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Education

Wednesday July 17 2013

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Technology is the key to teaching future skills

The world of education is on the brink of a digital revolution potentially as disruptive as that in media and finance, writes *Paul Taylor*

ILLUSTRATION: ØIVIND HOVLAND

When Barack Obama, the US president, last month announced a scheme to equip 99 per cent of pupils in state-run schools with improved broadband connectivity in an effort to boost educational attainment, he was underlining the fact that future generations need advanced technological skills to survive and prosper in the 21st century.

Such a focus ensures the business of IT in education is a concern of global proportions, but speedy internet connections are not the only requirement.

Many argue that education systems around the world are failing students, employers and society. The challenges include updating curriculums – which some feel do not meet the knowledge needs of young people – and low graduation and high dropout rates in many countries. In the US, for example, 46 per cent of college students fail to graduate within six years and teachers simply do not have the time to personalise the education experience and engage them more.

Employers are also worried. In a survey by the US-based Chronicle of Higher Education, half of respondents said they had trouble finding recent graduates qualified to fill positions – conclusions that have been echoed in surveys from around the world.

John Baker, chief executive of Desire2Learn, a provider of cloud-based learning tools, says: "While technology has been leveraged to automate simple tasks and for management productivity, it has not tackled the bigger issues of creating an engaging learning experience, improving overall outcomes and reducing dropout rates.

"Globally, we need to make the shift from a one-size-fits-all approach to education to learning systems that are intelligent, mobile, engaging and, most important of all, personal," he adds.

Mr Baker's experience is an

> 'Schools need much more sophisticated tools to empower teachers to improve their instruction'

example of how powerful digital learning can be. He formed his company in 1999 after identifying his own need for online learning while studying systems design engineering in Canada.

He is among an expanding group of entrepreneurs who believe that technology holds the key to resolving many of the problems facing education providers and institutions. They argue that education is on the brink of a digital revolution – one potentially as far reaching and disruptive as that which has already swept through other sectors such as media, entertainment and financial services.

The obvious signs of this revolution are the laptops, tablets and digital whiteboards widely available in lecture halls and classrooms in developed countries. The real innovation,

however, is in the software and delivery of education services, and in the analytical tools that underpin it.

Chris Davia, chief technology officer of online education company Connect-EDU, says. "Schools need much more sophisticated tools than many use today to empower teachers to improve their instruction.

"As big data and predictive analytics technologies edge their way into [state-run] schools, administrators, teachers, parents and even students will be able to use data to evaluate better the progress and needs of learners," he says.

Mr Davia and others say digitisation has the potential not just to democratise learning – providing low-cost,

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Coalition curriculum is a death knell for UK youth

Opinion
STEPHEN HEPPELL

Two years ago in Hong Kong, Kenneth Chen, the undersecretary of state for education, told school leaders the territory would not remain top of global science teaching tables "by continuing to teach science in the old ways".

He urged educationalists to "move away from a focus on content knowledge" and to embrace the concept of "learning to learn" that he had placed at the heart of education reforms. Technology was crucial to achieving that ambition.

A decade earlier in Singapore, Teo Chee Hean, the state's then minister for education, summed up an ambitious research project by saying "the pace of change of new technology is more rapid than the typical time line for educational research studies . . . Teachers need

to . . . produce and publish research findings on a more rapid cycle so that other teachers can build on their experiences, learn from them and implement these improvements in their own classrooms."

By 2012, looking back on past reforms, Heng Swee Keat, Singapore's current minister for education, noted today's focus on "developing a broader range of skills such as critical thinking and creativity, and to devolving more autonomy to our schools to encourage innovation".

Although it is not the only factor in these states' economic success, this pedagogic approach seems to be working. Between 2007 and 2013 the annual growth of Singapore's GDP averaged about 4.5 per cent while Hong Kong's GDP is growing at close to 3 per cent each year. The UK's GDP, by contrast, is forecast to grow at 0.9 per cent this year.

A key factor is that these economies view education as an investment, while in much of Europe and the US it is seen as a cost. In return for this investment, Singapore and Hong Kong want more than kids who can recall a finite set of facts. They want collaborative ingenuity.

Unsurprisingly, the OECD's Programme for International Student Assessment, an educational survey, following criticism of its own measures of educational success, has noted Singapore's focus on equipping "students with critical competencies, such as self-directed learning and collaboration skills". It will be introducing collaborative problem-solving as an international measure of educational effectiveness from 2015.

How well might English children perform on such tests? In England when a fact-based English history curriculum was announced, Richard III's skeleton was found

this has given us a huge diversity of school types, from free schools to studio schools, from university technical colleges to academy clusters, and a diverse pool of teachers, precisely what is needed to provide the "vibrant learning communities where exploration and experimentation are integral" spoken of by Mr

Heng. But while school diversity is necessary, it is not in itself sufficient and, rather less encouragingly, the other half of this bold experiment involves pupils learning content.

