

THE CHALLENGES OF DIGITAL EDUCATION IN THE INFORMATION AGE

A. A. Adams

Abstract

Digital technology has already created significant change in Higher Education (HE) over the last thirty years. The changes in the technological infrastructure are still increasing their pace, however, and the organisational structures of HE institutions may struggle to cope with the changing demands of students, employers, governments and their own staff. Alterations in the very minds of their students now growing up in a ubiquitously computational and networked world, the demise of the possibility of the closed book examination (and anyway its increasing irrelevance to the needs of both the individual as persona and as worker) and the rise of MOOCs (and other OPEN Educational Resources) pose significant challenges to a sector which has grown enormously in the space of just one or two generations and which is still struggling in many ways to cope with a shift to mass rather than elite higher educational practises.

Keywords

Higher Education, Digital Education, MOOCs

1. Introduction: The State of Higher Education (HE)

Digital technology has created significant disruption in many areas of life. Like previous technological changes, it has undermined or even destroyed certain things while opening up new possibilities for work, leisure, education and love. Content producers and distributors in text, graphic and audio-visual fields have been subjected to significant disruption of their ways of working and their revenue streams. Until recently, Higher Education (HE) has so far seen only the foothills of this disruption, with a gradual evolution towards electronic provision of learning materials, an exploration of enhanced learner-learner communications and learner-educator communications, development of interactive computer-aided learning materials, and computer-aided production of academic assessment work which is then graded by an educator. The scale and pace of disruption appears to be approaching the threshold of the ability of the higher education system to absorb these disruptions in a calm evolutionary manner, however, with some particular areas of concern emerging: the validity of qualifications based upon assessment methods which can no longer be relied upon to be the actual student's own activity; the cost of in-person tuition for a mass HE system outstripping the financial benefits available for a significant proportion of the graduates combined with a tendency to place more of the burden of payment onto the graduate instead of being funded by general taxation; the emergence of massively open online courses provided by institutions with the best reputations potentially undermining the *raison d'être* of schools with lower reputations.

Within the space of two generations HE has, in the developed world, shifted from being the privilege of the elite to a mass system, although in most countries still a minority pursuit (just under half in the US and the UK, for example, but over half in Canada, Japan and Korea – source: OECD (2012), all tertiary education which includes further education as well as HE). In contrast, the developing world has generally seen very limited expansion. This expansion has often, though not always or everywhere, included a shift of the burden of funding from the state to the individual, and has also seen a rise in for-profit HE institutions.

OECD (2012) reported that between 2000 and 2009, spending in the vast majority (18 of 25) of OECD countries on higher education shifted from society to the individual. Williams (2012) provides clear evidence that in the US state of California this shift was primarily a result of the 2007 financial crisis and the resulting drop in state support for higher education. The UK's coalition government has justified its shift of the burden of the costs of HE (according to OECD (2012) now one of the highest in the group at 70% individual) by appealing to the need for public spending austerity, although this

argument has been challenged by many on the grounds that no actual savings on current expenditure by the government will be seen for more than five years (if ever, since any reductions in public expenditure actually depend on the level of repayment of the new loans which are in turn dependent on average graduate salaries).

The emergence of affordable individual computer technology in the 80s and the growth of computer networking in the 90s Presented significant challenges to universities in both financial resources and staff capabilities, as well as providing a new set of subjects and topics for teaching and research.. As McCluskey & Winter (2012) report, the emergence of data analysis tools also applied to universities themselves and in some places this has been put to excellent use to identify students at risk of dropping out and provide them with extra support or encouragement (including warnings about lack of engagement leading to failure) and to identify good and poor pedagogical practices, hopefully replacing the latter with the former over time. In other institutions and at other times, however, this data analysis has been used by a growing managerial class to undermine academic freedom (individually and across the board in teaching and in research). The emergence of broadband Internet as a core communication technology (and the more recent development of mobile broadband Internet and the highly mobile mini-computers disingenuously called smart-phones) may well be the straws that break the camel's back in forcing a revolution on universities already struggling to evolve with the implications of prior changes in technology and society.

First, the relationships between learning, training, education, qualification and employment are presented. As universities in the developed world have seen enrolments massively increase (usually, though not always for every institution as well as across each country's sector) and in turn the roles their graduates will undertake have diversified (including many which did not exist a generation ago) universities have been pressured to become more focussed on graduate job skills and employability than on pure intellectual enquiry.

