Demand Driven Education

Merging work & learning to develop the human skills that matter

By Joe Deegan & Nathan Martin

About the Authors

Joe Deegan is a senior program manager with JFF, providing research and technical assistance at the intersection of postsecondary education and workforce development. He studies emerging and alternative education models that have the potential to benefit people from low-income backgrounds and other underrepresented college learners. He also provides program-level coaching to practitioners. Prior to working for JFF, Mr. Deegan managed a postsecondary bridging program that connected out-of-school youth to community college. He has taught English as a foreign language to Slovak middle and high school students as part of the Fulbright English Teaching Assistantship program. Mr. Deegan holds a bachelor's degree in English literature from King's College (Pennsylvania) and a master's degree in public affairs from Indiana University's School of Public and Environmental Affairs.

Nathan Martin is the director of Global Thought Leadership at Pearson. He brings education experience in the US and UK — in policy and technology environments, to improve learner outcomes. He has been involved with Pearson's work with efficacy, the Nevertheless podcast series and its efforts with the World Economic Forum. He has also helped lead work on Matterfund, a nonprofit project to help improve intelligence in education development and support promising education initiatives. Prior to Pearson, he worked for US and UK education foundations, directing local and national efforts to improve the effective use of digital learning. He began his career in journalism and has also worked for other education technology companies. He is based in the UK.

About Pearson

Pearson is the world's learning company. We're experts in educational courseware and assessment, and provide teaching and learning services powered by technology. We believe that learning opens up opportunities, creating fulfilling careers and better lives. So it's our mission to help people make progress in their lives through learning. *pearson.com*

About JFF

JFF is a national nonprofit that drives transformation in the American workforce and education systems. For 35 years, JFF has led the way in designing innovative and scalable solutions that create access to economic advancement for all. Join us as we build a future that works. *jff.org*

Contents

Executive Summary

To think about the future of work, first imagine a highway.

Take Route 66 in the US, connecting Chicago to Los Angeles. Or, in the UK, the 410 miles of the A1 from London to Edinburgh. There are defined endpoints, directional signs, entrances, and exits. Millions reach their destinations via these roads. Route 66 and the A1 were fit for purpose.

Traditional routes to employment have functioned much like these roads. Conventional credentials, university degrees, and vocational training have offered defined entrances and exits for individuals looking for jobs that lead to careers. But the world of work is changing fast. The future of work will require a more flexible, dynamic, and equitable system of preparation. A map of this system may look less like a highway and more like the iconic web of circles and intersections of the London Underground.

The last five years have been marked by a flurry of research and reports trying to chart the contours of the changing world of work.[1] The Future of Skills: Employment in 2030 (published in 2017 by Pearson in collaboration with Nesta and Oxford Martin) added an unprecedented level of detail to the debate.[2] The study challenged alarmism over projected widespread job automation. The authors introduced a novel mixed-method approach that combined machine learning with expert human judgment to examine seven key trends affecting employment by 2030. They analyzed not only the full spectrum of technological change, but also the potential effects of globalization, demographic shifts, environmental sustainability, urbanization, increasing inequality, and political uncertainty.

The report argues that the convergence of these trends will likely result in a world of work requiring specific knowledge and skills, especially complex thinking and interpersonal capabilities. As the future of work unfolds, what makes us human is what will make us employable.

But the pathway to sustained employment will not be linear. No single job will be a final destination. Maintaining a career will require a lifetime of learning. An education system fit for this evolving world — one which will value and strengthen essential human traits — will require significant reform.

To better understand the systemic change needed, JFF, with the support of Pearson, conducted an in-depth review of the field, interviewing more than 20 education and workforce experts in the US and the UK. JFF also performed original research comparing the data from The Future of Skills with United States Bureau of Labor Statistics projections.

This report, *Demand-Driven Education*, concludes that we are on the cusp of a new wave of postsecondary education reform. The first wave focused on access — getting more people to enter higher education. The second wave focused on improving academic success — getting more students to earn certificates and degrees. These waves served as the traditional highways to employment.

Now marks the transition to a third wave — which we call **"demand driven education"** — where programs focus more strongly than ever on ensuring graduates are job-ready and have access to rewarding careers over the course of their lifetimes. Demand-driven education adapts to the needs of the learner and the employer. It responds to signals from society to ensure alignment between desired qualifications and available training.

This wave represents the convergence of the worlds of education and work, creating new intersections, pathways, and possibilities for advancement. Much like the London Underground connecting its 32 boroughs via line, train, and bus, this new wave enables learners to take multiple routes throughout their lives to multiple destinations.

Demand-driven education takes account of the emerging global economy — technology-infused, gig-oriented, industry-driven — while also striving to ensure that new graduates and lifelong learners alike have the skills required to flourish. Bringing these practices to scale will require education systems to:

1. develop and measure the specific **skills** that will be most in demand, especially interpersonal skills and complex thinking;

2. utilize dynamic and work-based **pedagogy** to grow learners' competencies, while also preparing educators to embrace new forms of teaching and learning;

3. respond to the needs of the **labor markets** to ensure continuous alignment;

4. create flexible and adaptive **pathways** to allow learners to rapidly convert learning to earning; and

5. support changes that make the entire education **landscape** function better, enabling traditional and alternative providers to participate in creating the future of education alongside industry.

This report showcases promising practices from the US and UK to suggest a forward-looking agenda for education and training, moving from uncertainty to the economic advancement of all learners. Some of the strategies we profile include:

• competency-based education, which allows learners to show what they know as soon as they know it and move quickly to the next level;

• employer and industry-led models, which radically lower the opportunity costs of education by providing further training on the job;

• the latest labor market intelligence tools and techniques, which provide educators with powerful insights into the changing skills marketplace;

• dynamic and work-based pedagogy, to instill the critical skills needed for the future of work; and

• new pathways and business models that support access and completion for learners at any point in their career and at virtually any income level.

The future of work is becoming clearer. But changes in isolated schools, postsecondary institutions, and training centers will not be enough to create a system that develops and values those uniquely human qualities in the workforce.

Shifting from a static highway to a more dynamic network of pathways to employment will require individuals, industry, and education systems to take a more active, collaborative role. The recommendations offered at the conclusion of this paper are a start.

Introduction

The global forces shaping the future of work are making an impact on the teaching, learning, and assessment systems that must prepare workers for the future. Postsecondary education is changing at a rapid and accelerating pace in both the US and the UK.

Consider a few of the signs:

• The number of postsecondary competency-based education programs, which break the mold of traditional learning, grew in the US from 20 in 2012 to over 500 in 2018.[3]

• From 2002 to 2016, the number of apprenticeship participants in England rose from fewer than 400,000 to nearly 1 million.[4]

• The number of US short-term credentials, which require less time and less money than degrees, grew from 600,000 in 2002 to over 1 million in 2014.[5]

• As of 2014, the number of alternative education providers operating in the UK was 732 and growing, with a reported 1 in 5 interested in awarding degrees.[6]

• The global market for digital badges, which certify attainment of industry-specific skills, is expected to grow over 30 percent in the higher education sector alone from 2018 to 2022.[7]

A new landscape of education providers, industry innovators, and program funders has evolved in recent decades, signaling even bigger shifts to come. New combinations of actors are coordinating and competing with each other, creating a wide array of opportunities for learners.[8]

The emerging education ecosystem will look familiar in some ways. Most learners are served within traditional systems today. But many of those systems have started adapting to the new environment. They must continue evolving to respond effectively to technological change and industry demand. In some cases, traditional systems must accelerate the pace of change to meet the call for new skills. In others, a new infrastructure must emerge to support the growth and innovation already taking place.

