The Economist

SPECIAL REPORT
LIFELONG EDUCATION
January 14th 2017

Learning and earning

Learning and earning

Technological change demands stronger and more continuous connections between education and employment, says Andrew Palmer. The faint outlines of such a system are now emerging

THE RECEPTION AREA contains a segment of a decommissioned Underground train carriage, where visitors wait to be collected. The surfaces are wood and glass. In each room the talk is of code, web development and data science. At first sight the London office of General Assembly looks like that of any other tech startup. But there is one big difference: whereas most firms use technology to sell their products online, General Assembly uses the physical world to teach technology. Its office is also a campus. The rooms are full of students learning and practising code, many of whom have quit their jobs to come here. Full-time participants have paid between £8,000 and £10,000 ($9,900-12,400) to learn the lingua franca of the digital economy in a programme lasting 10-12 weeks.

General Assembly, with campuses in 20 cities from Seattle to Sydney, has an alumni body of around 35,000 graduates. Most of those who enroll for full-time courses expect them to lead to new careers. The company's curriculum is based on conversations with employers about the skills they are critically short of. It holds "meet and hire" events where firms can see the coding work done by its students. Career advisers help students with their presentation and interview techniques. General Assembly measures its success by how many of its graduates get a paid, permanent, full-time job in their desired field. Of its 2014-15 crop, three-quarters used the firm's career-advisory services, and 99% of those were hired within 180 days of beginning their job hunt.

The company's founder, Jake Schwartz, was inspired to start the company by two personal experiences: a spell of drifting after he realised that his degree from Yale conferred no practical skills, and a two-year MBA that he felt had cost too much time and money: "I wanted to change the return-on-investment equation in education by bringing down the costs and providing the skills that employers were desperate for."

▸▸

CONTENTS

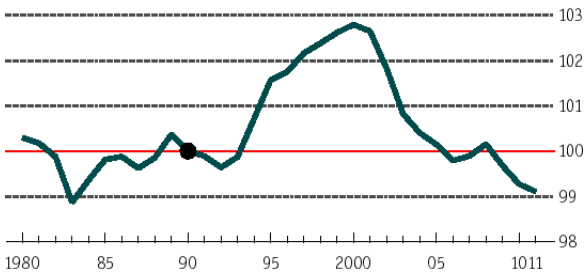
A list of sources is at **Economist.com/specialreports**

ACKNOWLEDGMENTS

Apart from those mentioned in the text, thanks for their help in preparing this report are due to: David Autor, Bill Blase, Anna Breman, Brian Callaghan, Tom Davenport, Shernaz Daver, Rasmus Enemark, Karen Evans, Charles Fadel, Jose Ferreira, Jonathan Finkelstein, Alison Fuller, Art Graesser, Guy Halfteck, Kathleen Hogan, Peter Horrocks, Denis Hurley, Jerry Kaplan, Ewart Keep, Nathan Kuncel, Rose Luckin, Christian Lyhne Ibsen, Robert Lyngman, Michael Moe, Mona Mourshed, Liz Rees, Laurent Reich, Bart Rienties, Sanjay Sarma, Stefano Scarpetta, David Schejbal, Nicole Smith, Mitchell Stevens, Andrew Tolmie, Anders Vind, David Willetts, Dan Willingham and Jonathan Zimmerman.

Brain drain

US, average cognitive intensity of tasks done by employed college graduates
1990=100



Source: "The Great Reversal in the Demand for Skill and Cognitive Tasks", by P. Beaudry, D. Green & B. Sand, NBER Working Paper 18901

In rich countries the link between learning and earning has tended to follow a simple rule: get as much formal education as you can early in life, and reap corresponding rewards for the rest of your career. The literature suggests that each additional year of schooling is associated with an 8-13% rise in hourly earnings. In the period since the financial crisis, the costs of leaving school early have become even clearer. In America, the unemployment rate steadily drops as you go up the educational ladder.

Many believe that technological change only strengthens the case for more formal education. Jobs made up of routine tasks that are easy to automate or offshore have been in decline. The usual flipside of that observation is that the number of jobs requiring greater cognitive skill has been growing. The labour market is forking, and those with college degrees will naturally shift into the lane that leads to higher-paying jobs.

The reality seems to be more complex. The returns to education, even for the high-skilled, have become less clear-cut. Between 1982 and 2001 the average wages earned by American workers with a bachelor's degree rose by 31%, whereas those of high-school graduates did not budge, according to the New York Federal Reserve. But in the following 12 years the wages of college graduates fell by more than those of their less educated peers. Meanwhile, tuition costs at universities have been rising.

A question of degree, and then some

The decision to go to college still makes sense for most, but the idea of a mechanistic relationship between education and wages has taken a knock. A recent survey conducted by the Pew Research Centre showed that a mere 16% of Americans think that a four-year degree course prepares students very well for a high-paying job in the modern economy. Some of this may be a cyclical effect of the financial crisis and its economic aftermath. Some of it may be simply a matter of supply: as more people hold college degrees, the associated premium goes down. But technology also seems to be complicating the picture.

A paper published in 2013 by a trio of Canadian economists, Paul Beaudry, David Green and Benjamin Sand, questions optimistic assumptions about demand for non-routine work. In the two decades prior to 2000, demand for cognitive skills soared as the basic infrastructure of the IT age (computers, servers, base stations and fibre-optic cables) was being built; now that the technology is largely in place, this demand has waned, say the authors. They show that since 2000 the share of employment accounted for by high-skilled jobs in America has been falling. As a result, college-educated workers are taking on jobs that are cognitively less demanding (see chart), displacing less educated workers.

This analysis buttresses the view that technology is already playing havoc with employment. Skilled and unskilled workers alike are in trouble. Those with a better education are still more likely to find work, but there is now a fair chance that it will be unenjoyable. Those who never made it to college face being squeezed out of the workforce altogether. This is the argument of the techno-pessimists, exemplified by the projections of Carl-Benedikt Frey and Michael Osborne, of Oxford University, who in 2013 famously calculated that 47% of existing jobs in America are susceptible to automation.