Next, the evolution of the role of educators and librarians is examined to consider their change from providers of scarce information to guides to finding and using the right information from amongst the abundance available.

Third, the question of assessment and qualifications is considered, and in particular the difficulties presented by external pressures on qualification versus the educational utility of assessment and the validity of assessments for qualification in an age where isolated examination is impossible, technology for cheating appears ascendant over technology for detection and the extrinsic benefits of qualification appear to students to outweigh the intrinsic benefits of gaining a real education.

Finally, the structure of higher education and its relationship to social justice, employment and personal fulfilment is considered, alongside the possibilities for existing and new approaches and institutions to co-exist and for both to thrive. The likelihood of a significant number of institutional collapses (already seen in Korea and beginning to appear in Japan) and the consequences of allowing such failures to emerge instead of being managed are also presented.

This paper focusses entirely on the issue of Higher Education. The research and other activities of HE institutions, sometimes equally effected by digital technology (for example the debate about open access to the scholarly and scientific literature) are not addressed.

2. The Multiple Facets of the Idea of a University

Universities are seen by many different stakeholders in education as having a wide variety of purposes and ideal mechanisms. Governments may see universities as threats to the social order (many revolutions in the twentieth century have featured or even been started by students) but may also see them as mechanisms to directly hold down youth unemployment figures while improving the employability of their graduates and therefore as indirect wealth generators. Government also typically expect universities to engage with the broader economy in multiple ways, from creating spin-off companies and licensing inventions to training the next generation of knowledge workers (including the vast majority of civil servants, medics, nurses, engineers, social workers, lawyers etc.). Students may see university as simply the next stage in their schooling, as the expected standard

pathway where for some groups a university education is seen as an expectation rather than simply an option.

McCluskey & Winter (2012) give a highly US-centric treatment of many of the themes of this article. Their conception of the digital university draws many lessons from their experience of both non-profit and for-profit HE in the US, and is at times quite insightful about some of the challenges of, for example, digital data about student outcomes from courses and how they are used (or ignored) in various types of institution and by various stakeholders (students, academics, politicians, parents of students, alumni, employers, civil servants). However, their conception of curriculum design is rooted in US liberal arts, and is so far removed from UK practices of deep single-subject degree courses as to be of little use as a map for evolution of their approaches. They also dismiss the issue of increasing plagiarism, contract cheating and assessed work-sharing amongst students

The concept of a higher education as an end in itself and as a preparation for gainful employment (and whether such employment should make direct or only indirect use of the specific skills of a degree course) have exercised academics and politicians since at least the 1850s (Newman, 1852). These days many employers regard a degree as simply a shibboleth to ensure certain general character traits (Attwood, 2010). Others such as providers of medical care, however, rely strongly upon the training of their recruits as proof of their basic competence in areas with potentially life-and-death consequences for failure.

3. Educators and Librarians: From Information Scarcity to Information Abundance

In regards to their role in teaching, universities by the mid-twentieth century acted as both keepers of knowledge and conduits to access it. This knowledge was held primarily in two forms: the written records kept in libraries and the expertise kept in the heads of its staff (both academics and librarians). Access to the libraries was and is sometimes partly or mostly open to members of the public, primarily in person but also through the inter-library loan (ILL) scheme (Chudnov, 2001) where holdings in other libraries may be accessed via a local one (usually for a fee and including one or both of a loan of a physical object or a no-return-expected photocopy). Access to both local and remote (ILL) holdings varied depending on the policy of the library: some material, particularly physically fragile materials, could only be accessed by a select few even within the University. At the other end of the scale some university libraries would offer limited borrowing rights to local citizens, and in-person use of some resources by anyone (unless they had previously been personally banned). In addition to the materials, the knowledge of librarians about what material they had (partly itself held as accessible meta-data first in the form of card catalogues and then electronically in databases and partly as the skills of librarians) represented another significant resource. From 1967, university (and other) libraries around the world began cooperating in making their digital catalogues jointly interoperable through the WorldCat run by the non-profit Open Computer Library Centre, Incorporated (WorldCat, n.d.). Access to the expertise of library staff is often restricted to, or prioritised for, members of the university (staff and students). Academic staff expertise lies partly in knowing where to find specific knowledge, a shared expertise with library staff. In addition, academic staff also have (or are supposed to have) other forms of skills in applying knowledge and have the ability to impart those skills to students. The form of that knowledge varies radically between disciplines, though Bloom *et al.* (1956) presented a taxonomy of academic skill types which provides a useful categorisation, including concepts such as application (applying a method to a well-stated problem), synthesis (creating a new method from combinations of others) and evaluation (judging the appropriateness of a method for solving a problem or a solution to a problem emerging from the application of a method). Students attending a university became (very junior) members of that university and in doing so gained an opportunity to use the resources made available to them, including the library, the expertise of the librarians and the proffered teaching of the academic staff. This teaching includes a variety of elements, with variation depending on the subject as well as on the approach of the university but includes:

- lectures: primarily one-to-many delivery of information in audio form with some visual assistance;
- educator-created explanatory material (primarily text and visual material);
- educator-selected explanatory material;
- meta-data pointing to recommended sources for specific information;
- seminars: interaction audio exchange of information between lecturers and students often including formal peer learning between students, i.e. one-to-many and many-to-many interactive learning with guidance from the educator;
- exercises in applying the skills of the course;
- grading of student-completed exercises;
- feedback on student-completed exercises.

Howard-Jones (2009) and Small *et al.* (2009) , among many others present compelling evidence that in both teenagers and older adults (and almost certainly all other ages as well) there are significant general brain changes associated with significant use of the Internet. Cull (2011), among other issues, summarises recent research on the impact of online sources of information on the reading habits of “researchers” (everyone from undergraduates to professors seeking information from written sources). This research points to developing habits in all ages and levels of research-reader to skim material rather than read in depth and to follow “horizontal” searching techniques (looking for breadth of coverage) instead of “vertical” (reading a sequence of articles in depth to follow the development of an idea through argument, counter-argument and supporting material). There are regular complaints by academics in the columns of the self-reflective magazines¹ for HE such as the Times Higher Education Magazine and the Chronicle of Higher Education that modern students are unwilling or even unable to approach reading lists of the size and complexity of yesteryear (Brabazon, 2011), that they will reference a Wikipedia article rather than the primary research that Wikipedia itself claims as it's justificatory sources (Grove, 2012), see Wikipedia's own self-reflective articles):

- Notability: en.wikipedia.org/wiki/Wikipedia:Notability
- Verifiability: en.wikipedia.org/wiki/Wikipedia:Verifiability
- No Original Research: en.wikipedia.org/wiki/Wikipedia:No_original_research
- What Wikipedia is Not: en.wikipedia.org/wiki/Wikipedia:What_Wikipedia_is_not

and similar complaints about the information-seeking and interpretation habits of modern students. Not all academics are equally dismissive of these new approaches, as Grove (2011) reported, with some academics seeking to embrace Wikipedia as a useful academic resource (but seeking to put it in a suitably academic context for the students).

The pace of change introduced by the shift from 1990 where few subjects other than computer science and high energy physics had electronic versions of scholarly articles at all, to 2013 where there is so much information that the dominant skill is seeing the trees amongst the wood rather than seeing the wood made up from the trees. This is less than one generation and today's academic workforce is primarily still made up of those for whom their primary information tasks as students themselves, and in their academic training beyond, were about deep digestion of the smaller number of relevant pieces available. Their students are more used to an abundance of information and their strategies are primarily about keeping the time spent internalising the information to a minimum and building an internal index link to where to find it.

It is becoming increasingly unclear as to whether the ingrained practices of traditional HE noted above can still fit the needs of modern learners as learners or fit them for the workplace they will find upon graduation (if they even graduate). On the other hand, the new models of online HE (including massive open online courses [MOOCs], for-profit online colleges and distance education courses in developing countries (Liyanagunawardena, 2012)) are emerging very quickly, but evaluation of their quality and validity for learners seeking education and qualification, for employers seeking filters for

recruitment, for governments seeking qualification for licensed occupations, is difficult because of their newness and the still fast pace of change within them.