It was ironic that, in a month when a fact-based English history curriculum was announced, Richard III's skeleton was found

under a car park in Leicester. As English schoolchildren were being told of the irrevocable supremacy of their history books, archeologists were saying "we will have to rewrite the text books".

Oh dear. Focusing on content is a common economic mistake. In the 20th century, in parallel with the expensive misunderstandings of the dotcom bubble, education-based companies thought their market would be content delivery. Surely, content was king and delivery equalled dollars? The answers were it wasn't and it didn't.

In a world awash with content, much of it free, ingenuity and creativity were increasingly scarce and valued commodities.

However, will English schoolchildren, newly returned to rote learning, sitting down to an exam paper and hoping there are no surprises, be ready for

the continuing uncertainty and the constant surprises that characterise our current economic circumstances?

This concentration on being able to repeat facts rather than learning how to critique and apply knowledge feels reckless.

In a world that has witnessed the collapse of unskilled clerical jobs, filling our schools with unskilled clerical tasks is not likely to offer a positive outcome for tomorrow's youth in terms of educational or economic returns.

At this stage in the world's race for economic survival, the UK coalition's educational focus on uncritical content is starting to look like a suicide note.

The writer advises governments and organisations around the world on large education and other IT projects.

Universities go high-tech to cut dropout rates

Higher education
Jessica Twentyman on ways to help keep students engaged

Academic administrators worldwide are asking if technology can help keep learners on track as they grapple with the question of why students leave higher education without graduating.

In the US, almost half all four-year college students fail to earn a degree within five years, while in the UK about one in five students do not complete their studies. In Australia, about 20 per cent quit in their first year.

That is bad for students and institutions. Ruth Drysdale, e-learning programme manager at Jisc, a UK-based charity that advises the education sector on digital technologies, says: "Low retention rates not only reflect a negative picture of the student experience, but institutions affected are liable to lose valuable government funding."

While the reasons why students drop out vary widely, financial considerations are perhaps the biggest cause, as rising tuition fees and debts, coupled with uncertain post-graduation job prospects, lead many students to question the value of university.

Such problems point to a need for technologies that help students to pick the right courses and that allow them to study in the way that best suits them, so they get the most out of their time and money.

As a result, the market for IT in higher education has coalesced around two big themes: monitoring students' activities and achievements using business intelligence-style applications and extending the classroom experience beyond the lecture hall or seminar room.

At Arizona State University (ASU), for example, student retention rates have risen above national averages for public universities in recent years. Staff say much of the credit for that goes to the university's online student advisory system, eAdvisor.

Introduced in 2007, it was designed to "take the guesswork out of earning a degree", by mapping out for each student the compulsory courses they are required to take to graduate in a specific academic major, as well as the elective courses by which they can earn extra credits. This lets them track their progress towards their degrees, while their supervisors can use the data to monitor and advise them, as well as letting them identify students at risk of dropping out.

ASU, the US's largest public university with a student body of some 72,000, has almost 9,000

students enrolled in more than 60 undergraduate and graduate programmes that are made available entirely online through what is called a virtual learning environment, ASU Online.

ASU's use of technology is unusual compared with other public universities in the US, says Rachel Fishman, an education policy analyst at US think-tank The New America Foundation. She says it is one of only a handful of "next-generation universities" (along with University of Central Florida, Georgia State University and University of Texas) that use technology to help large and increasingly diverse student populations stick with their studies.

"The main reasons for low uptake [of such technologies] are generally cost and the challenges of getting faculty buy-in," she says. "Recent cuts in state funding have made getting the IT infrastructure in place almost impossible for some. And faculty buy-in remains a difficulty, as some academics don't feel that online education offers the same high quality as face-to-face."

Funding is also an issue in the UK. However, in the past three years, Manchester Metropolitan University has used technology to revamp its curriculum design and delivery, based on student feedback, and introduced a programme called Enhancing Quality and Assessment for Learning, which was funded by Jisc.

This incorporates a virtual learning environment, Moodle, that lets students access personalised information

'Institutions with low retention rates are liable to lose government funding'

on timetables, deadlines, reading lists and course materials via laptops and mobile devices. It also allows them to see what courses they have taken and what they achieved, as well as making their next steps and module options clearer to them.

As of May, Moodle was receiving about 450,000 visits a day from 30,000 individual users.

It also provides staff with real-time student monitoring capabilities that provide reports on student engagement with Moodle, so that they are made aware if someone has not downloaded essential reading material, for example.

It is too early to say whether this will affect retention over the long term, says Jisc's Ms Drysdale, but it is this kind of active engagement on both sides of the faculty/student equation that may help to keep students on track.