The Future of Skills: Employment in 2030 (published in 2017 by Pearson in collaboration with Nesta and Oxford Martin) provides a lens with which to identify the education and training practices most likely to be relevant as economic and geopolitical trends reconfigure the workplace.[9] The report highlights seven key trends:

• technological change, especially related to automation and within the IT sector;

• globalization, as markets become more integrated worldwide;

• demographic shifts, including an aging workforce and the impact of millennials;

• environmental sustainability, as the global economy responds to climate change;

• urbanization, with population centers becoming increasingly dense;

• increasing inequality, as the middle class continues to dissipate and socioeconomic disparities persist; and

• political uncertainty, as institutions and policymakers strive to maintain geopolitical stability in the face of societal change.

The workforce of the future will need to work creatively and collaboratively to respond to these trends, to maximize the opportunities they represent, and to minimize the risks. This will require workers to develop specific skill sets not previously in high demand. In order to meet the skill needs predicted, educators will have to go beyond scaling existing best practices to incorporating new kinds of actors and initiating broader reform.

It should be no surprise that many education practitioners in the vanguard are either enabled by IT or engaged in digital training. Postsecondary education for so-called "new economy" careers, such as web development and data science, prepares learners for occupations that set the pace for change in the global economy. These graduates must be open to change, continually returning to strategies to collaborate, learn, and relearn.

Not all technology training is innovative. Not all innovators work in the digital education space. The tools and solutions needed to meet the demands forecast in The Future of Skills will surface from many sources. Postsecondary systems will draw upon proven approaches from K-12 education, apprenticeship, workforce education, short-term training, and more, lowering the walls that separate these models. If implemented well, thoughtful combinations of strategies will result in education options that are engaging, experiential, and rooted in real-world contexts.

In order to be successful, learners in the US and the UK will need to master an array of cross-cutting skills in interpersonal and higher-order cognitive domains. These skills will form a foundation upon which they can build and rebuild the specific occupational skills that will define the jobs of the future. Education systems will have to use intelligent technological and in-person engagement with the labor markets to demystify employer demand and ensure continuous alignment with skill needs.

The skills most essential to the future of work are the most difficult to impart in conventional classroom environments because little is known about how to promote their growth at wide scale. The most important skills are also highly contextual, meaning their development on the job will be very different from their development in class. Instead, educators must experiment with new ways to intermingle education and work experience within classrooms and the workplace. Where pedagogy is rote, it must become dynamic. Where it is isolated from the world outside the school building, it must become interwoven. Such change will require new roles for educators, who must build the specific competencies needed to be effective in the learning environments of the future.

In general, education will need to become more flexible and adaptive to learners, moving to a mass-customization paradigm with close involvement of employers and industry. Learners who are ready to move quickly will require approaches to accelerate their learning, while systems must also provide support for those who are slower to master core skills. This is an increasingly urgent issue for students

from low-income backgrounds and other groups who have been traditionally underrepresented in higher education. Many individuals have not had access to high-quality foundational skill building. Serving their needs must be front and center to meet the challenges of the new economy.

This report responds to The Future of Skills by exploring its implications for education systems and lifting up examples of forward-thinking practices in the US and the UK. To affect the postsecondary education landscape at scale, exceptional strategies will have to become new norms. Reconfiguration will be necessary at the personal, institutional, systems, and policy levels. The sea change will be driven by overwhelming demand for the key skills themselves — and so skills must be the starting point.

Skills
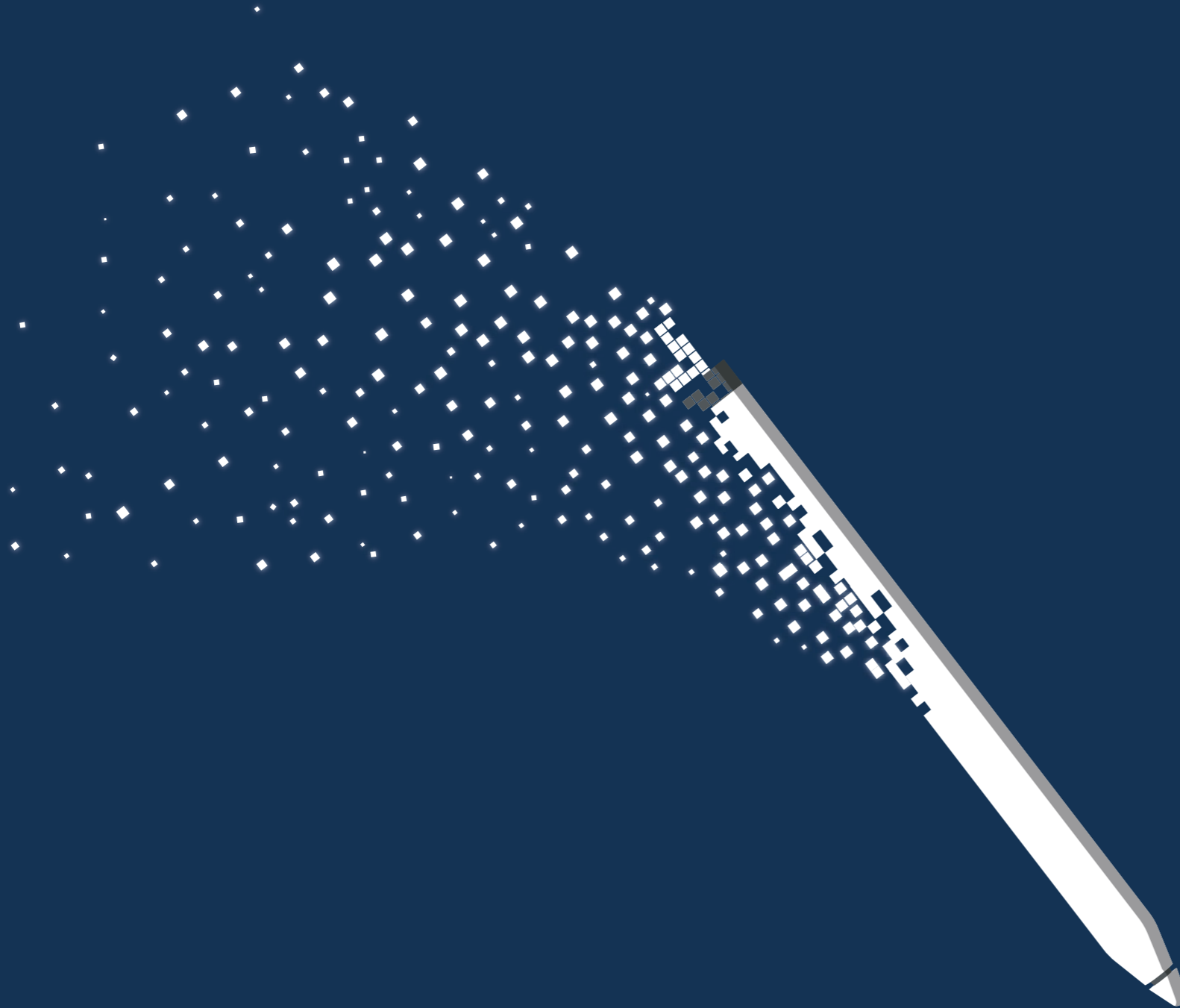
As the future of work unfolds, what makes us human is what will make us employable. Jobs requiring effective social interaction — such as management, teaching, nursing, and counseling — increased by over 10 percent in the US labor force between 1980 and 2012.[10] Ongoing demographic change and the growing impact of globalization mean this trend will likely increase over time, as intercultural interactions become increasingly critical.[11]

It is no coincidence that educators, employers, researchers, and policymakers have been calling for greater emphasis on so-called "21st-century skills" in schools and training centers for decades, generating a broad and overlapping array of frameworks.[12] Helping people prepare for the future of work, however, will require a more precise understanding of the skills that will drive the economy well into the 21st century.