There is another, less apocalyptic possibility. James Bessen, an economist at Boston University, has worked out the effects of automation on specific professions and finds that since 1980 employment has been growing faster in occupations that use computers than in those that do not. That is because automation tends to affect tasks within an occupation rather than wiping out jobs in their entirety. Partial automation can actually increase demand by reducing costs: despite the introduction of the barcode scanner in supermarkets and the ATM in banks, for example, the number of cashiers and bank tellers has grown.

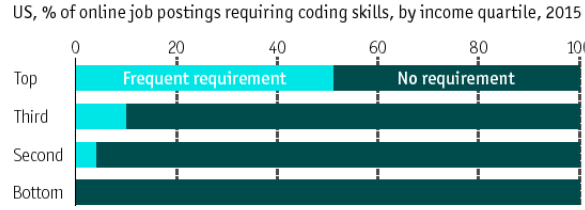
But even though technology may not destroy jobs in aggregate, it does force change upon many people. Between 1996 and 2015 the share of the American workforce employed in routine office jobs declined from 25.5% to 21%, eliminating 7m jobs. According to research by Pascual Restrepo of the Massachusetts Institute of Technology (MIT), the 2007-08 financial crisis made things worse: between 2007 and 2015 job openings for unskilled routine work suffered a 55% decline relative to other jobs.

In many occupations it has become essential to acquire new skills as established ones become obsolete. Burning Glass Technologies, a Boston-based startup that analyses labour markets by scraping data from online job advertisements, finds that the biggest demand is for new combinations of skills—what its boss, Matt Sigelman, calls "hybrid jobs". Coding skills, for example, are now being required well beyond the technology sector. In America, 49% of postings in the quartile of occupations with the highest pay are for jobs that frequently ask for coding skills (see chart). The composition of new jobs is also changing rapidly. Over the past five years, demand for data analysts has grown by 372%; within that segment, demand for data-visualisation skills has shot up by 2,574%.

A college degree at the start of a working career does not answer the need for the continuous acquisition of new skills, especially as career spans are lengthening. Vocational training is good at giving people job-specific skills, but those, too, will need to be updated over and over again during a career lasting decades. "Germany is often lauded for its apprenticeships, but the economy has failed to adapt to the knowledge economy," says Andreas Schleicher, head of the education directorate of the OECD, a club of mostly rich countries. "Vocational training has a role, but training someone early to do one thing all their lives is not the answer to lifelong learning."

Code to riches

US, % of online job postings requiring coding skills, by income quartile, 2015



Source: Burning Glass Technologies

Such specific expertise is meant to be acquired on the job, but employers seem to have become less willing to invest in training their workforces. In its 2015 Economic Report of the President, America's Council of Economic Advisers found that the share of the country's workers receiving either paid-for or on-the-job training had fallen steadily between 1996 and 2008. In Britain the average amount of training received by workers almost halved between 1997 and 2009, to just 0.69 hours a week.

Perhaps employers themselves are not sure what kind of expertise they need. But it could also be that training budgets are particularly vulnerable to cuts when the pressure is on. Changes in labour-market patterns may play a part too: companies now have a broader range of options for getting the job done, from automation and offshoring to using self-employed workers and crowdsourcing. "Organisations have moved from creating talent to consuming work," says Jonas Prising, the boss of Manpower, an employment consultancy.

Add all of this up, and it becomes clear that times have got tougher for workers of all kinds. A college degree is still a prerequisite for many jobs, but employers often do not trust it enough to hire workers just on the strength of that, without experience. In many occupations workers on company payrolls face the prospect that their existing skills will become obsolete, yet it is often not obvious how they can gain new ones. "It is now reasonable to ask a marketing professional to be able to develop algorithms," says Mr Sigelman, "but a linear career in marketing doesn't offer an opportunity to acquire those skills." And a growing number of people are self-employed. In America the share of temporary workers, contractors and freelancers in the workforce rose from 10.1% in 2005 to 15.8% in 2015.

Reboot camp

The answer seems obvious. To remain competitive, and to give low- and high-skilled workers alike the best chance of success, economies need to offer training and career-focused education throughout people's working lives. This special report will chart some of the efforts being made to connect education and employment in new ways, both by smoothing entry into the labour force and by enabling people to learn new skills throughout their careers. Many of these initiatives are still embryonic, but they offer a glimpse into the future and a guide to the problems raised by lifelong reskilling.

Quite a lot is already happening on the ground. General Assembly, for example, is just one of a number of coding-bootcamp providers. Massive open online courses (MOOCs) offered by companies such as Coursera and Udacity, feted at the start of this decade and then dismissed as hype within a couple of years, have embraced new employment-focused business models. LinkedIn, a professional-networking site, bought an online training business, Lynda, in 2015 and is now offering courses through a service called LinkedIn Learning. Pluralsight has a library of on-demand training videos and a valuation in unicorn territory. Amazon's cloud-computing division also has an education arm.

Universities are embracing online and modular learning more vigorously. Places like Singapore are investing heavily in providing their citizens with learning credits that they can draw on throughout their working lives. Individuals, too, increasingly seem to accept the need for continuous rebooting. According to the Pew survey, 54% of all working Americans think it will be essential to develop new skills throughout their working lives; among adults under 30 the number goes up to 61%. Another survey, conducted by Manpower in 2016, found that 93% of millennials were willing to spend their own money on further training. Meanwhile, employers are putting increasing emphasis on learning as a skill in its own right. ■

The role of employers

Cognition switch

Companies are embracing learning as a core skill

A STRANGE-LOOKING SMALL room full of vintage furniture—an armchair, a chest of drawers, a table—was being built in the middle of Infosys's Palo Alto offices when your correspondent visited in November. Tweed jackets hung from a clothes rack; a piano was due to be delivered shortly. The structure was rough and unfinished. And that, according to Sanjay Rajagopalan, was largely the point.

Mr Rajagopalan is head of research and design at the Indian business-services firm. He is a disciple of "design thinking", a problem-solving methodology rooted in observation of successful innovators. His goal is an ambitious one: to turn a firm that built a global offshoring business by following client specifications into one that can set the terms of its projects for itself.