India struggles with logistics of IT provision nationwide

Asia State governments are trying to promote the use of technology in education, but there are many obstacles, reports *Amy Kazmin*

Access for all: a class in Delhi run by charity group No Child In Trash
Suzanne Lee

The computer room at New Delhi's Lady Irwin primary school – a state-run establishment with 1,400 students – contains 14 desktop computers used to familiarise pupils aged between nine and 11 with digital technology.

The questions "What is an operating system?", "What is a desktop?" and "What is an icon?" are written neatly on a chalkboard above the machines, which are not connected to the internet. Students practise using Microsoft Excel and Word, and graphics programs. "The kids love to draw and paint on the computer – and play games such as *Angry Birds*," says Radhika Bist, a computer teacher.

Lady Irwin's lessons reflect India's fumbling but eager embrace of digital technology in education, as schools grapple with how to integrate computers into the curriculum and try to bridge the country's vast digital divide.

"Earlier, the question was 'Should computers be brought into the schools?'," says Ashutosh Chadha, head of corporate affairs for south Asia at Intel, the technology company. "Now we know that computers should be brought into schools, but for what, and how? What we still need to crack is the 'how'?"

Access to computers and digital learning materials in the classroom – and the way these are used – depend heavily on students' economic status, and the type of school they attend.

Many private schools are investing in advanced digital education systems to enliven classes with interactive learning materials. Technopak Advisors, a consultancy, estimates that between 80,000 and 100,000 of India's 260,000 private schools have invested in some form of classroom technology.

Companies such as Educomp, NIIT, Core Education & Technologies and Pearson, which owns the Financial Times, are promoting digital education systems. Wiring up a single class can cost about Rs200,000 ($3,300), but companies are often willing to bear the initial installation costs, then charge monthly user fees per student.

Technopak estimates India's market for digital learning systems at about $500m a year, although the competition for orders is fierce, and private schools in smaller cities are among some of the biggest customers.

"Second and third-tier cities are where there is a lot of action," says Enayet Kabir, the head of Technopak's education division. "Parents there realise their children will not

have a location advantage, compared with children who live in the bigger cities, but there is a desire to give them a high-quality education."

State governments are also trying to promote the use of computers in their schools, but efforts vary widely, from teaching basic computer literacy to using digital technology to enhance learning in every subject. Many such initiatives are still in development, leaving hundreds of millions of students with no access at all.

Haryana, in northern India, has computer labs in more than 2,600 secondary schools to teach basic computing, and has a $50m project to give five schools full digital learning systems.

In the southwest, in Karnataka, whose capital Bangalore is a hub of India's information technology industry, state authorities are trying to establish computer-aided learning centres in every state school: with five computers and CDs with educational material in local languages. So far, about 20 per cent have been received their equipment.

The many obstacles include the lack of internet connections, trained teachers and even people to set up the machines. In some state schools, administrators are so terrified that

the computers will be damaged, they are never taken out of their boxes.

In 2011, the Indian government announced what was supposed to be a groundbreaking scheme to provide highly subsidised, education-focused tablet computers to university students. The Aakash, produced by Datawind, was touted as the world's cheapest tablet, selling at just $35. But so far, the government has ordered just 100,000 and the devices have been plagued by quality issues.

Meanwhile, the government of Uttar Pradesh has begun handing out free notebook computers to those graduating from state high schools and enrolling in higher education, fulfilling a campaign promise of Akhilesh Yadav, the chief minister. Hewlett-Packard has won a $515m order to supply 1.5m computers for the giveaway over a seven-month period.

But Intel's Mr Chadha says policy makers need to move beyond just giving out devices. "It's not just about providing devices in a classroom or in the hands of students," he says. "Are you providing connectivity? Do you have local content available to them? And are the teachers trained? All of these are important to help bridge the digital divide."

Critics sceptical of Argentina's efforts to bridge the digital divide

Latin America
Jude Webber looks at a scheme to issue computers to pupils that aims to close the equality gap

The lesson is, ironically, on new technologies, but only six of the fourth-grade students in the scruffy room in secondary school No. 24 in La Plata, near Buenos Aires have brought their state-issued netbooks.

Two boys sit glued to their screens in silence. Two pupils share a laptop and a set of earphones. Half a dozen others cluster around desks where there are two netbooks, but only their owners look at them.

One girl blows bubblegum and plays with her phone, another rests her head on the desk, eyes closed.

It is a far cry from some private schools in Mexico, at the other end of Latin America, where iPads are used as teaching tools, or from interactive whiteboards common in the UK and US. Romina Giddings, a former primary teacher who has also worked in the UK, quit after moving to Buenos Aires over what she calls Argentina's antiquated system. "Can you believe that in 2013, we still use blackboards?" she says.

In an attempt to close the digital gap in Latin America's third-biggest country and guarantee computer literacy for a new generation, the government launched Connecting Equality in 2010, a programme to give a netbook to all students in state secondary schools.