4. Education, Qualification and Assessment

As previously presented (Adams, 2011) the new technologies of mobile, networked and (soon) wearable computing are challenging many of the assumptions about how educational progress can be assessed. The Internet, just as it allows a seller of an obscure item to find a buyer perhaps half the world away, or sharers of obscure interests to find enough others to form a vibrant network, puts unscrupulous students together with unscrupulous brokers and providers of bespoke coursework completion services. Everything from essays to computer programs and even entire Masters dissertations are offered for bespoke cheating, though as with many areas of a grey economy the claimed and actual quality of such purchased material may or may not match up to its claims (Baty, 2005). Such issues gave weight to those critical of coursework heavy assessments who claimed that unseen exams were the gold standard and should be used as the primary, perhaps only, standard assessment format. However, mobile networked computers have already shown that such exams can no longer be assumed to be taking place in an isolated situation (Yomiuri Shimbun, 2011). Given the changes in neural development that the abundance of information and the ubiquity of networked information technology are creating, it is also becoming doubtful whether such artificial test conditions are actually relevant to the purposes of the assessment anyway. No serious programmer develops computer code by trying to write it out longhand on paper. Instead they make full use of integrated development environments with help files, syntax checkers, library browsers and many other tools to help them, including access to their own prior work and sample code from others. Software engineering indeed teaches about the benefits of code re-use as a core element of its curriculum. Working lawyers and legal researchers do not rely on their brains to remember all the details of statute law or precedential decision. Instead, they used to rely on printed texts and indexes, but now rely heavily on database searches in free (legal information institutes) or subscription (such as LexisNexis) systems. Employers also constantly stress that in general they are more interested in team players than lone wolves as recruits, so requiring students to sit exams in isolation from their peers also seems unrelated to their likely workplace.

On the other hand the benefits of qualifying for a degree are substantial in terms of access to careers which are either or both financially and intellectually rewarding. It is the individual financial rewards in particular that have underpinned the justification from HE institutions raising tuition fees in the US and from governments shifting the cost of tuition from society onto students in Australia and the UK.

In a world where it is practically impossible to distinguish the work of a skilled fraudster from a dedicated student, particularly in the middle-rank, in assessments, it was suggested in (Adams, 2011) that universities must focus instead back on offering an education, in which the purpose of formative assessments remains as it always has been (focussed on developing the skills of students by practising the skills of the discipline) while summative assessments are used to inform students and educators of students' suitability to progress to the next stage, not in a sense of a barrier to progression but in the sense that without the underlying skills of pre-requisites further advanced education is generally inaccessible to the student. However, digital technology has recently thrown a further curveball into this mix in the shape of MOOCs.

Since MIT announced their OpenCourseWare (OCW) project in 2001 (Goldberg, 2001), there has been significant attention paid to questions of Open Educational Resources where educators and experts (and sometimes crackpots and incompetents) make learning material available online for free, usually under a permissive copyright license (frequently some version of Creative Commons). In 2007, the University of Manitoba announced that from 2008 it would be offering a course designed to be taken online by large numbers of students. Registration and engagement in the course would be free, although it would not carry academic credits and assessment of any assigned work would be carried out only where feasible to be done automatically by computer or voluntarily by fellow students. Since that announcement, the concept of MOOCs has somewhat exploded and to some extent eclipsed the OCW approach. Unlike OCW material, MOOCs are typically offered without copy

and reuse rights – students signing up for the course have no more rights to the material than students ever do to the learning materials they are provided in a normal educational setting: they may make use of them for their own learning but not pass them to others, nor reuse them as the platform for becoming educators themselves.

Something of a bandwagon emerged in 2011 with the launch of MOOCs by institutions such as Stanford University. In 2012 two competing platforms and organisational bodies to support MOOCs were launched in the US: Coursera based at Stanford and EdX (originally called MITx but renamed when Harvard joined as co-sponsor). Coursera is a for-profit organisation and EdX a non-profit. The UK's Open University, which had already entered the OCW field with OpenLearn in 2006, launched a UK-based MOOCs platform and organisation (as a wholly-owned for-profit subsidiary of the non-profit Open University) in 2013. One UK universities had already signed up to run MOOCs on Coursera, and both Coursera and EdX have other European and Asian partners, although as of writing FutureLearn included only UK partners.

So far, MOOCs have been successful in attracting students to register, but have struggled in getting students to complete the course. They have also struggled to identify clear business models for funding their ongoing operations, though some are moving towards fees for credit-bearing registration such as the University of Texas system (Matthews, 2012). The Open University's Vice-Chancellor Martin Bean described MOOCs in 2012 as a potential “Napster moment” for higher education (Corbyn, 2012). In combination with the doubts raised by ubiquitous networked communications and mobile computing/communications devices detailed above, this prediction seems persuasive. Despite prophecies of doom due to Napster and its successor sharing sites, the recorded music business has not collapsed (in fact such predictions have been rife for decades, such as the “Home Taping is Killing Music” campaign of the 70s) although their profits have been cut and some major music recording companies have been through tough times. It is likely that HE would see similar results to a Napster moment. Cosy expectations that the future will be very much like the past may be rudely shown false. In the resulting disruption, it is likely that both positive and negative consequences for society will emerge.