Design thinking emphasises action over planning and encourages its followers to look at problems through the eyes of the people affected. Around 100,000 Infosys employees have gone through a series of workshops on it. The first such workshop sets the participants a task: for example, to improve the experience of digital photography. That involves moving from the idea of making a better camera to considering why people value photographs in the first place, as a way of capturing memories. As ideas flow, people taking part in the workshops immediately start producing prototypes with simple materials like cardboard and paper. "The tendency is to plan at length before building," says Mr Rajagopalan. "Our approach is to build, build, build, test and then plan."

That baffling structure in Palo Alto was another teaching tool. Mr Rajagopalan had charged a small team with reimagining

the digital retail experience. Instead of coming up with yet another e-commerce site, they were experimenting with technologies to liven up a physical space. (If a weary shopper sat in the chair, say, a pot of tea on an adjacent table would automatically brew up.) The construction of the shop prototype in Infosys's offices was being documented so that employees could see design thinking in action.

Infosys is grappling with a vital question: what do people need to be good at to succeed in their work? Whatever the job, the answer is always going to involve some technical and specific skills, based on knowledge and experience of a particular industry. But with design thinking, Infosys is focusing on "foundational skills" like creativity, problem-solving and empathy. When machines can put humans to shame in performing the routine job-specific tasks that Infosys once took offshore, it makes sense to think about the skills that computers find harder to learn.

David Deming of Harvard University has shown that the labour market is already rewarding people in occupations that require social skills. Since 1980 growth in employment and pay has been fastest in professions across the income scale that put a high premium on social skills (see chart, next page).

Social skills are important for a wide range of jobs, not just for healthcare workers, therapists and others who are close to their customers. Mr Deming thinks their main value lies in the relationship between colleagues: people who can divide up tasks quickly and effectively between them form more productive teams. If work in future will increasingly be done by contractors and freelancers, that capacity for co-operation will become even more important. Even geeks have to learn these skills. Ryan Roslansky, who oversees LinkedIn's push into online education, notes that many software engineers are taking management and communications courses on the site in order to round themselves out.

Building a better learner

Another skill that increasingly matters in finding and keeping a job is the ability to keep learning. When technology is changing in unpredictable ways, and jobs are hybridising, humans need to be able to pick up new skills. At Infosys, Mr Rajagopalan emphasises "learning velocity"—the process of going from a question to a good idea in a matter of days or weeks. Eric Schmidt, now executive chairman of Alphabet, a tech holding company in which Google is the biggest component, has talked of Google's recruitment focus on "learning animals". Mark Zuckerberg, one of Facebook's founders, sets himself new personal learning goals each year.

An emphasis on learning has long been a hallmark of United Technologies (UTC), a conglomerate whose businesses include Pratt & Whitney, a maker of aircraft engines, and Otis, a lift manufacturer. Since 1996 UTC has been running a programme under which its employees can take part-time degrees and have tuition fees of up to $12,000 a year paid for them, no strings attached. Employers often balk at training staff because they might leave for rivals, taking their expensively gained skills with them. But Gail Jackson, the firm's vice-president of human resources, takes a different view. "We want people who are intellectually curious," she says. "It is better to train and have them leave than not to train and have them stay."

Such attitudes are becoming more common. When Satya Nadella took over as boss of Microsoft in 2014, he drew on the work of Carol Dweck, a psychology professor at Stanford University, to push the firm's culture in a new direction. Ms Dweck divides students into two camps: those who think that ability is innate and fixed (dampening motivation to learn) and those who believe that abilities can be improved through learning. This "growth mindset" is what the firm is trying to encourage. It has

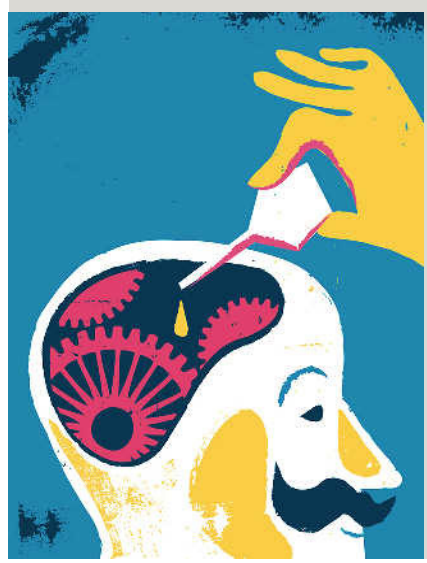
Old dogs, new tricks

As people age, the brain changes in both good ways and bad

IF YOU ARE over 20, look away now. Your cognitive performance is probably already on the wane. The speed with which people can process information declines at a steady rate from as early as their 20s.

A common test of processing speed is the "digit symbol substitution test", in which a range of symbols are paired with a set of numbers in a code. Participants are shown the code, given a row of symbols and then asked to write down the corresponding number in the box below within a set period. There is nothing cognitively challenging about the task; levels of education make no difference to performance. But age does. Speed consistently declines as people get older.

Why this should be is still a matter of hypothesis, but a range of tentative explanations has been put forward. One points the finger at myelin, a white, fatty substance that coats axons, the tendrils that carry signals from one neuron to another. Steady reductions in myelin as people age may be slowing down these connections. Another possibility, says Timothy Salthouse, director of the Cognitive Ageing Laboratory at the University of Virginia, is depletion of a chemical called dopamine, receptor sites for which decline in number with advancing age.

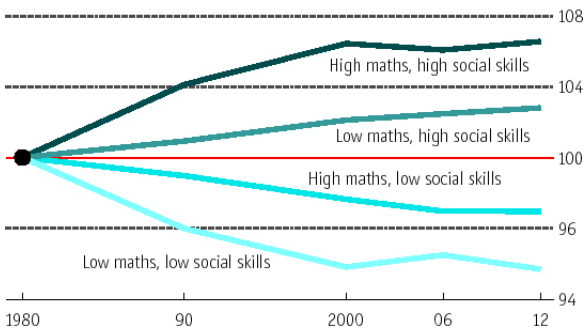


Fortunately, there is some good news to go with the bad. Psychologists distinguish between "fluid intelligence", which is the ability to solve new problems, and "crystallised intelligence", which roughly equates to an individual's stock of accumulated knowledge. These reserves of knowledge continue to increase with age: people's performance on vocabulary and general-knowledge tests keeps improving into their 70s. And experience can often compensate for cognitive decline. In an old but instructive study of typists ranging in age from 19 to 72, older workers typed just as fast as younger ones, even though their tapping speed was slower. They achieved this by looking further ahead in the text, which allowed them to keep going more smoothly.