It is the biggest programme of its kind in the world, in terms of netbooks handed out, says Silvina Gvirtz, the programme's executive direc-

tor. Three million had been handed out by early July and the scheme is likely to have cost $3.5m by the year's end. She declines to put a figure on the programme's total cost, but it has been avidly promoted by Cristina Fernández, the president, who says Argentina spent 2 per cent of GDP on education in 2003, when her late husband was elected president.

Now it spends 6.5 per cent. "Netbooks aren't the only thing needed," Ms Gvirtz says. "But without them, reducing the digital gap is impossible."

Although 163 of the 183 students at School No. 24 were given their netbooks in early June, some have been locked out because of account inactivity and at least one is broken. But Malvina Castillo, the head, says pupils are more attentive and better behaved.

The netbooks come with books, educational content,

some games, and connect to an intranet. "They can't use Facebook or connect to the internet. This limits the distractions," smiles teacher Elian Tesoriero.

The social challenges of digital access that Connecting Equality seeks to

'Netbooks aren't the only thing needed, but without them reducing the digital gap is impossible'

address are illustrated by the fact that the primary school in the same building in the rundown neighbourhood on the outskirts of La Plata has a canteen serving breakfast, lunch and tea to ensure its pupils – many from poor or abusive back-

grounds – get enough food.

Primary schools are not covered by the programme, though in Buenos Aires and some provinces there are local schemes. At this school in La Plata, primary students have not yet received netbooks.

Claudia Nieto, whose sons attend Carlos Pellegrini, one of Argentina's most prestigious state high schools, says the programme is not focused enough. "Since they are given to all kids at Pellegrini, regardless of the family's ability to buy a laptop, I would say more than half of the computers given out are never going to make any real difference since the families probably already have at least one other computer at home," she says.

Other Latin American countries have introduced such programmes. Uruguay blazed the trail with its Plan Ceibal, initially targeted at primary pupils,

and the country has offered Mexico assistance with a similar scheme. Brazil and Peru are among the countries that already have limited programmes or are looking to expand them.

But Fabio Tarasow, co-ordinator of the education and new technologies programme at the Latin American Social Sciences Institute in Argentina, doubts their efficacy. "I don't think Connecting Equality will improve the quality of secondary education or Argentina's Pisa scores," he says, referring to the OECD's three-yearly school standards evaluations.

In the latest, in 2009, Argentina was below Chile, Uruguay, Mexico, Colombia and Brazil for reading, though its scores improved in maths and science.

Ms Castillo says one of the programme's failings is a lack of training for teachers in school time, while Mr Tarasow says teaching in

Cristina Fernández: spending on education has risen

the digital era needs a rethink. "Transformation is not going to happen just because of technology."

For Ms Gvirtz, the programme guarantees rights and social justice and

improves a once vaunted state school system that has been long in decline.

"It's not that Argentine education is marvellous," she says. "But there has been a lot of improvement."

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Online tools can boost chances of employment

Private sector Businesses are co-operating to train tomorrow's workers, writes *Sarah Murray*

Signing on: would-be employees apply for work at a job fair in Jakarta — *Reuters*

Despite alarming global levels of youth unemployment, business investment in education remains inadequate, particularly in developing countries. Just how little the private sector invests emerged at this year's World Economic Forum in Davos.

A paper released by Unesco, the UN cultural agency, found that the combined amount spent by corporations and private foundations on education in developing countries was just $683m a year.

Many people in the corporate sector acknowledge this must change, and not just in developing countries, because, despite the record levels of joblessness among the young, companies often struggle to find qualified candidates to fill their vacancies.

One programme in the Middle East is aiming to start turning the tide. The Jordan Education Initiative, which has support of businesses including Cisco, HP, Microsoft and IBM, uses IT to develop the skills students need to secure jobs. It not only equips schools in the country with computers, but also develops IT-based curriculums and teacher-training software packages.

"As corporate enterprises, we are going to need to do our own re-skilling," says Jeanne Beliveau-Dunn, head of the online learning network at equipment maker Cisco.

The initiative demonstrates that the corporate sector can contribute more than in-house training and education funding – particularly if companies harness their internal capabilities to develop digital teaching methods and online educational content that can potentially be used by millions.

However, since young people lack the most basic of skills. Here, too, technology can help. As part of its charitable Skills To Succeed programme, for example, Accenture, the professional services company, has developed games for teenagers based on its own business simulations.

Users play the role of a character on screen and, as the game proceeds, make choices and receive coaching. Decisions might help them learn how to create a CV or find out what it is like to work in different sectors. Other options are designed to overcome some of the basic obstacles that young people face in finding and keeping a job. "It can be as simple as the fact that they don't dress properly or they don't use deodorants," says Mike Byrne, head of talent and organisation performance for Accenture in the UK and Ireland.

"The richer the content is and the more choices and options people have, the more powerful the learning technique," he says.