The Future of Skills made a giant leap in this direction, identifying the specific skills that are likely to grow in demand as megatrends — such as the rise of intelligent technology — redefine the global economy. These top skills, which include interpersonal capabilities and complex systems thinking, are difficult to instill and measure using standard methods, which explains why progress has been slow thus far in closing skill gaps.[13] To be successful, education systems will have to build on innovative strategies. Both digital and in-person solutions are emerging, providing education systems with ways to enhance distinctly human abilities.

The 21st-Century Skills Landscape

The sheer number of 21st-century skills frameworks illustrates the growing awareness that learners must be able to solve complex problems as readily as they can reproduce knowledge — and do so collaboratively.[14] These frameworks are wide ranging, but the constructs share many similarities, usually an emphasis on thinking critically, managing one's own workload, working well with others, and demonstrating technological literacy.[15]

Employer demand for these skills is illustrated in a 2017 survey by the Confederation of British Industry (CBI) and Pearson. The survey found that employers value above all the attitudes and aptitudes that will enable graduates to be effective in the workplace, in addition to academic preparedness. More than half of graduate recruiters (55 percent) ranked this as the single most important factor in hiring decisions, while the vast majority (90 percent) cited it among the three most important factors.[16]

This burgeoning interest in skills, however, has not yet resulted in better preparation at scale. Employers report that current graduates of postsecondary programs are not well prepared in several key dimensions of 21st-century skills. A survey conducted on behalf of the Association of American Colleges and Universities compared the opinions of major employers with those of graduating students regarding the graduates' level of preparation for career success. Researchers found a more than 20 percent gap between the two

groups' views regarding graduates' ability to work within a team; locate, organize, and evaluate information; be innovative; think critically; and make ethical decisions.

In-Demand Skills in the Foreground

The Future of Skills adds clarity to the 21st-century skills movement by highlighting the skills that will be in greatest demand in the US and UK in the future. The chart below spells out the top 10 knowledge areas, skills, and abilities for both countries (with the full technical report listing all 120 in rank order). While the two lists share some common themes, each context has unique features. In the US, personal and social capabilities are particularly important. Workers in emergent and future occupations will need to think, work, and learn collaboratively, teaching and persuading those around them as they solve novel problems. Higher-order cognitive skills related to creativity and complex problem solving figure prominently, as well. In the UK, skills related to systems-oriented thinking — understanding how a complex and interdependent set of phenomena operate and respond to conditions and to the environment — top the list.

CHART: TOP 10 Knowledge Areas, Skills, and Abilities for the UK and the US

	UK		USA
1	Judgement & Decision Making	1	Learning Strategies
2	Fluency of Ideas	2	Psychology
3	Active Learning	3	Instructing
4	Learning Strategies	4	Social Perceptions
5	Originality	5	Sociology & Anthropology
6	Systems Evaluation	6	Education & Training
7	Deductive Reasoning	7	Coordination
8	Complex Problem Solving	8	Originality
9	Systems Analysis	9	Fluency of Ideas
10	Monitoring	10	Active Learning

> What makes us human is what will make us employable

Many, if not all, of the skills on this list are difficult to assess individually using current measurement tools.[19] Fortunately, educators are coming up with innovative ways to improve assessment, using new technologies as part of the solution. The jobs of the future will require braiding human and technological capabilities, and so will the learning and assessment systems that prepare people for these roles.

Measuring the Development of Future Skills: Emerging Models and Proven Ones

Reliably instilling the specific skills needed for the future of work will require a deep understanding of how learners develop them.[20] For example, an instructor might provide examples of collaboration skills by first encouraging brainstorming, a relatively easy activity, and progress through additional steps before tackling a more difficult task, such as negotiation.[21] The challenge facing the field is that our current understanding of how these critical skills form over time — and thus how learning activities should be scaffolded and taught — is limited.[22]

Measuring proficiency in these higher-order areas will require new models of assessment, as well. The inherent complexity of future-facing skills will require education systems to employ many strategies of measurement, positioned along what US assessment experts David Conley and Linda Darling-Hammond term the "continuum of assessments." The continuum stretches from standardized, multiple-choice tests on one end to entirely student-led projects on the other.[23] A thoughtful combination of approaches will allow educators to capture and reinforce deeper learning, a concept that encompasses the interconnected abilities to communicate, collaborate, regulate one's learning, and persevere in the face of difficulties.[24]

"Performative" or "performance" assessment is one especially critical point along the assessment continuum. This technique requires test takers to generate complex outputs, often by demonstrating tasks ("performances"), such as a scientific investigation or a literary analysis.[25] Performance assessment will become increasingly important since the most relevant skills for the future of work are performative by definition. The only way to "measure" or "observe" them is through their enactment in a relevant context. For example, collaboration and negotiation in one environment may differ completely from collaboration and negotiation in another setting. This demonstrates the importance of ensuring that teaching, learning, and assessment occur in authentic contexts, as opposed to traditional classrooms, which don't resemble any other real-world setting. Both the in-person techniques and digital approaches profiled below are emerging or established forms of performance assessment.

The jobs of the future will require braiding human and technological capabilities, and so will the learning and assessment systems that prepare people for these roles

Collecting data is the first step in developing and measuring higher-order skills. Educators must embrace new learning and assessment technology to collect rich data on individual progress. As education researchers Kristen DiCerbo and John Behrens at Pearson argue, education is creating a "digital ocean" of data, where both formal and informal learning activities can generate valuable information for educators.[26] Traditionally, instructors needed to maintain a mental profile of each learner's skills and attributes alongside graded activities and scores from standardized assessments. Information was limited by the capacity of the instructor to observe, store, and update these mental models using painstaking analog documentation processes. Little of this information would transfer from instructor to instructor, especially the nuances of both cognitive and noncognitive progress of each learner. Digital learning — the use of fully or partially computerized learning — is beginning to fill in the gaps and has the potential to create more sophisticated and portable learning profiles.

"Serious games," digital environments explicitly designed to educate or train, allow educators to both observe and influence complex skill development.[27] These games can collect data on various aspects of a participant's actions, depending on the intent and design of the game environment. These include time spent on decision making, messages sent to other participants, objects accessed within the game, and choices leading to the solving of a problem. Though more widespread in K-12 education, postsecondary career-focused game models are already emerging.

For example, Cisco's Packet Tracer, a computer network simulator, allows learners to refine their skills at configuring computer networks, simulating real-world connectivity problems for them to solve.[28] Researchers have modified Packet Tracer to include competitive and collaborative scenarios and are collecting metadata on how quickly learners increase their efficiency at problem solving in groups.[29] Serious games have the potential to accelerate our understanding of how key skills develop in real time. With more study, it may be possible to use these insights to inform the design of more effective learning scenarios and better assessment tools.

Digital learning is becoming increasingly sophisticated through the expanding role of AI, which can leverage learner data to suggest activities tailored to the needs and assets of individual learners.[30] Machine tutoring, where artificial intelligence (AI) interacts with a human learner to build and evaluate skills, is already becoming more prevalent.

One prominent example is the chatbot created by language training provider Duolingo. Users who install the chatbot app on their smartphones can interact with it each day to learn Spanish, German, or French from an AI tutor.[31] A study funded by Duolingo but conducted by independent researchers found that a majority of Spanish language learners using the chatbot made statistically significant gains on a standardized language test after eight weeks.[32] These results bode well not only for AI in education, but also illustrate how dynamic interactions generally may enable faster skill acquisition that will be essential for an ever-changing workplace.

AI-driven systems also can identify potential matches between learners and specific career paths, especially for individuals underrepresented in current systems. The predictive talent analytics firm Knack uses a game-based platform to identify traits and abilities of participants. Gameplay data are compared against pre-built occupational profiles developed in partnership with employers. When a Knack user's performance matches the requirements of a specific job, the user is identified as a good fit for that role. In a study of 600 young people (ages 16 to 24) who were not in school or working, Knack found that 83 percent scored at or above the aptitude level of average-performing incumbent workers in entry-level roles at four major companies. Their skills and abilities were distributed in a similar pattern, unrelated to race, ethnicity, or education level.[33] Technology like this has the potential to drive intelligent mapping of the traits that predict success in the workplace, while also reducing bias in hiring.