What does all this mean for a lifetime of continuous learning? It is encouraging so long as people are learning new tricks in familiar fields. "If learning can be assimilated into an existing knowledge base, advantage tilts to the old," says Mr Salthouse. But moving older workers into an entirely new area of knowledge is less likely to go well.

Getting along and getting on

US, change in employment share by skills required, 1980=100



Source: "The Growing Importance of Social Skills in the Labor Market", by David Deming, Aug 2016

amended its performance-review criteria to include an appraisal of how employees have learned from others and then applied that knowledge. It has also set up an internal portal that integrates Lynda, the training provider bought by LinkedIn (which Microsoft itself is now buying).

AT&T, a telecoms and media firm with around 300,000 employees, faces two big workforce problems: rapidly changing skills requirements in an era of big data and cloud computing, and constant employee churn that leaves the company having to fill 50,000 jobs a year. Recruiting from outside is difficult, expensive and liable to cause ill-feeling among existing staff. The firm's answer is an ambitious plan to reskill its own people.

Employees each have a career profile that they maintain themselves, which contains a record of their skills and training. They also have access to a database called "career intelligence", which shows them the jobs on offer within the company, what skills they require and how much demand there is for them. The firm has developed short courses called nanodegrees with Udacity, the MOOC provider, and is also working with universities on developing course curriculums. Employees work in their own time to build their skills. But AT&T applies both carrot and stick to encourage them, by way of generous help with tuition fees (totalling $30m in 2015) for those who take courses and negative appraisal ratings for those who show no interest.

As continued learning becomes a corporate priority, two questions arise. First, is it possible for firms to screen candidates and employees on the basis of curiosity, or what psychologists call "need for cognition"? Getting through university is one very rough proxy for this sort of foundational skill, which helps explain why so many employers stipulate degrees for jobs which on the face of it do not require them.

Curiouser and curiouser

More data-driven approaches are also being tried. Manpower, a human-resources consultancy, is currently running trials on an app that will score individuals on their "learnability". Knack, a startup, offers a series of apps that are, in effect, gamified psychological tests. In Dashi Dash, for example, participants play the part of waiters and are asked to take the orders of customers on the basis of (often hard to read) expressions. As more and more customers arrive, the job of managing the workflow gets tougher. Every decision and every minute change in strategy is captured as a data point and sent to the cloud, where machine-learning algorithms analyse players' aptitudes against a reference population of 25,000 people. An ability to read expressions wins points for empathy; a decision always to serve customers in the order in which they arrive in the game, for example, might serve as an indicator of integrity. Intellectual curiosity is one of the traits that Knack tests for.

The second question is whether it is possible to train people to learn. Imaging techniques are helping unlock what goes on in the mind of someone who is curious. In a study published in 2014 in *Neuron*, a neuroscience journal, participants were first asked to rate their curiosity to learn the answers to various questions. Later they were shown answers to those questions, as well as a picture of a stranger's face; finally, they were tested on their recall of the answers and given a face-recognition test. Greater curiosity led to better retention on both tests; brain scans showed increased activity in the mesolimbic dopamine system, a reward pathway, and in the hippocampus, a region that matters for forming new memories.

It is too early to know whether traits such as curiosity can be taught. But it is becoming easier to turn individuals into more effective learners by making them more aware of their own thought processes. Hypotheses about what works in education and learning have become easier to test because of the rise of online learning. MIT has launched an initiative to conduct interdisciplinary research into the mechanics of learning and to apply the conclusions to its own teaching, both online and offline. It uses its own online platforms, including a MOOC co-founded with Harvard University called edX, to test ideas. When MOOC participants were required to write down their plans for undertaking a course, for example, they were 29% more likely to complete the course than a control group who did not have to do so.

Information about effective learning strategies can be personalised, too. The Open University, a British distance-learning institution, already uses dashboards to monitor individual students' online behaviour and performance. Knewton, whose platform captures data on 10m current American students, recommends personalised content to them. Helping people to be more aware of their own thought processes when they learn makes it more likely they can acquire new skills later in life. ■

Upstarts and incumbents

The return of the MOOC

Alternative providers of education must solve the problems of cost and credentials

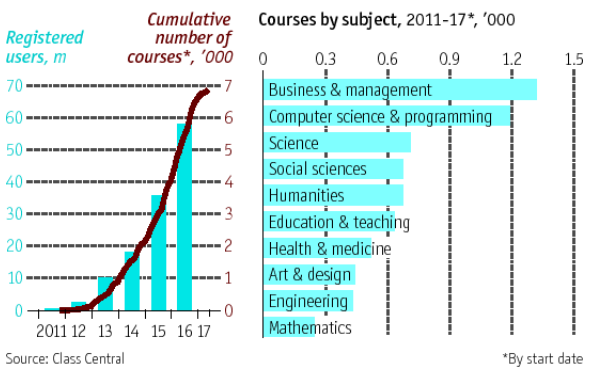
THE HYPE OVER MOOCs peaked in 2012. Salman Khan, an investment analyst who had begun teaching bite-sized lessons to his cousin in New Orleans over the internet and turned that activity into a wildly popular educational resource called the Khan Academy, was splashed on the cover of *Forbes*. Sebastian Thrun, the founder of another MOOC called Udacity, predicted in an interview in *Wired* magazine that within 50 years the number of universities would collapse to just ten worldwide. The *New York Times* declared it the year of the MOOC.

The sheer numbers of people flocking to some of the initial courses seemed to suggest that an entirely new model of open-access, free university education was within reach. Now MOOC sceptics are more numerous than believers. Although lots of people still sign up, drop-out rates are sky-high.