5. Higher Education, Privilege and Social Justice

Is education a privilege or a right? The Universal Declaration of Human Rights has it as a right and suggest that it should be free (i.e. zero cost, although only requiring that it be free at the elementary level the suggestion is that it should be funded by society not the individual learner).

Article 26.

- (1) Everyone has the right to education. Education shall be free, at least in the elementary and fundamental stages. Elementary education shall be compulsory. Technical and professional education shall be made generally available and higher education shall be equally accessible to all on the basis of merit.

Once one has achieved a certain level of education, however, this is sometimes regarded as creating privilege, even amongst those of otherwise oppressed groups (in Europe and the US: female, race other than white, homosexual or bisexual, etc.). This is not an uncontroversial view. What is close to undeniable is that a higher education is more easily and freely available to those with other privileged states in their society (males, white people, able bodied people, heterosexuals) and that this is one of the reasons for continued dominance and perpetuation of privilege by and for those groups. What changes might the disruptions to HE systems detailed above make in this privileged and privileging system?

Rising university tuition fees in the US (in all sectors – public, private non-profit and private for-profit) and the shift to loan-based systems in the UK and Australia are claimed to reduce the possibility of university education for those from the lowest socio-economic groups. However, HEPI in the UK found no significant evidence of a drop in the number of young people from such backgrounds when the fees payable by students jumped from around £3.5k to £9k between 2011 and 2012 (Thompson and Bekhradnia, 2012), nor did it find an impact on course choice or university

location choice (i.e. whether to attend only a local university and continue living with parents or move to a university further away). This perhaps reflects a success of the UK government's work in stressing the income-contingency repayment nature of the UK student tuition loan system, where repayments are only due beyond an income threshold higher than the parental income of the students concerned. Although recent changes in funding regime in the UK have had no apparent negative impact on the HE opportunities of those from lower socio-economic backgrounds, there remains a significant divide in both participation at all, and in the prestige of the institution attended, likelihood of completion of course, depending on socio-economic class measures (see the website of the Higher Education Statistics Agency [HESA]: www.hesa.ac.uk for detailed figures). In the US, there are similar concerns, particularly over the rising costs to students of full first degrees at both state and private HE institutions.

The fees and the privileges that attendance at high prestige institutions brings may or may not survive the Napster moment of MOOCs

6. Conclusions

If cheating on educational assessments becomes rife, as seems possible, then HE institutions face problems at both ends of their system. If they cannot rely on exam results at the end of school (A-levels in the UK, SATs in the US, entrance examinations in Japan) then institutions which seek to admit students with high ability will find it difficult, or perhaps impossible, to distinguish the students they are seeking. In addition, such cheating will also most probably undermine the confidence of employers in valuing the educational assessments of universities, removing the financial benefit of having the degree qualification. Employers will instead be forced to find other ways of recruiting staff with the skills they need, evaluating them on-the-job. Even employers may find it difficult to ensure that their employees actually have the skills they claim, as demonstrated by the recent story of a Verizon worker who had successfully outsourced his own computer programming job to China for several years, and been regularly evaluated as one of their top coders (Kim, 2013). He was only caught due to irregular Internet access usage being noted by the firm's security staff (having given direct access to the company's VPN to his contractors).

At the same time as their qualification processes are being undermined, universities are faced with competition for their educational services from free online offerings of MOOCs, using peer learning as a core replacement for teacher/learner interaction within a course designed by an academic at a high brand university. If businesses come to accept the undertaking of such courses as sufficient to warrant access through the initial recruitment filters, then mid-level universities and perhaps local community colleges may well suffer from sufficient loss of enrolment to undermine their institutional existence. The benefits of in-person contact with the academics, and other factors such as endowment funding which in some cases negates the necessity of charging fees to students at all and can in many other cases reduce fees sufficiently to allow institutional continuity, are likely to see the high prestige universities survive and continue to offer their expertise via MOOCs. The economies of scale they thus achieve might even allow them to charge sufficiently modest fees for enrolment and even some form of limited "qualification" that their place is assured. Other institutions may not fare so well and with no deep pocket of endowments, no the prestige to tap governments for subsidies and no prestige to attract large numbers of students to their MOOCs, from whom a percentage might pay for the rest, they may be facing a bleak future.

HE is in for some interesting times over the next two decades as networked communication infrastructures expand via Moore's Law and overtake the information guardianship of academics in teaching and librarianship.

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