As the scale of AI in education grows, so will its capabilities, because the machine learning functions of AI become more useful with larger organized data sets to draw upon.[34] Tutoring providers, such as Third Space Learning, are already using voice recognition and activity monitoring to collect data on person-to-person tutoring to improve the performance of machine tutors in the future.[35] Since machine tutors can enable "anytime, anywhere" learning at low cost, this technology has the potential to aid millions of low-income students who may not have reliable or affordable access to human tutors. This is especially true given the spread of smartphone technology in both the US and the UK, where adoption rates are well over 80 percent of the population of each country and climbing.[36]

Learners will also have a role in curating and showcasing their own competencies, creating individual portfolios of learning artifacts to demonstrate their accomplishments leading, communicating, and analyzing. Digital portfolio providers like Pathbrite are already making it easier to store and organize multiple types of information,

including documents, video, credentials, and digital projects.[37] Meanwhile, LinkedIn allows users to display work samples alongside resume information, skill endorsements, and recommendations from colleagues.[38] Through the use of dynamic and portable portfolios, learners can curate their work and training experiences in a way employers might quickly understand.

Overcoming Barriers to Expansion

For digital learning to make a difference at scale, however, education systems will have to overcome several barriers. For example, there are pressing concerns around access to, and ownership of, educational data.[39] On a practical level, educators must learn how to utilize massive new flows of information. Beyond recognizing the value of the "digital ocean," practitioners will have to determine what data to collect, when to collect it, and what to do with what is collected.

The challenges also include issues of validity and reliability. In order to be broadly useful, digital learning tools must actually measure the skills they purport to measure, and the standard methods that researchers use to validate conventional assessments must be adapted to evaluate digital learning environments.[40] Technology must also evolve to reliably capture the collaborative and interpersonal skills of groups of learners in a way that predicts performance in the real world.

While digital approaches mature, educators can use in-person techniques to measure capacity for complex problem solving, systems analysis, and collaboration. Career areas such as health care, where simulation learning has a decades-long history of helping students develop and measure critical competencies, demonstrate that in-person scenarios judged by a human instructor can yield highly valid qualitative information.[41] In this type of performance assessment, evaluators employ rubrics designed to judge complex skills displayed within individual or group exercises. Strategic human resources managers have developed and refined methods of measuring candidate performance in assessment centers, where recruits demonstrate job-related activities. Assessment center methods have been shown to be predictive of job performance over time.[42]

Even when digital learning systems reach full maturity, there will be a need for skilled educators to fill in gaps by assessing learners in person. The challenge for education and training systems will parallel the challenges of the evolving workplace: how to continuously and intelligently reconfigure human-centered, in-person approaches to complement increasingly valid and useful technology for instilling and measuring critical skills.

This technology has the potential to aid millions of low-income students who may not have reliable or affordable access to human tutors

Defining and assessing complex and relevant skills cannot take place in a vacuum. Educators must use emerging tools and techniques within a pedagogical framework that is itself configured for the task. Aided by digital learning tools and fluent in performative assessment techniques, the next generation of educators must work with students to co-create learning experiences that are active, engaging, and relevant to the future world of work.

Pedagogy

To impart the skills that will matter most in the workplaces of the future, teaching and learning must fundamentally shift from a paradigm of knowledge transfer to one of collaborative insight; from auditorium to laboratory. Fortunately, pockets of innovation at the K–12 grade levels are growing as more people explore learning approaches that are creative, collaborative, and focused on problem solving. The demand for new skills is setting the conditions for more dynamic pedagogy to emerge in the postsecondary space, as well.

Since these skills differ greatly depending on the occupational context, work-based learning, bolstered by the same digital advancements that are reconfiguring the economy, will figure prominently in the next generation of postsecondary teaching and learning. Bringing new models to scale will require testing, refining, and spreading the best innovations throughout well-designed systems, supporting them with appropriate assessments and policy; and redefining the competencies that educators need. Fully integrating these approaches will also require educators and employers to develop new expertise as co-creators of dynamic learning experiences.

Dynamic Learning

Around the globe, a new generation of primary and secondary learning environments are supporting what education innovator Charles Leadbeater terms "dynamic learning," which knits together interlocking domains of knowledge, personal development, social experiences, and individual agency.[43] These schools vary widely in approach but exhibit some common characteristics. Learning is active and uses problem solving to develop foundational skills and knowledge. Curricula are designed to encourage and reward creativity and collaboration. Such schools resist routine, teacher-led instruction in favor of learner-led exploration that increases in difficulty with the ambition of the challenges educators set. Tools of the trade include blended learning, project-based learning, experiential learning, and more. Educators perform roles beyond planning, instruction, and grading.

Even many dynamic classrooms, however, are not yet relevant to the workplace. Work-based learning (WBL) is a promising approach to extend and focus dynamic learning through exposure to real-world experiences in fields of interest. High-quality WBL models require learners to go to a workplace or work with an employer on meaningful job tasks that help them develop skills, enter a career field, or advance along a career pathway.[44] Collaborative, experiential, and problem-based, WBL can provide the authentic challenges that students must learn to solve as well as the real-world environments in which to solve them.[45] WBL fosters metacognitive and interpersonal development through meaningful relationships with supervisors and mentors, as well as with educators.[46] This approach simultaneously strengthens both knowledge and skills as participants collaborate with colleagues and communicate with employers about their work activities.[47]

This harmony of industry and higher education offers the chance to tailor training to the needs of employers but also provides an example of a more optimistic take on the future of work. The recently opened UK-based Dyson Institute of Engineering and Technology partners

The demand for new skills is setting the conditions for more dynamic pedagogy to emerge in the postsecondary space

with the University of Warwick to offer students the chance to earn a bachelor's degree in engineering while working alongside Dyson engineers and earning a salary. As founder and inventor Sir James Dyson told The Guardian in 2017, "A lot more of our production is fully automated, but people are needed for other things. We don't need to worry about automation or robots at all. It increases the number of more interesting jobs for people."[48]

WBL has the potential to respond to increasing inequality as well as skill gaps. The wages paid to many WBL participants both reward their efforts and support the inclusion of low-income learners by providing an opportunity to combine learning and earning. In settings where all learners have access to it, WBL also evens out disparities in social capital by connecting participants to viable professional opportunities regardless of their personal connections with others in the working world.[49] For example, a participant in a finance program with a work-based learning (WBL) component would not need pre-existing contacts in the industry in order to secure an internship; the matching process would be facilitated by program-level partnerships with employers.

Digital Providers and the Work-Based Learning Continuum

WBL programs exist along a continuum broadly divided into three categories of increasing intensity, with each category requiring more commitment from all stakeholders and a higher level of employability skills from participants than the last:

- career exposure, which facilitates broad familiarity with an industry or occupation and might include job shadowing or mentoring;

- career engagement, which explicitly builds employability and occupational skills, and might consist of internships or simulations; and

- career experience, where participants learn skills, receive paid work experience, and might rise to the level of an apprenticeship.[50]

There is an entire field of emerging practitioners working at individual points along this continuum. These models leverage new technologies to blend education and work, challenging learners in novel ways.

