to support this ever growing market.

Unbundling student needs for a cost-effective college residence experience may be possible through online education technology. The Minerva Project, a San Francisco start-up, anticipates most of its students will be from outside the US. It will enlist operators to create mini-campuses worldwide where students can live together in residence hall, take online courses and work together on projects (Christensen C M and Horn M B 2013).

Can cost savings due to efficiencies in online learning allow public institutions to fund online education?

Redesigning the business model to incorporate increased enrolment, lower cost and improved learning can have significant cost savings. Savings of up to \$3.1 million per year in operating costs have been achieved in pilot studies. A landmark course redesign study by Carol Twigg provides evidence of 30 institutions redesigning courses with documented increased enrolment, improved learning and reduced costs of 37% on average and other institutional savings of 15–77%. To some degree all 30 shared the following traits: whole course redesign (not a section/module), active learning, computer-based learning resources, mastery learning (engagement flexibility), on-demand help, and alternative staffing. A number of techniques aided the learning improvement and cost-savings:

1. A 'replacement model' reduced in-class time with online interactive learning activities for students
2. An 'emporium model' replaced class meetings with on-demand learning resources and personal assistance
3. Consistent content coverage for all students resulted in significant improvements in course coherence and quality control
4. The course was formatted as a set of products and services that could be modified and improved as necessary (Twigg, C.A. 2003)

An introductory psychology course redesigned utilising an online format found improved learning, increased access, increased student satisfaction, lowered costs and maximised faculty time and resources. The traditional course structure cost \$113 per student, while the projected revised course cost was \$58 (almost half). The main differences between the traditional and redesigned course include halving of lecture time (which was replaced by interactive computer activities), increased interaction between students, and between students and faculty members (personalised online attention), development of common material across multiple course sections, a 60% increase in class size and the introduction of asynchronous learning material (Broida, J. , The Future of State Universities 2011).

Online education allows colleges to be innovative about the quality, length and cost of their offerings. It should be possible to offer shorter and cut-price degrees that are demonstrably equivalent (in terms of employability) to the degrees of today (Explains, T.E. 2013). Currently, there is pressure on publicly funded universities to accept online credits, and the American Council on Education says that it will evaluate MOOCs for college credit.

Issues and implications for Australia

Australian universities have the potential to embrace rapid technological change to achieve efficiency gains through the adoption of online tertiary education methods. Although campuses will

remain, the technological potential lies in the transformation of access and delivery of information and in how 'value' is created by higher education providers (Ernst & Young 2012).

Online tertiary education such as MOOCs should not yet be seen as a campus replacement in Australia for the following reasons – they do not offer degree programs; Australian universities rarely offer credit for overseas MOOCs courses; and Australian students cannot receive income support while they study a MOOC alone. In addition, MOOCs do not offer the social and lifestyle experiences of a campus (Informa Australia 2013). A number of Australian universities are beginning to embrace MOOCs to complement existing education programs. The University of Melbourne is in the process of incorporating material from its Coursera MOOCs into on-campus subjects. The Australian National University recently made free online courses available through EdX and in 2013 the University of NSW and the University of Western Australia announced plans to participate in MOOCs through Coursera (Stenger M 2013, EdX 2014). If these are done well, they could show how online educational technology improves rather than replaces the on-campus experience (Informa Australia 2013).

Replacement of a significant proportion of the teaching workforce by an entirely digital education system is highly unlikely; a combination of face-to-face and online teaching is more likely (i.e. SPOCs and flipped classrooms). A recent US report surveyed 2500 colleges and universities and found almost half of the institutions had increased demand for face-to-face courses and program. Seventy five per cent reported an increased demand for online courses and programs because of the economic downturn (Allen, I.E. and Seaman, J. 2010). As higher education changes to incorporate the use of online education, we may need administrator and teacher training.

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