Nonetheless, the MOOCs are on to something. Education, like health care, is a complex and fragmented industry, which

Learning curve

Massive open online courses, main international providers



Source: Class Central

*By start date

makes it hard to gain scale. Despite those drop-out rates, the MOOCs have shown it can be done quickly and comparatively cheaply. The Khan Academy has 14m-15m users who conduct at least one learning activity with it each month; Coursera has 22m registered learners. Those numbers are only going to grow. FutureLearn, a MOOC owned by Britain's Open University, has big plans. Oxford University announced in November that it would be producing its first MOOC on the edx platform.

In their search for a business model, some platforms are now focusing much more squarely on employment (though others, like the Khan Academy, are not for profit). Udacity has launched a series of nanodegrees in tech-focused courses that range from the basic to the cutting-edge. It has done so, moreover, in partnership with employers. A course on Android was developed with Google; a nanodegree in self-driving cars uses instructors from Mercedes-Benz, Nvidia and others. Students pay $199-299 a month for as long as it takes them to finish the course (typically six to nine months) and get a 50% rebate if they complete it within a year. Udacity also offers a souped-up version of its nanodegree for an extra $100 a month, along with a money-back guarantee if graduates do not find a job within six months.

Coursera's content comes largely from universities, not specialist instructors; its range is much broader; and it is offering full degrees (one in computer science, the other an MBA) as well as shorter courses. But it, too, has shifted its emphasis to employability. Its boss, Rick Levin, a former president of Yale University, cites research showing that half of its learners took courses in order to advance their careers. Although its materials are available without charge, learners pay for assessment and accreditation at the end of the course ($300-400 for a four-course sequence that Coursera calls a "specialisation"). It has found that when money is changing hands, completion rates rise from 10% to 60% . It is increasingly working with companies, too. Firms can now integrate Coursera into their own learning portals, track employees' participation and provide their desired menu of courses.

These are still early days. Coursera does not give out figures on its paying learners; Udacity says it has 13,000 people doing its nanodegrees. Whatever the arithmetic, the reinvented MOOCs matter because they are solving two problems they share with every provider of later-life education.

The first of these is the cost of learning, not just in money but also in time. Formal education rests on the idea of qualifications that take a set period to complete. In America the entrenched notion of "seat time", the amount of time that students spend with school teachers or university professors, dates back to Andrew Carnegie. It was originally intended as an eligibility requirement for teachers to draw a pension from the industrialist's nascent pension scheme for college faculty. Students in their early 20s can more easily afford a lengthy time commitment because they are less likely to have other responsibilities. Although millions of people do manage part-time or distance learning in later life—one-third of all working students currently enrolled in America are 30-54 years old, according to the Georgetown University Centre on Education and the Workforce—balancing learning, working and family life can cause enormous pressures.

Moreover, the world of work increasingly demands a quick response from the education system to provide people with the desired qualifications. To take one example from Burning Glass, in 2014 just under 50,000 American job-vacancy ads asked for a CISSP cyber-security certificate. Since only 65,000 people in America hold such a certificate and it takes five years of experience to earn one, that requirement will be hard to meet. Less demanding professions also put up huge barriers to entry. If you want to become a licensed cosmetologist in New Hampshire, you will need to have racked up 1,500 hours of training.

In response, the MOOCs have tried to make their content as digestible and flexible as possible. Degrees are broken into modules; modules into courses; courses into short segments. The MOOCs test for optimal length to ensure people complete the course; six minutes is thought to be the sweet spot for online video and four weeks for a course.

Scott DeRue, the dean of the Ross School of Business at the University of Michigan, says the unbundling of educational content into smaller components reminds him of another industry: music. Songs used to be bundled into albums before being disaggregated by iTunes and streaming services such as Spotify. In Mr DeRue's analogy, the degree is the album, the course content that is freely available on MOOCs is the free streaming radio service, and a "microcredential" like the nanodegree or the specialisation is paid-for iTunes.

How should universities respond to that kind of disruption? For his answer, Mr DeRue again draws on the lessons of the music industry. Faced with the disruption caused by the internet, it turned to live concerts, which provided a premium experience that cannot be replicated online. The on-campus degree also needs to mark itself out as a premium experience, he says.

Another answer is for universities to make their own products more accessible by doing more teaching online. This is beginning to happen. When Georgia Tech decided to offer an online version of its masters in computer science at low cost, many were shocked: it seemed to risk cannibalising its campus degree. But according to Joshua Goodman of Harvard University, who has studied the programme, the decision was proved right. The campus degree continued to recruit students in their early 20s whereas the online degree attracted people with a median age of 34 who did not want to leave their jobs. Mr Goodman reckons this one programme could boost the numbers of computer-science masters produced in America each year by 7-8%. Chip Paucek, the boss of 2U, a firm that creates online degree programmes for conventional universities, reports that additional marketing efforts to lure online students also boost on-campus enrolments.

Educational Lego

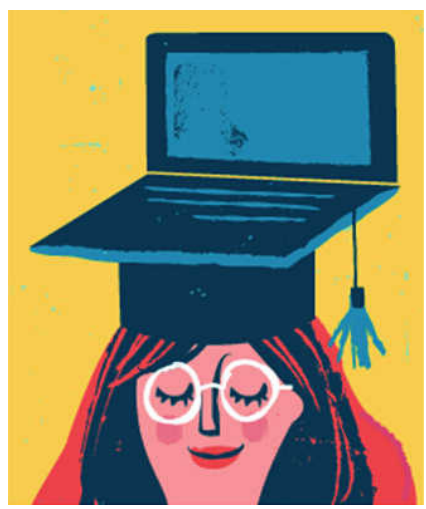
Universities can become more modular, too. Edx has a micromasters in supply-chain management that can either be taken on its own or count towards a full masters at MIT. The University of Wisconsin-Extension has set up a site called the University Learning Store, which offers slivers of online content on practical subjects such as project management and business writing. Enthusiasts talk of a world of "stackable credentials" in which qualifications can be fitted together like bits of Lego.

Just how far and fast universities will go in this direction is unclear, however. Degrees are still highly regarded, and increased emphasis on critical thinking and social skills raises their value in many ways. "The model of campuses, tenured faculty and so on does not work that well for short courses," adds Jake Schwartz, General Assembly's boss. "The economics of covering fixed costs forces them to go longer."