Career exposure can now take place virtually on platforms that bring industry expertise directly into the classroom. The online learning platform Nepris facilitates interactions between industry leaders in STEM fields and educators. Educators can tune into live industry conversations or request on-demand video interactions with experts in specific fields. Though designed for K-12 classrooms, postsecondary institutions and regional STEM hubs have also used the platform.[51]

Solutions like Nepris empower learners to connect with experts to test their own hypotheses about vexing problems, a relevant skill in what will become an increasingly networked and interdependent workplace. This lowers the barriers to access for rural and low-income communities, or for institutions that may have skill gaps in their region. For example, one high school teacher in rural Louisiana used Nepris to connect students in his classes to over 30 different experts from across the nation.[52]

Career engagement is happening in the form of digital simulations, live challenges, and remote internships that develop and, in some cases, assess learners' skills in real time and under real-world conditions. For example, Mursion is a virtual platform that blends human actors and AI to simulate demanding interpersonal scenarios in fields such as education, health care, and hospitality.[53] Mursion provides real-time feedback to participants on their performance, helping them to refine their skills in a safe and transparent environment.[54] Digital simulations are not new, but the previous generation collected data on specific occupational problem solving, while Mursion captures information from complex interpersonal challenges.

Some models go beyond simulation to provide a real-world problem for learners to solve in real time. For example, the online course provider +Acumen, which is connected with the social lending organization Acumen, conducts real-time, live-action challenges for its invitation-only community of users.[55] The challenges are two-hour events that take place on the team collaboration platform, Slack. +Acumen works with a social entrepreneur to present a difficult problem to over 200 individuals logged in and assigned to small groups. Participants are a mix of expert practitioners and completers of +Acumen courses from around the globe who work together to explore the problem with the entrepreneur and generate solutions.[56] Eventually, educators are likely to build curricula around several novel, real-world challenges throughout a learning experience, not unlike clinical teaching applications in medicine and law.

Digital internships, where all work activities take place remotely, are also increasing in prominence. These are driven by both experiential learning platforms that connect learners to employers and by employers themselves. For example, the digital collaboration developer Basecamp offers selective 12-week summer internships that take place entirely online. Interns work for Basecamp staff on real product development, with their experiences usually culminating in a deliverable for the company.[57] The changing nature of work will continue to enable learners to access high-quality career engagement like this from anywhere.

Career engagement experiences like these vary in both the skill level required for participation as well as the amount and kind of feedback that learners receive. Designing learning experiences around these modalities will require educators to take on new roles that complement learner experiences, including scaffolding skills and providing direct coaching and feedback. For example, an educator might use data from a virtual interaction or internship supervisor to set the agenda for instruction around a specific skill, such as negotiation or time management.

As digital career exposure, engagement, and experience opportunities continue to grow, care should be taken not to underestimate the value of in-person interactions and relationship building with mentors in the workplace. Done in concert with other opportunities, exposure and engagement mediated by technology can solve problems of scale and grant access to rural or otherwise disconnected learners. Just as digital skills assessment complements performative approaches, so do these digital experiences complement in-person ones.

Apprenticeship models, co-ops, and on-the-job training provide career experience at the most intensive end of the work-based learning (WBL) spectrum. They are built around paid work experience that develops transferable skills within an industry, complemented by rigorous coursework. Digital apprenticeship programs in IT and adjacent fields most closely resemble the kind of dynamic skill attainment that will be increasingly necessary in the global workforce. The problems that these workers are learning to resolve inherently require a blend of human ingenuity and digital fluency.

For example, the London Legacy Development Corporation, associated with Queen Elizabeth's Olympic Park, coordinates youth apprenticeships in several industries with digital skill gaps, especially the rapidly digitizing construction industry. Apprentices work at the intersection of technologies like building information modelling and the literal brick-and-mortar processes of construction.[58] London Legacy is helping to meet demand for digital skills while also diversifying the industry, bringing young people from underrepresented backgrounds into high-wage jobs.[59] The success of apprentices in these models exemplify how WBL as a pedagogy can help learners advance in a field that is rapidly transforming due to technological change.

In the US, Amazon created a Registered Apprenticeship program to train military veterans in cloud computing in partnership with the United States Department of Labor.[60] Participants spend 16 weeks in a community college, where they earn industry-recognized certifications like CompTIA Network+, Linux+, and AWS Solutions Architect, followed

by structured, work-based training in an Amazon web services center.[61] The Amazon model shows how apprenticeships can help adult learners rapidly adapt to a new career path, an option that is increasingly necessary given the aging US population and a more frequent rate of career change. Amazon offers a similar program in the UK called re:Start.[62]

Education systems can serve multiple roles in apprenticeship models, from organizing partners to supporting learners.[63] High-quality apprenticeships also require related technical instruction and coursework that is aligned to real-world tasks.

In the UK, Pearson Business and Technology Education Council (BTEC) courses have features similar to apprenticeships, but completely integrate technical instruction with on-the-job learning. All the projects and assessments in a BTEC course are contextualized, corresponding to the real-life conditions of industry. Schools, colleges, and universities offer the courses, which can be taken alongside other academic coursework or full time. [64]

JFF has helped some US community colleges to experiment with work-based courses, which resemble both BTEC courses and apprenticeships. In a work-based course, learners are paid for their work and receive rigorous instruction in the workplace and also in a classroom, lab, or online setting. Unlike apprenticeships, work-based courses incorporate employer evaluations into the grading scheme. The courses, which are co-designed with industry, do not necessarily lead to a single occupation as apprenticeships do, but fit into an academic program of the college. This means that the credit that students earn corresponds to a required course rather than going toward general graduation requirements. Work-based courses help accelerate learners toward readiness without the extensive hour requirements and regulatory compliance of a full apprenticeship. For example, the work-based courses partnership between Owensboro Community and Technical College in Kentucky and manufacturer Kimberly-Clark has produced candidates who are ready to enter a manufacturing setting more quickly than those who pursued either on-the-job training or education alone.[65]

Work-based learning, in all its forms, has the potential to disrupt and enhance the postsecondary learning environment, bringing problem solving and interpersonal competencies into the foreground. These models prepare learners in multiple ways: their networked delivery modalities, the collaborative digital competencies that they require learners to develop, and the novel problems that learners will have to solve under real-world conditions.

> Work–based learning, in all its forms, has the potential to disrupt and enhance the postsecondary learning environment, bringing problem solving and interpersonal competencies into the foreground.

Work is already underway to map the configuration of capabilities that providers will need to successfully support in-depth work-based learning models into the future. The Collab Group of colleges (UK) developed the Organisational Capabilities Framework to guide improvements to technical and professional education providers who seek to implement high-quality, employer-led programs. The framework recommends that providers evaluate and increase their capacity in four key areas: delivering customer value; partnering and integrating; adapting and innovating; and performing and improving.[66]

Integrating Work-Based Learning as a Dynamic Pedagogy

As the landscape of work-based learning (WBL) opportunities evolves, education systems will have to coherently incorporate them into programs while helping learners develop the skills and knowledge necessary for success. Flexible frameworks, such as the Pearson Career Success Program, which connects career preparation to academics and progressively builds employability skills, are increasingly important in the interim period while institutions adapt to new paradigms of working and learning.[67] Learners will need support in navigating the WBL opportunities and understanding the required self-management skills.

Educators will require new skills to shift from instructor-led classroom teaching to more dynamic, personalized pedagogies that prepare learners for work-based experiences and fully leverage those experiences as objects of study. Participating employers must adapt to being co-owners of these learning experiences. Effective WBL will not result from learners simply participating in work. Rather, educators and employers will have to work together to help learners make meaning of their experiences, introducing them to new ways of thinking that will guide their transition into professional life.

New sets of principles are emerging to address the skills that instructors need to move beyond the legacy system of classroom teaching. For example, a US team led by Rebecca E. Wolfe of JFF and Jennifer Davis Poon of the Council of Chief State School Officers synthesized 12 pre-existing teaching and learning frameworks in the K-12 space to create the Educator Competencies for Personalized, Learner-Centered Teaching, which organizes educator competencies into four domains:

• cognitive — the academic content and learning science that instructors must know;

• intrapersonal — the habits, expectations, and attitudes they must process and model;

- interpersonal — the social and leadership skills they must use in relationship to others; and

- instructional — the pedagogical approaches and methods they must use.[68]

Instructor training must evolve across these dimensions to fully support dynamic learning and skill attainment. More research is needed to fully understand how educator competencies like these might translate to the postsecondary environment, where emerging faculty typically receive little to no training on teaching practice.[69] For example, it is likely that many of the educator skills related to the cognitive domain can apply to postsecondary faculty with little modification, as those competencies refer to specific content and developmentally appropriate learner strategies. However, the interpersonal strategies written for a K-12 system may need to look completely different when applied to a postsecondary context with adult learners and different governance structures.