Employers are also recognising that the talents and attributes employees require are changing. Assessment & Teaching of 21st Century Skills, a project that brings together governments, schools, academics and industries, has identified four categories of necessary skills, says Anthony Salcito, head of education at Microsoft, one of the project's sponsors.

These are: how students think creatively; how they use tools and data to reach decisions; how they work collaboratively; and how they think about global issues. Technology plays a critical role in developing these skills. This is partly because routine training can be provided digitally, which means more time is available for face-to-face sessions to focus on so-called softer skills – personal traits that enhance a jobseeker's employability, such as developing emotional intelligence.

Mr Salcito says social media and other technologies have expanded learning opportunities.

"Technology enables a level of collaboration that would have been hard to achieve outside a classroom in the past," he says.

Companies are turning to digital forms of education because they often need to train teams that are dispersed across the world and because employees today need constant access to education and training.

"The world is changing so fast, industries are reinventing themselves, and your employees can't sit still," says Ms Beliveau-Dunn.

In the absence of the regular, long-term jobs enjoyed by previous generations, IT training can equip people to start their own businesses, says Chris Coward, co-founder, of the University of Washington Information School's technology and social change group.

He sees potential in hybrid models. "People are learning through online courses, using social media to connect with each other on the course and using Meetup [a website that allows groups with similar interests to arrange meetings] to connect physically," he says.

However, while face-to-face encounters are likely to remain an important part of education, digital training has become a far richer experience than it used to be. Gone are the days when companies simply transferred materials from hard copy to a website.

Today, whether courses are accessed via online video, gaming or social media sites, students and employees can now learn in virtual teams and participate in simulations rather than simply having to absorb information passively.

"Collaboration and video are the breakthrough tools for the next century," says Ms Beliveau-Dunn.

Key to teaching future skills

quality education directly for students wherever they are – but also to tailor learning to the individual needs of students from pre-school age, through school and college and into the workplace.

Underpinning these changes are technologies such as the web and broadband that provide the transport and delivery mechanisms for much of the new content. These include video, to support digital learning, together with social media and other tools that foster collaboration and feedback.

But perhaps the most powerful and transformative tools being applied to education are so-called adaptive learning, pioneered by companies such as New York-based Knewton, and predictive analytics, which turn data into insights that guide decision-making.

Predictive analytics can help teachers forecast student performance more accurately so that lessons can be more easily adapted to specific areas of need, rather than delivering a one-size-fits-all curriculum.

"By using data to evaluate students in real time and applying predictive algorithms, educators can drive more targeted curriculums. This should allow earlier interventions to ensure that students are on track to meet whatever measures of success exist," says ConnectEDU's Mr Davia.

Meanwhile, other technology start-ups, such as Coursera, which was founded by a group of Stanford University graduates to provide the technological underpinnings for massive open online courses, or Moocs, are shaking up the delivery of education in much the same way as the UK's Open University – which effectively provided distance learning via television – did in the 1970s.

So far most Moocs, including those established by Harvard University, Massachusetts Institute of Technology and other top universities, have focused on the higher education market, but that may change. Ten large US public universities and post-secondary systems have decided to join forces with Coursera in an effort to enhance the educational offering and bridge the gap between post-16 and higher education.

David Reynolds, an equity analyst with Jeffries, wrote in a recent note to investors: "While higher education is the focus for now, some partners [are] focusing efforts with Coursera directly at [students aged between five and 18], seeking to improve student readiness for higher education and consequently improve attainment."

Anant Agarwal, a professor of electrical engineering and computer science at MIT and president of edX, and a leading provider of Moocs, told the Financial Times recently: "Online learning is going to be transformative. Traditional education is never going to be the same again. It has already changed."
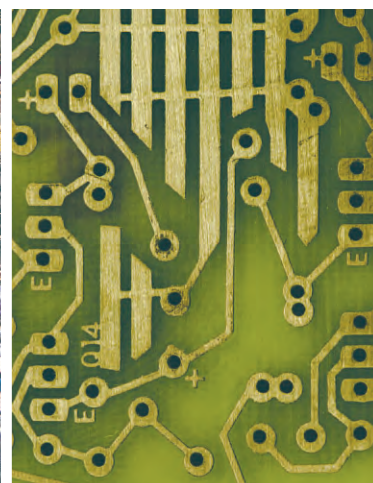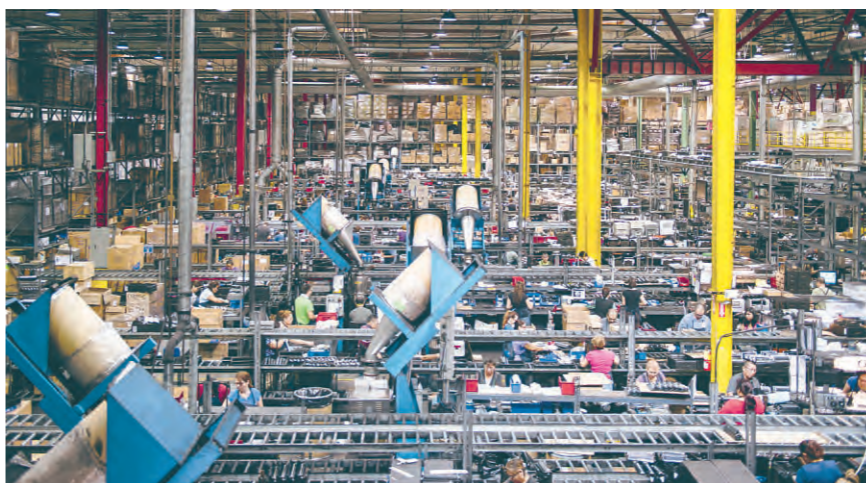
But not all education experts are convinced.