Academic institutions also struggle to deliver really fast-moving content. Pluralsight uses a model similar to that of book publishing by employing a network of 1,000 experts to produce and refresh its library of videos on IT and creative skills. These experts get royalties based on how often their content is viewed; its highest earner pulled in $2m last year, according to Aaron Skonnard, the firm's boss. Such rewards provide an incentive for authors to keep updating their content. University faculty have other priorities.

Beside costs, the second problem for MOOCs to solve is credentials. Close colleagues know each other's abilities, but modern labour markets do not work on the basis of such relationships. They need widely understood signals of experience and expertise, like a university degree or a baccalaureate, however imperfect they may be. In their own fields, vocational qualifications do the same job. The MOOCs' answer is to offer microcredentials like nanodegrees and specialisations.

But employers still need to be confident that the skills these credentials vouchsafe are for real. LinkedIn's "endorsements" feature, for example, was routinely used by members to hand out compliments to people they did not know for skills they did not possess, in the hope of a reciprocal recommendation. In 2016 the firm tightened things up, but getting the balance right is hard. Credentials require just the right amount of friction: enough to be trusted, not so much as to block career transitions.



People are more likely to invest in training if it confers a qualification that others will recognise. But they also need to know which skills are useful in the first place

Universities have no trouble winning trust: many of them can call on centuries of experience and name recognition. Coursera relies on universities and business schools for most of its content; their names sit proudly on the certificates that the firm issues. Some employers, too, may have enough kudos to play a role in authenticating credentials. The involvement of Google in the Android nanodegree has helped persuade Flipkart, an Indian e-commerce platform, to hire Udacity graduates sight unseen.

Wherever the content comes from, students' work usually needs to be validated properly for a credential to be trusted. When student numbers are limited, the marking can be done by the teacher. But in the world of MOOCs those numbers can spiral, making it impractical for the instructors to do all the assessments. Automation can help, but does not work for complex assignments and subjects. Udacity gets its students to submit their coding projects via GitHub, a hosting site, to a network of machine-learning graduates who give feedback within hours.

Even if these problems can be overcome, however, there is something faintly regressive about the world of microcredentials. Like a university degree, it still involves a stamp of approval from a recognised provider after a proprietary process. Yet lots of learning happens in informal and experiential settings, and lots of workplace skills cannot be acquired in a course.

Gold stars for good behaviour

One way of dealing with that is to divide the currency of knowledge into smaller denominations by issuing "digital badges" to recognise less formal achievements. RMIT University, Australia's largest tertiary-education institution, is working with Credly, a credentialling platform, to issue badges for the skills that are not tested in exams but that firms nevertheless value. Belinda Tynan, RMIT's vice-president, cites a project carried out by engineering students to build an electric car, enter it into races and win sponsors as an example.

The trouble with digital badges is that they tend to proliferate. Illinois State University alone created 110 badges when it launched a programme with Credly in 2016. Add in MOOC certificates, LinkedIn Learning courses, competency-based education, General Assembly and the like, and the idea of creating new currencies of knowledge starts to look more like a recipe for hyperinflation.

David Blake, the founder of Degreed, a startup, aspires to resolve that problem by acting as the central bank of credentials. He wants to issue a standardised assessment of skill levels, irrespective of how people got there. The plan is to create a network of subject-matter experts to assess employees' skills (copy-editing, say, or credit analysis), and a standardised grading language that means the same thing to everyone, everywhere.

Pluralsight is heading in a similar direction in its field. A diagnostic tool uses a technique called item response theory to work out users' skill levels in areas such as coding, giving them a rating. The system helps determine what individuals should learn next, but also gives companies a standardised way to evaluate people's skills.

A system of standardised skills measures has its own problems, however. Using experts to grade ability raises recursive questions about the credentials of those experts. And it is hard for item response theory to assess subjective skills, such as an ability to construct an argument. Specific, measurable skills in areas such as IT are more amenable to this approach.

So amenable, indeed, that they can be tested directly. As an adolescent in Armenia, Tigran Sloyan used to compete in mathematical Olympiads. That experience helped him win a place at MIT and also inspired him to found a startup called CodeFights in San Francisco. The site offers free gamified challenges to 500,000 users as a way of helping programmers learn. When they know enough, they are funnelled towards employers, which pay the firm 15% of a successful candidate's starting salary. Sqore, a startup in Stockholm, also uses competitions to screen job applicants on behalf of its clients.

However it is done, the credentialling problem has to be solved. People are much more likely to invest in training if it confers a qualification that others will recognise. But they also need to know which skills are useful in the first place. ■

Career planning

Pathway dependency

How to turn a qualification into a salary

UNIVERSITY EDUCATION IS designed to act as a slipway, launching students into the wider world in the expectation that the currents will guide them into a job. In practice, many people get stuck in the doldrums because employers demand evidence of specific experience even from entry-level candidates. Whether this counts as a skills gap is a matter of debate. "If I cannot find a powerful, fuel-efficient, easy-to-park car for $15,000, that doesn't mean there is a car shortage," says Peter Cappelli of the Wharton School of the University of Pennsylvania. But whether the fault lies with the educators or the employers, there is a need for pathways that lead individuals into jobs.

Sometimes those pathways are clearly defined, as in medicine and the law. Vocational education combines classroom and work-based learning to prepare young people for specific trades. In many European countries, one-third to half of later-stage secondary schoolgoers are on a vocational path (see chart). Britain is due to introduce an apprenticeship levy in April.

But pathways are needed to smooth transitions in other countries (America, for example, lacks a tradition of vocational education); in less structured occupations; and when formal education has come to an end. The nanodegree is an example of such a pathway, as is General Assembly's bootcamp model. Both rely heavily on input from employers to create content; both use jobs rather than credentials as a measure of success.

That is particularly important in the early stages of people's careers, which is not just when they lack experience but also when earnings grow fastest. An analysis of American wage growth by economists at the New York Federal Reserve showed that the bulk of earnings growth took place between the ages of 25 and 35; on average, after the age of 45 only the top 2% of lifetime earners see any earnings growth. So it is vital for people to move quickly into work once qualified, and to hold on to jobs once they get them.