The continuing development of high-quality training for educators in postsecondary systems, especially community colleges (in the US) and further education colleges (in the UK), will be of paramount importance. These colleges serve the broadest cross-section of society in both countries, meeting the needs of local and global economies, and yet face chronic resource scarcity.[70] Closing skill gaps, especially as the world of work rapidly changes, will require broad access to the best pedagogy. Investments in educator competency at the college level are a prerequisite. The impetus is not on college faculty alone, however. Employers and educators must learn from each other as they collaborate to make pedagogy more dynamic and relevant to the changing workplace.

Finally, course content must update more rapidly as the pace of change increases in industry. In addition to creating learning experiences that lead to skill gains in interpersonal, systems-thinking, and problem-solving domains, educators will need to address the specific occupational skills that are in demand in the labor markets. The following section outlines transformations in how education systems interpret the demand for skills to ensure continuous alignment with current needs.

Labor Markets

Technology will continue to disrupt the workplace, forcing employers to redesign occupations over and over as automation changes skill and knowledge requirements. Education providers quickly understand which occupational skills are critical for success and create programs that are responsive to market demand. The education system should leverage increasingly sophisticated sources of labor market data to drive intelligent collaboration with employers and more nimble program design cycles. The ability to quickly move from data analysis, to employer engagement, to program redesign and back again will be a core component of successful education programs.

Data Sources and Tools

Fortunately, labor market information tools are becoming increasingly accessible for educators. Most community colleges in the US utilize a form of labor market information (LMI) data service,[71] with labor market analysis units becoming almost as common as offices of institutional research. At the same time, mergers, such as the purchase of LMI provider Economics Modeling LLC (Emsi) by Strada Education Network, illustrate the strategic advantages of incorporating powerful LMI functions directly into education systems.[72]

LMI vendors are making it easy for analysts to spot in-demand skills and credentials in their markets using little more than a web browser. This includes traditional LMI, real-time LMI derived from online job postings, and other emerging data sources that are mapping career advancement in the real world and identifying the key behaviors of successful incumbents.

Traditional LMI, which is derived from public sources such as the Quarterly Census of Employment and Wages (US) or the Labour Force Survey (UK), provides insight into the scope of job and wage trends over time as well as occupational and industry projections. Traditional labor market aggregators such as Emsi apply proprietary methods to estimate suppressed data (values that are not disclosed in public datasets), link disparate data sets (covering different regions, industries, and types of workers), and parse data at the regional and metro levels, allowing for data with greater detail and reliability.

Meanwhile, real-time labor market information (RT LMI) is based on online job postings that have been aggregated, de-duplicated, and coded in a manner that allows users to analyze up-to-date trends by geography, occupation, and/or industry. RT LMI offers a current source of business intelligence that also provides more detail about the skills and credentials employers are seeking and the specific employers posting jobs. RT LMI aggregators, such as those produced by Burning Glass Technologies, can extract and derive information from more than 70 data elements in a single online job posting.[73] RT LMI allows educators to identify trends in skills at a granular level much more quickly, adding detail to the predictive modeling of traditional LMI.

These analysis methods are being supplemented with emerging data sets that go beyond labor market demand to also understand the experiences of incumbent workers.

Upwards of 69 percent of companies are building databases of employee traits and behaviours in order to improve talent decisions

For example, the City University of New York's Center for Urban Research partnered with PayScale.com and Monster.com to link resume data with self-reported wage data and longitudinal postsecondary student records. This effort allowed CUNY to produce career maps illustrating career progressions from entry level through late middle career in several sectors that included actual wage data.[74] The result was an unprecedented level of detail in terms of how people progress (or fail to progress) in actual careers, arming policymakers with powerful tools for better understanding how training programs can better prepare people for the workforce, both from the short-term occupational perspective and the longer career perspective.

Finally, the field of people analytics has reached maturity, with one 2017 study reporting that upwards of 69 percent of companies are building databases of employee traits and behaviors in order to improve talent decisions.[75] Employers are using next-generation tools to collect data including travel patterns, office hours, email metadata, and even external sources of data in social networks. These are fed into AI systems that compare them to performance and advancement, providing insight into the behaviors and attitudes that predict success in a complex and knowledge-driven economy. People analytics is changing hiring processes, management training, and incentive structures within the organizations that embrace the approach.

Google famously used people analytics to identify eight key behaviors of great managers. In 2008, Google faced an internal revolt of its highly skilled engineers against managers, whom they viewed as an obstacle to their work. Several years earlier, the company had abolished hierarchy altogether, but reverted back when the daily challenges of management outstripped co-founder Larry Page's ability to respond.[76] Google hired a team of data scientists, who mined the company's databases of 360-degree performance evaluations, employee surveys, and exit interviews, and compared these data against performance outcomes, such as worker happiness, turnover rates, and internal productivity measures. Dubbed Project Oxygen, the analysis revealed that great managers actually add value to the teams they manage, and identified a set of ideal management behaviors, complete with activities and best practices for each. For example, the behavior "empowers the team and does not micromanage" includes supporting activities such as "[advocating] for team with others outside the team."[77] Google used the results of Project Oxygen, which has since added two new behaviors to its list for a total of 10, to inform management training and drive performance improvement across the organization.[78]

Education systems will be able to capitalize on people analytics as another LMI source, developing multiple use cases for the insights that organizations uncover about successful workers. The real-world behaviors and attitudes that predict success can add more detail to competency models for specific occupations and industries — and therefore the curricula designed around them. Data-driven career counseling could compare the personality profiles of learners to known archetypes, like those developed from employee data by one global restaurant chain appearing in a McKinsey case study, and help learners choose career paths that correspond to their strengths.[79] Finally, people analytics will likely grow the market for customized, business-to-business training programs once organizations can pinpoint results, such as improved retention rates, that lead to returns on investment in training.

Even the most complete and relevant data sources cannot help educators if they work in isolation. Real collaboration with industry is necessary to make meaningful changes to curricula and beyond. This means redesigning pathway structures that cover academic and technical learning and employability skills in and out of the workplace. New forms of collaboration with employers are already emerging.

Employer Engagement as a Data Source

Just as the future of work will pair advanced technology with uniquely human skills, so must educators enhance their data analysis with strategic employer engagement.[80] Serving employers through business-to-business or incumbent worker training programs, reverse engineering the hiring process, and using industry expertise to refine program designs are three primary ways that employer engagement can add to labor market insights and facilitate continuous alignment to market demands. Engaging industry is also much less time-intensive and costly than creating sophisticated, new data methodologies to predict skill needs.