"Cheerful claims that US higher education is undergoing an irresistible change driven by digital technology are unduly optimistic," says the Hudson Institute, a Washington-based research organisation, in a report entitled *Beyond Retrofitting: Innovation in Higher Education.*

The authors, Andrew Kelly and Frederick Hess, accept that technology has the potential to transform higher education just as it has other knowledge-based sectors such as music, journalism and financial services, where new providers have unbundled goods and services, and improved access and convenience while reducing costs.

But they argue that technology does not guarantee innovation and that entrepreneurs must provide this drive.

However, such changes – and not just in higher education – may be slow to be implemented, as they demand the modernisation of educational systems in ways that may prove to be controversial, not least because they are likely to overthrow generations' worth of received wisdom about how and what people need to learn.

Without the backing of those who design curriculums and run institutions around the world, the reforms needed by future generations in order to develop the useful workplace skills of tomorrow could still be a long time coming.

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MBA providers respond to call for specialists to interpret 'big data'

Business schools

Many executives are struggling with the information deluge says *Charlotte Clarke*

Consumer industries are amassing huge data sets, highlighting the importance of choosing the right analytical models to help make commercial decisions.

Analysing data is a straightforward matter for statisticians or engineers, but not for many executives. As a result there is demand for more commercially savvy IT professionals, known as data scientists, and business schools are responding to this call.

Imperial College London recently announced a research partnership with Chinese telecoms company Huawei in July. Backed by the UK government, academic and business experts will work together to develop technologies that utilise "big data" – the term used to describe masses of information harvested from commercial activities, social media and other sources.

Another sign of the times can be seen at University of Oxford Saïd Business School, which has added a big data module to its MBA programme. This is taught through an online platform called "Global Opportunities and Threats: Oxford", and aims to help students learn how to ask questions of the data that will help an organisation to prosper.

"We want Oxford MBAs to be able to apply new business models that will respond creatively to the challenges and opportunities that big data will bring," says Janet Smart, senior research fellow at Saïd, who specialises in systems engineering and programme management.

"When an organisation makes the investment in skills and technical resources, it needs to be able to generate a return on that investment. That will require people who can ask the questions of the data that will lead to the actionable insights."

In the Netherlands, Nyenrode Business Universiteit is trying to bridge the gap between business leaders and cyber knowledge with its Business and IT MBA.

Launched in 2010, the programme now has more than 80 students and is supported by CIONet, Europe's biggest community of IT executives.

Modules from the programme have been shared with Technical University Munich in Germany and the University of St Gallen in Switzerland.

"Chief information officers think their departments should be more prominent in organisations and I think they are right, especially when they are spending €1.3bn a year on IT," says professor Marcel Creemers, programme director at Nyenrode. "The financial business model now relies heavily on IT."

He recently organised a cyber security masterclass with KPMG, at which students and invited chief information officers took part in a business simulation of a cyber attack in order to put together some best practice measures for companies to employ against hacking.

> 'We should worry about whether our senior managers are numerate enough'

Meanwhile, the first cohort of the Masters in Business Analytics course at the Schulich School of Business at Canada's York University is about to graduate, having spent a year studying the subject, including work on a data analysis project directly applicable to the corporate world.

And in the US, Eric Bradlow and Peter Fader, marketing professors known for their ability to analyse consumer data to predict trends and formulate business strategies, are directing Customer Analytics Initiative for the Wharton school at the University of Pennsylvania.

Jonathan Wareham, vice-dean of research at Esade Business School in Spain and a professor of information systems, says: "Students are typically resistant to subjects on database technologies, data structures or pure statistics.

"However, when they see the applications – how the data can be used to address real operational decisions – their attitude changes substantially . . . They see the incredible power that knowledge of such technologies commands."

For some academics, however, it is important that business schools respond to the emerging trend with care.

Clive Holtham, professor of information management at City University Cass Business School in the UK, says: "Our job is to bring a broader, balanced view [and] the actual value of big data is probably less than is being claimed."