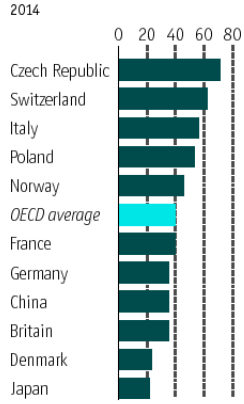
That is the insight behind LearnUp, a startup that works with applicants without college degrees for entry-level positions. Users applying for a job online can click on a link and take a one-hour online training session on how to be a cashier, sales clerk or whatever they are after. Employers pay LearnUp a fixed fee to improve the pool of candidates. Recruitment and retention rates have risen.

Generation, a philanthropically funded programme run by the McKinsey Social Initiative, a not-for-profit arm of the consultancy, uses a bootcamp approach and some typically McKinsey-esque thinking to train people from difficult backgrounds for middle-skilled positions in industries like retailing and health care. The programme starts by going into workplaces and identifying key events (how an IT helpdesk handles a call from an irate customer, for example) that distinguish high performers from the rest.

Curriculum designers then use that analysis to create a full-time training programme lasting between four and 12 weeks that covers both technical knowledge and behavioural skills. The programme has gone live in America, Spain, India, Kenya and Mexico. By the end of 2016 it had 10,000 graduates, for whom it claims an employment rate of 90% and much higher retention rates than usual. The trainees pay nothing; the hope is that employers will fund the programme, or embed it in their own training programmes, when they see how useful it is.

Practical types

Students* enrolled in vocational programmes, as % of total
2014



Source: OECD

*15- to 19-year-olds

A little help from your friends

Such experiments use training to take people into specific jobs. In the past, an initial shove might have been all the help they needed. But as middle-skilled roles disappear, some rungs on the job ladder have gone missing. And in a world of continuous reskilling and greater self-employment, people may need help with repeatedly moving from one type of job to another. Vocational education is good at getting school-leavers into work, but does nothing to help people adapt to changes in the world of work. Indeed, a cross-country study in 2015 by researchers at the Hoover Institution suggests that people with a vocational education are more likely than those with a general education to withdraw from the labour force as they age. The pattern is particularly marked in countries that rely heavily on apprenticeships, such as Denmark, Germany and Switzerland.

Large companies may have the scale to offer their employees internal pathways to improve their skills, as companies like AT&T do. But many workers will need outside help in deciding which routes to take. That suggests a big opportunity for firms that can act, in effect, as careers advisers. Some are better placed than others to see where the jobs market is going. Manpower, which supplies temporary workers to many industries, last year launched a programme called MyPath that is based on the idea of an iterative process of learning and working. It allows Manpower's army of temporary workers in America to earn a degree from Western International University at no financial cost to them. The degree is structured as a series of three or four episodes of education followed by periods in work, in the expectation that Manpower has a good overview of the skills leading to well-paid jobs.

LinkedIn is another organisation with a decent understanding of wider trends. The professional-networking site likes to call the data it sits on "the economic graph", a digital map of the global economy. Its candidate data, and its recruitment platform, give it information on where demand from employers is greatest and what skills jobseekers need. And with LinkedIn Learning it can now also deliver training itself.

The firm can already tell candidates how well their qualifications for any advertised job stack up against those of other applicants. In time, its data might be used to give "investment advice", counselling its members on the financial return to specific skills and on how long they are likely to be useful; or to show members how other people have got into desirable positions.

The difficulty with offering mass-market careers advice is finding a business model that will pay for it. LinkedIn solves this problem by aiming itself primarily at professionals who either pay for services themselves or who are of interest to recruiters. But that raises a much bigger question. "There is no shortage of options for folks of means," says Adam Newman of Tyton Partners, an education consultancy. "But what about LinkedIn for the linked-out?" ■

Low-skilled workers

The elephant in the truck

The emerging system of lifelong learning will do little to reduce inequality

IMAGINE YOU ARE a 45-year-old long-distance lorry driver. You never enjoyed school and left as soon as you could, with a smattering of qualifications and no great love of learning. The job is tiring and solitary, but it does at least seem to offer decent job security: driver shortages are a perennial complaint in the industry, and the average age of the workforce is high (48 in Britain), so the shortfalls are likely to get worse. America's Bureau of Labour Statistics (BLS) says there were 1.8m truckers in 2014 and expects a 5% rise in their number by 2024. "As the economy grows, the demand for goods will increase and more truck drivers will be needed to keep supply chains moving," predicts the BLS website, chirpily.

But the future might unfold very differently. For all the excitement over self-driving passenger cars, the freight industry is likely to adopt autonomous vehicles even faster. And according to a report in 2014 by Morgan Stanley, a bank, full automation might reduce the pool of American truck drivers by two-thirds. Those projections came hedged with caveats, and rightly so. The pace of adoption may be slowed by regulation. Drivers may still be needed to deal with unforeseen problems; if such jobs require more technical knowledge, they may even pay better. Employment in other sectors may grow as freight costs come down. But there is a chance that in the not too distant future a very large number of truckers will find themselves redundant. The implications are immense.

Knowing when to jump is one problem. For people with decades of working life still ahead of them, it is too early to quit but it is also risky to assume that nothing will change. Matthew Robb of Parthenon-EY, a consultancy, thinks that governments should be talking to industry bodies about the potential for mass redundancies and identifying trigger points, such as the installation of sensors on motorways, that might prompt retraining. "This is a boiling-frog problem," he says. "It is not thought about."

For lower-skilled workers of this sort the world of MOOCs, General Assembly and LinkedIn is a million miles away. Around 80% of Coursera's learners have university degrees. The costs of reskilling, in terms of time and money, are easiest to bear for people who have savings, can control their working hours or work for companies that are committed to upgrading their workforce. And motivation is an issue: the tremendous learning opportunities offered by the internet simply do not appeal to everyone.

Whosoever hath not

The rewards of retraining are highest for computing skills, but there is no natural pathway from trucker to coder. And even if there were, many of those already in the workforce lack both the confidence and the capability to make the switch. In its Programme for the International Assessment of Adult Competencies, the OECD presents a bleak picture of skills levels in 33 member countries (see chart). One in five adults, on average, has poor reading and numeracy skills. One in four has little or no experience of computers. On a measure of problem-solving ability using technology, most adults are at or below the lowest level of proficiency.