Providers of accelerated digital training, such as General Assembly and PerScholas, already work directly with employers on business-to-business projects. These initiatives range from co-designed, proprietary skill assessments to entire talent pipelines that provide on-ramps for jobseekers who may not already have technical skills. By creating a portfolio of employer-funded services, providers gain valuable insights that they can use to drive improvements for their open enrollment programs, which are available to the general public. Community colleges in the US have done similar work in noncredit and contract training programs for decades, but the extent to which digital skills can be transferred is making it easier than ever for

educators to use the insights gained from business-to-business work to inform their entire approach to education. [81]

Other innovators are reverse engineering the hiring process by serving jobseekers as well as learners and employers. Some digital training programs assist graduates of traditional education to secure jobs in digital fields, gaining insight on up-to-date strategies for seeking and persisting in employment. Practices like these help them include what Pearson has termed "transition skills," competencies such as interviewing and networking that are critical to moving from education into work, and ensure that graduates know how to present their most important knowledge, skills, and abilities to employers.[82]

Using Perishable Data to Refresh Programs More Quickly

While many employability and transition skills are almost timeless, other occupational and demand signals have a much shorter shelf life. Educators must continue refining processes for more agile and adaptable program design to capitalize on up-to-date information from the field. These include the makeup and structure of instructional design units as well as the learning modalities that these units apply to organize learning and assessment. Ideally, curriculum architects would be able to function like an agile software development team, with a team lead supported by instructional designers, labor market analysts, user experience specialists, and subject matter experts who can refresh learning content on a regular basis. These teams could validate new iterations of curricula with employers through hypothesis testing and external review, additional sources of demand signals from industry. Instructional design must also go beyond curricula to continuously update and design experiences that bring learning to life through work-based learning.

Elements of such a design team exist today. Short-term digital training organizations like General Assembly use a blended staff structure that allows them to develop and test courses in the same way their graduates work with software, iterating on what already exists and bringing in industry input through both roundtable sessions and formal channels.[83] Pearson College London, which provides full degree programs in the UK, takes this process even further by bringing in industry experts from major employers to teach courses directly.[84] In the traditional postsecondary field, there are many configurations for instructional design teams, from single designers who work as generalists, through large teams with defined specialties and course loads.[85] These designers work with faculty members to build courses that work well in online and blended learning environments. For example, at Oregon State University Ecampus, a team of eight

instructional designers offers services covering the entire course development process, with options for more basic consultancy if a faculty member prefers to take the lead.[86]

Competency-based education (CBE), which already allows for nimbler curriculum design today, would further enable instructional designers to create programs that are built to be upgraded frequently. In a CBE program, the design process begins with a set of distinct yet interrelated competencies that reflect what a participant must know and be able to do. The rest of the program, including assessment and instruction, is then built backward to precisely instill and validate those competencies. CBE is therefore inherently modular, allowing designers to replace or revise outdated competencies while retaining relevant ones.

This ability for CBE to be updated as industry changes is becoming a widely recognized feature. The Competency-Based Education Network, which sets quality standards for postsecondary CBE models in the US, lists the practice of continuously updating individual competencies based on the needs of employers and society as a key norm of highly developed programs.[87] Industry leaders can help educators define current, job-critical competencies based on the occupational skills that are most in demand now and for the future, while broader cross-cutting competencies remain unchanged as long as they are relevant.[88]

Innovations such as competency-based education are valuable not only for their flexibility in a changing skills marketplace, they also have deeper structural features that allow for the creation of more adaptive pathways for learners. The following section outlines the need for people to more rapidly convert learning to earning, as well as innovations that are enabling such conversion to take place.

Pathways

Career pathways represent the strategic alignment of education and industry to set learners on a trajectory to credentials with value in the labor market Traditionally envisioned as a ladder or series of experiences leading to a rewarding career, the concept of pathways will have to expand in response to large-scale changes in the economy.

The pace of economic change is accelerating, as is the demand for a workforce with postsecondary credentials.[89] At the same time, the structure of employment itself is shifting. Workers in both the UK and the US are changing jobs more frequently, while the proportion of the labor force engaging in "gig" (contract) work and other alternative work arrangements in both countries is significant and on the rise.[90] Employers will continuously redesign jobs to balance technology and human resources, so even with a solid foundation of cross-cutting skills, workers will have to master new information throughout their careers. Workers will require more flexible learning opportunities to build knowledge while minimizing opportunity costs. Even today, many workers are interested in pursuing further education, but view time commitments, scheduling, and cost as significant barriers.[91]

Education systems will have to meet new demands from both employers and learners, expanding access to programs that allow learners to demonstrate their existing skills and fill in the remaining gaps more rapidly. Fortunately, there are several sources of innovation to draw from to meet this challenge. The traditional for-credit postsecondary system has pioneered and tested effective acceleration strategies for years. Digital training academies are operating new intensive models for both novices and incumbent workers. Meanwhile, an entire ecosystem of short-term credentials offers yet another set of options for low-cost and rapid training. Model employers are already partnering with education and training providers to weave together multiple elements of these systems to create pathways for their employees.

Adaptive pathways must allow learners to begin their education and make substantial progress regardless of their level of preparation or life circumstances. The strategies profiled below represent the components that will make up the career pathways of the future.

Credit for Prior Learning

Aside from direct credit transfer, credit for prior learning (CPL) is the fastest way anyone can make progress toward a degree.[92] CPL allows students to earn academic credit at traditional postsecondary institutions for prior knowledge, military service, work experience, or even massive open online courses. The most common way that learners earn credit is through standardized exams, though many institutions also offer proprietary "challenge" exams, credit for participation in certain kinds of vetted training programs, and credit awarded based on a portfolio or interview that demonstrates a learner's competencies.[93] The dual demands for more accelerated learning that also emphasize employability skills are producing models that can accomplish both objectives.

Lipscomb University in Tennessee created an immersive model that allows learners to demonstrate what they know through behavioral assessment. Lipscomb's Customized, Outcome-based, Relevant Evaluation (CORE) program awards up to 30 credits in eight hours. Eligible learners have the opportunity to demonstrate multiple competencies during an intensive, in-person process composed of individual and collaborative challenges evaluated by trained faculty.[94] Evaluators judge candidates' interpersonal skills and critical thinking in the context of simulated work challenges. An award of 30 credits represents an entire year of studies toward some of Lipscomb's bachelor's degrees. In its first year of operation, the assessment center awarded an average of 21 credits to learners.

This model shows the potential of CPL to dramatically shorten the time for skilled individuals to receive a degree. This fits with the overall outcomes for CPL as a model: it has been shown to increase the likelihood of timely degree completion for participants, helping them finish programs of study more quickly.[95] More important, CPL strategies recognize the value of work experiences, which will become increasingly relevant to educators as occupations change and workers will need to port their existing competencies to new roles.

Competency-Based Education

Where CPL accelerates progress by awarding credit outright, competency-based education allows learners to demonstrate what they know, as soon as they know it, on a more granular level. In competency-based education (CBE) programs, learners advance by demonstrating mastery of specific competencies through assessments, rather than by completing a traditional, time-bound course. CBE is therefore flexibly paced, allowing participants to "sprint" through content they already know, or slow down to master more challenging material.[96] CBE practitioners can further encourage acceleration by using pace charts to help learners set and achieve more ambitious goals for completion.[97] At Lipscomb, the CPL assessment process described above is followed by a CBE design that allows learners yet another avenue for acceleration.[98]

Since they explicitly spell out what learners must know and be able to do, competency-based designs lend themselves to a high degree of alignment with employer needs, paving the way for success in the workplace. For example, College for America at Southern New Hampshire University creates customized, accredited degree programs in partnership with major employers. Holiday Inn Club Vacations leveraged a partnership with College for America to create customized pathways to management via a competency-based associate's degree program. Students, who are all employees of

---

Workers in both the UK and the US are changing jobs more frequently

CBE is flexibly paced, allowing participants to "sprint" through content they already know, or slow down to master more challenging material

Holiday Inn Club Vacations, invest about $500 per year to participate.[99] The program is allowing Holiday Inn Club Vacations to achieve growth and improve employee retention at the same time, and it's just one of several high-profile programs co-designed with industry. An evaluation of competency-based IT programs at Sinclair Community College in Ohio also found that the greater degree of employer alignment afforded by community-based education (CBE) led to improved post-program outcomes in the workplace.[100]

In addition to its potential for accelerating and customizing learning, CBE has additional characteristics that will prepare people for the future of work. Even though the model is inherently individualized, educators can still emphasize interpersonal and group communications skills. In the K-12 context, Shireland Collegiate Academy in the UK has made the achievement of mastery in any competency contingent on a student helping another achieve that same competency.[101] In the US, postsecondary institutions like Salt Lake Community College in Utah make room for peer-to-peer learning in a self-paced design by creating a learning lab environment that is student-led and supported by skilled faculty.[102] These nuances make all the difference given that skills like instructing and active learning are predicted to be in high demand in the future, and most CBE programs incorporate digital platforms to deliver content and assess skills.[103] Success in a high-quality CBE model demands both interpersonal competency and technological fluency, allowing learners to immediately begin practicing the strategies, behaviors, and attitudes that will be important in the workplace.