Vast quantities of historical data are not necessarily going to help you make the right decisions over the coming months or years, he says. Furthermore, data often come from unreliable sources. Hurricane Sandy, for example, generated thousands of tweets but most were from the Manhattan area. Those in poor areas – who were either affected the worst or just did not own smartphones – were not represented.

Prof Holtham says: "Rather than worry too much about having too few data scientists, we should worry about whether our senior managers are numerate enough and whether we have enough critical thinking skills across the whole workforce."

Business schools need to continue teaching quantitative and research methods, he adds, methods that have been around for a long time.

Students tune in to lectures as classroom walls begin to vanish

On course: model Mackenzie Drazan of California completes her high school calculus homework behind the catwalk during New York Fashion Week in February · *Reuters*

Moocs Online learning methods are dissolving the longstanding barriers that have kept people out of higher education, reports *Jane Bird*

University education has traditionally been the preserve of relatively wealthy people in the developed world. But this has begun to change with the introduction of massive open online courses, or Moocs, that are virtually free and available worldwide.

These will not destroy real universities, as some people suggest, says Simon Nelson, chief executive of FutureLearn, an online learning platform owned by the UK's Open University. "However, they will have a fundamental impact on higher education by making it available to people who previously wouldn't have been able to afford it, lacked entry level qualifications or lived in the wrong place."

Moocs involve global "classrooms" in which people can watch recorded video lectures, take tests, earn certificates and participate in discussion groups. They have begun to appear in the past two years, from organisations such as Coursera and Udacity, both of which emerged from Stanford University, and edX, from Harvard and MIT.

Some Moocs have more than 100,000 students. Their size and capacity to grow make them a game changer, says Andrew Ng, co-founder of Coursera, which has attracted almost 4m students to its 400 courses, a third of them from developing countries.

Moocs are created by educational institutions – Coursera has 83 providers so far. Initially focused on computer science, they now cover many topics including other sciences, arts, humanities, business and finance.

Mr Nelson sees them as part of a wide range of online learning options, which include the Open University's OpenLearn and organisations such as the Khan Academy and Codecademy, which provide entertaining and innovative online teaching on topics such as maths and software programming.

FutureLearn, which will launch its first courses this year, intends to connect these Moocs to the digitised archives of its partner institutions, the British Library, the British Council and the British Museum.

One consequence of the explosion in online education is the prospect of letting students take a "pick'n'mix" approach and choose courses offered by different institutions, rather than being restricted to the options offered by a single campus.

For this "unbundling" to happen, employers would need to recognise new forms of qualifications says William Lawton, director of the Observatory on Borderless Higher Education, a think-tank. Countries would need a national framework, he says.

The technology could also enable the pooling of foundation courses between universities, Mr Lawton suggests, so the same course could be offered through several institutions.

But such innovations are likely to take 10 or 15 years to come about because of the threat to vested interests, he believes. Lack of funds may also cause delays.

Edinburgh University spent £250,000 developing its first six Moocs, launched on Coursera in January.

Jeff Haywood, the university's vice-principal, says the main motivation is educational research and experimentation. "Our aim is partly to learn how online technologies can be used on campus. For example, we plan to try incorporating our equine nutrition Mooc into the undergraduate veterinary science curriculum." Reputation is another factor. "We want to be seen as at the forefront of technology in education and investing in the future," says Prof Haywood.

Raising revenue is not a primary goal, but Edinburgh has licensed philosophy and critical thinking Moocs to the University of Maryland.

The technology has limitations, says Mr Ng. "We are at the early

> 'We are at the early stages of figuring out how to make it a more social experience'

stages of figuring out how to make it a more social experience, so people can find friends for life this way just as they do at a traditional university."

Nor is it suitable for hands-on subjects such as sports or neurosurgery. Certification also presents challenges. Coursera has developed technology that verifies a student's identity using a webcam and typing rhythm analysis. Then there are cultural issues. Men in the Middle East may not want to watch a lecture given by a woman without a headscarf, says Dr Lawton.

The benefit for developing countries is about meeting demand, he says. In the developing world, there are not enough teachers to cope with growing need for higher education.

Edinburgh's Prof Haywood sees the importance of Moocs as stimulating discussion on new methods of learning and education. It is "inconceivable" that teaching will be the same in 10 years, he says.

"The evidence can be seen in the fact that vice-chancellors and senior decision makers in education are talking about online learning and how to modernise and innovate in traditional campus settings, rather than sticking to their usual focus on funding."

Case study Meet the public speaking lecturer who has to address a class of 87,000 and counting

Teaching a class of 100,000 students might seem daunting to the average lecturer, but not to Matt McGarrity from the University of Washington. By the time his massive open online course, or Mooc, on public speaking began on June 24, 87,000 students had registered, and 1,000 more were signing up each day.

"It's very exciting and an amazing opportunity to be teaching one of the biggest audiences in the world, ever," says Mr McGarrity. The numbers will also please the Gates Foundation, which put up $50,000 to support the course.