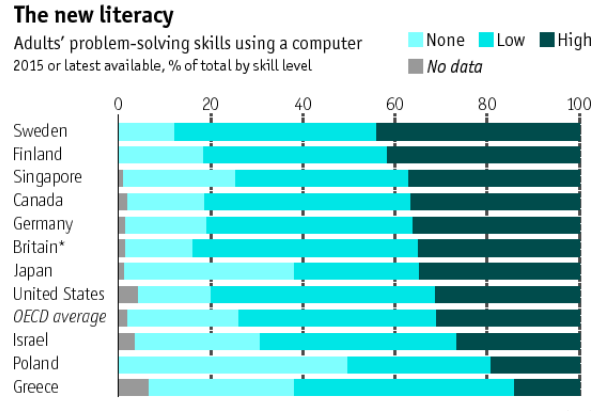
Moreover, learning is most effective when people are able to practise their new skills. Yet many jobs, including lorry-driving, afford little such opportunity, and some of them are being deskilled further. Research by Tom Higgins of Cardiff University suggests that the numeracy requirements for retail assistants and care-home workers in Britain went down between 1997 and 2012. The head of one of the world's biggest banks worries that a back-office operation in India has disaggregated its work into separate tasks so effectively that employees are no longer able to understand the processes as a whole, let alone make useful suggestions for improving them.

So the truckers' dilemma will be very hard to solve. "It's difficult when you don't have a good answer even in an ideal world," says Jesper Roine, an economist who sat on a Swedish commission to examine the future of work. But as a thought experiment it highlights some of the problems involved in upgrading the stock of low-skilled and mid-skilled workers. Any decent answer will need a co-ordinated effort to bring together individuals, employers and providers of education. That suggests a role for two entities in particular.

One is trade unions. They have an industry-wide view of trends that may not be available to smaller employers. They can also accompany people throughout their working lives, which

The new literacy

Adults' problem-solving skills using a computer
2015 or latest available, % of total by skill level



Source: OECD
*England

may become increasingly important in a world of rising self-employment. Denmark's tripartite system, for example, binds together employers, government and unions. Firms and unions get together to identify skills needs; collective-bargaining agreements enshrine rights to paid leave for training. The country's famed "flexicurity" system offers unemployed workers a list of 258 vocational-training programmes.

In Britain a well-regarded programme called UnionLearn uses union representatives both to inform workers about training options and to liaise with employers on workers' requests for training. Employees seem more likely to discuss shortfalls in basic skills with union representatives than with managers. An analysis by academics at Leeds University Business School shows that between 2001 and 2013 union members in Britain were a third more likely to have received training than non-unionised workers.

The second entity is government. There is much talk about lifelong learning, though few countries are doing much about it. The Nordics fall into this less populated camp. But it is Singapore that can lay claim to the most joined-up approach with its SkillsFuture initiative. Employers in the city-state are asked to spell out the changes, industry by industry, that they expect to happen over the next three to five years, and to identify the skills they will need. Their answers are used to create "industry transformation maps" designed to guide individuals on where to head.

Since January 2016 every Singaporean above the age of 25 has been given a S$500 ($345) credit that can be freely used to pay for any training courses provided by 500 approved providers, including universities and MOOCs. Generous subsidies, of up to 90% for Singaporeans aged 40 and over, are available on top of this credit. The programme currently has a budget of S$600m a year, which is due to rise to S$1 billion within three years. According to Ng Cher Pong, SkillsFuture's chief executive, the returns on that spending matter less than changing the mindset around continuous reskilling.

Some programmes cater to the needs of those who lack basic skills. Tripartite agreements between unions, employers and government lay out career and skills ladders for those who are trapped in low-wage occupations. Professional-conversion programmes offer subsidised training to people switching to new careers in areas such as health care.

Given Singapore's size and political system, this approach is not easily replicated in many other countries, but lessons can still be drawn. It makes sense for employers, particularly smaller ones, to club together to signal their skills needs to the workforce at large. Individual learning accounts have a somewhat chequered history—fraudulent training providers helped scupper a British experiment in the early 2000s—but if well designed, they can offer workers educational opportunities without being overly prescriptive.

The outlines of a new ecosystem for connecting employment and education are becoming discernible

Any fool can know

In June 2016, this newspaper surveyed the realm of artificial intelligence and the adjustments it would require workers to make as jobs changed. "That will mean making education and training flexible enough to teach new skills quickly and efficiently," we concluded. "It will require a greater emphasis on lifelong learning and on-the-job training, and wider use of online learning and video-game-style simulation."

The uncertainties around the pace and extent of technological change are enormous. Some fear a future of mass unemployment. Others are sanguine that people will have time to adapt. Companies have to want to adopt new technologies, after all, and regulators may impede their take-up. What is not in doubt is the need for new and more efficient ways to develop and add workplace skills.

The faint outlines of a new ecosystem for connecting employment and education are becoming discernible. Employers are putting greater emphasis on adaptability, curiosity and learning as desirable attributes for employees. They are working with universities and alternative providers to create and improve their own supply of talent. Shorter courses, lower costs and online delivery are making it easier for people to combine work and training. New credentials are being created to signal skills.

At the same time, new technologies should make learning more effective as well as more necessary. Virtual and augmented reality could radically improve professional training. Big data offer the chance for more personalised education. Platforms make it easier to connect people of differing levels of knowledge, allowing peer-to-peer teaching and mentoring. "Education is becoming flexible, modular, accessible and affordable," says Simon Nelson, the boss of FutureLearn, the Open University MOOC.

But for now this nascent ecosystem is disproportionately likely to benefit those who least need help. It concentrates on advanced technological skills, which offer the clearest returns and are relatively easy to measure. And it assumes that people have the money, time, motivation and basic skills to retrain.

Thanks to examples like Singapore's, it is possible to imagine ways in which continuous education can be made more accessible and affordable for the mass of citizens. But it is as easy—indeed, easier—to imagine a future in which the emerging infrastructure of lifelong learning reinforces existing advantages. Far from alleviating the impact of technological upheaval, that would risk exacerbating inequality and the social and economic tensions it brings in its wake. ■