Mr McGarrity expects his students to watch 90 minutes of lectures a week, which can be viewed in short chunks. Students are encouraged to take online tests, undertake speech assignments, and interact with others in forums, spending a total of three to five hours each week online. There is no text book.

The data regarding who has signed up are intriguing. Most are over 25, and although 24 per cent are from the US, the rest are scattered worldwide, with 10 per cent from coming from India.

"This shows the Mooc is not a threat to bricks and mortar university teaching," says Mr McGarrity. "The real surprise is that 40 per cent already have an advanced degree and the vast majority are professionals."

Fewer than half will complete the course, says Mr McGarrity, and only some of those will participate fully, taking part in discussion forums and posting speeches for peer review.

Mr McGarrity is still preparing the lectures, because much of the material he uses in face-to-face training does not work online.

"It has to be accessible for people from Belize or Moscow. Ensuring it is not overly westernised or limited to topics of interest to the developed world has been the biggest challenge."

He is trying to focus on technique and raise awareness, as opposed to dealing with specific topics. "I would never universalise any one public speaking technique, although I am using the English language and the westernised tradition of rhetoric."

Mr McGarrity also wants to minimise the risk of political antagonism in the assignments. "For example, you would avoid asking a Palestinian to talk about how the settlements on the West Bank are entirely justified."

Adapting to the camera was also difficult, says Mr McGarrity, who has had some blunt criticism from students, as people thought he spoke too quickly during some of his early lectures.

Nor have all students appreciated his animated hand gestures, which he says he has developed over years off ace-to-face lectures to stop people getting bored. "Some really like it, but others think I am karate chopping," he says. "People in Asia think it's rude when I point at the camera."

Jane Bird

Analytics give opportunity to customise learning

Student choices

Courses can easily be personalised to ensure better results, says *Sarah Murray*

The topic of big data is making its way into the classroom, and the ability to analyse information is helping educators make better decisions and customise content for individuals, raising hopes of improved results and lower dropout rates.

In most industries, big data (complex information produced in huge amounts) come from websites and social media as well as devices such as mobile phones, video recorders, satellites and sensors.

In education, the information is generated by everything from online learning tools on laptops, mobile phones or tablets to school league tables, student record systems and data collected by education departments and regulators.

John McAlister, a decision sciences specialist at PA Consulting, says: "Most parents would be surprised at the level of data being captured in education."

However, while large volumes of data have long been generated by the education sector, software now allows this information to be used to analyse everything from the relative success of different teaching methods to the length of time students spend on one type of course versus another. Central to the success of predictive analytics is the fact that education is moving into an online world, where activities can be tracked.

In education, the big data approach is "only enabled by an increasing number of students and teachers conducting their lives online", says Gartner, the IT research company.

Of course, this raises concerns. With schools and universities holding such information on the performance of each student and teacher, governments and education institutions will need to establish policies to protect individuals' privacy.

However, data analytics promise many benefits. Armed with information, parents and students can make better choices when selecting schools and universities. This has particular relevance in countries where tuition fees are rising or governments are cutting student subsidies.

"If you're moving to a self-funded university system, students should be more interested in the data on different universities," says Mr McAlister.

When it comes to individual courses, students could identify which ones – based on their personalities – they would be more likely to succeed in, or those that would do most to secure them the jobs they want.

"We could have that personalisation and convenience we've come to expect in online shopping," says Ellen Wagner, executive director of the Western Interstate Commission on Higher Education Co-operative for Educational Technologies, which promotes technology-enhanced teaching in US higher education.

For educators, analytics software provides insights into what works best in the classroom.

Schools or universities could use data to identify courses in which students are struggling and compare them with others where they are doing better, allowing improvements to be made. Such methods also allow educators to personalise study programmes for individuals based on their learning styles, strengths and weaknesses.

"Institutions are going to be able to offer a more engaging learning experience," says Michael King, head of the global education industry unit at IBM, the technology company.

Customisation can take place rapidly. Data generated as students go through a course can be used to inform immediate changes in pace or content.

John Baker, president and chief executive of Desire2Learn, which provides software for educational applications, says: "Instead of everyone using the same text book and going through it at the same pace, it's tailoring the experience.

"And when you put this technology in the hands of teachers and educators around the world, we're seeing students who would normally drop out finishing high school and students who are struggling through university getting better advice," he adds.

Traditional schooling is also being turned on its head. Pupils will no longer need to spend the day in lectures and evenings doing homework designed to help absorb what they learnt in class.

When highly customised instruction can be accessed online at home, the school day can be devoted to team activities, real-life experiences and the practical application of knowledge.

As a result, scarce educational resources can be better used. IBM's Mr King says: "You can use that expensive classroom and teacher time to allow the students to work in groups and build other skills."

Work and play: learning can take place off campus · *Getty*