Developmental Education Redesign

The next generation of education models will have to overcome persistent difficulties to make flexible, rapid pathways accessible to everyone. Innovations in developmental education redesign have begun to do just that in the traditional postsecondary field, where nearly two-thirds of students who enroll in US community colleges are deemed unprepared for college-level work in core subjects like reading or mathematics.[104] Seventy percent of these students never complete college.[105] While most remediation in the UK takes place at the secondary level, some leading universities have had to offer remedial math classes for students entering STEM fields — even for students with high scores on the General Certificate of Secondary Education exam.[106] Requiring developmental coursework before learners can begin postsecondary study (a prerequisite model) can create delays and lead to more students dropping out.

Many US colleges are redesigning developmental education to accelerate progress instead of hindering it. Corequisite remediation, where underprepared learners are placed directly into college-level courses and provided with additional, supported learning experiences, has shown promising results, allowing learners to enter college courses immediately and complete them at higher rates than those enrolled in prerequisite, developmental-only sequences.[107] This shows that good design can accomplish quality at a faster pace, raising the bar for learners while providing the supports they need to succeed.

Digital Bootcamps

Outside of traditional degree programs, short-term "bootcamps" are proliferating, offering intensive training in digital skills for learners of any academic background. The classic bootcamp model immerses participants in full-time training for an average of 12 weeks.[108] Learning is practical, collaborative, and builds employability skills like communication and teamwork alongside occupational skills like software development, digital photography, or business intelligence. Bootcamp providers incorporate industry demand to make sure that graduates are ready. General Assembly (GA), which operates in both the US and the UK, aligns its programs through industry contact with GA instructional and product design teams; courses that are taught by industry practitioners; and business-to-business operations where GA sells custom training programs directly to employers.[109] Though bootcamps are known for helping learners rapidly enter a new career field, many also sell their services to incumbent workers seeking to upgrade their skills in a short time. They successfully serve both learners and employers as customers.

Bootcamp programs on software coding have demonstrated their ability to quickly upskill learners and connect them to employment. For example, GA regularly produces an outcomes report, audited by a third party, for its full-time programs. The 2016 report showed that 76 percent of GA graduates participated in their career services offerings during that program year, and 99 percent of those participants got a job within 180 days.[110] Other bootcamp models have also embraced open-source reporting, creating the Council on Integrity in Results Reporting that aggregates outcomes reports by data bootcamps to show actual placement rates.[111] Meanwhile, an independent survey of US data bootcamp graduates in 2017 found that 80 percent of them are employed with a related job and report an average salary increase of 50.5 percent.[112]

> Bootcamps are known for helping learners rapidly enter a new career field, many also sell their services to incumbent workers seeking to upgrade their skills in a short time

Even as non-accredited, private entities that do not qualify for traditional financial aid, bootcamp models are challenging the traditional education system by providing a shorter on-ramp to complex, higher-wage jobs. The average cost of a US bootcamp program was $11,451 in 2016.[113] However, some programs are opening access for low-income individuals. In the UK, the government has rolled out a comprehensive public-private partnership strategy to provide thousands of learners with free digital skills training in partnership with companies like Google and Accenture.[114] In the US, the education provider Per Scholas has partnered with General Assembly to offer a free, 18-week program called CodeBridge to eligible youth in the Bronx, demonstrating that open-access models can succeed there as well.[115]

CodeBridge, which is funded through a combination of private donations and public grants, has increased access to IT training for low-income individuals in the Bronx. The first cohorts of participants are only just emerging from the program, so it remains to be seen whether their bootcamp experience will lead to employment at scale and for the long term. Individual success stories, however, are promising, such as one CodeBridge graduate and former janitor who launched a coding career with a tech startup.[116]

Much of the success of CodeBridge can be attributed to the high-quality model being implemented by Per Scholas, which operates in an area where 40 percent of residents live below the poverty line.[117] Admission to Per Scholas is needs-based and requires no IT experience.[118] Many Per Scholas participants enter the program with eighth-grade-level reading and math scores. Per Scholas provides the highest quality preparation for young people in part by leveraging the investments of industry-leading partners such as Capital One. The Future Edge Initiative by Capital One, of which Per Scholas is one partner, includes funding, expert industry input into cyber security curricula, and direct volunteer engagement with participants.[119]

Bootcamp models — especially those featuring deep partnerships with industry — clearly demonstrate the tactics and strategy required to achieve continuous industry alignment and produce rapid employment outcomes. Yet for the model to truly become a platform for instilling lifelong skills, providers will have to demonstrate a balance between the short-term gains they achieve for learners and the kind of deep employability preparation that will become increasingly critical in the future of work. Tom Ogletree, director of Social Impact at General Assembly, put this aspiration best: "We don't just teach participants how to code, but how to be coders."

Learners can earn in-demand credentials quickly to build and demonstrate new skills, making new combinations of working and learning possible

It will be incumbent upon education systems to fit these models into a broader vision for career preparation, making good on the promise that model bootcamp providers are working toward.

Alternative Credentials

By far the most complex and dynamic landscape in education pathway design is the blossoming alternative credentials field, which has evolved in response to the demand for more rapid, economical, and specialized postsecondary training. Alternative credentials require shorter-term training than a two-year degree, and vary greatly in quality, provider, and connection to industry standards. The three most common alternative credentials are:

• certificates, which are earned by completing a program of study;

• certifications, which usually indicate mastery of industry-defined competencies; and

• microcredentials, which are more narrowly focused than either certificates or certifications.[120]

Digital badging, typically associated with microcredentials, refers to the digital platforms used for issuing and displaying microcredentials.[121] Learners can earn and "stack" alternative credentials to make progress toward a degree or to gain and communicate a specific configuration of competencies.

As the need for certain competencies shift in an increasingly changeable labor market, learners can earn in-demand credentials quickly to build and demonstrate new skills, making new combinations of working and learning possible. Instead of one intensive period of credential earning early in life, followed by a career of uncredentialed professional learning, individuals could return time and again to formally improve their skills. This resembles the Stanford Design School's concept of "The Open Loop University," where learners can loop in and out of education as their careers demand it.[122] If implemented well, credentials could make it possible for education pathways to adapt to the goals of every learner, instead of learners planning their lives around an educational design.

Despite their appeal, alternative credentials still face a number of barriers to widespread adoption. Only a small proportion of employers are aware of the many credential options that exist in their industries, and many of those who are aware of credentials remain skeptical that they predict job readiness in the real world.[123] Colleges face structural and regulatory barriers to implementing short-term credential programs, in addition to a general lack of resources to market such programs optimally.

The need for better integration of data systems, covered in the "Landscape" section of this report, poses an additional, cross-cutting threat to the viability of credentials, which can be difficult to distinguish and verify in the qualifications marketplace. Realizing the full potential of alternative credentials as a component of flexible career pathways will require collaboration among many actors in industry and postsecondary systems to address these and other barriers.

The contemporary credentialing landscape is crowded and noisy, but in both the US and the UK there are examples that illustrate the potential of alternative credentials to offer more flexible pathways to skills and employment. Google's Grow with Google initiative, which provides adults in the US and Europe access to skill-building opportunities for jobs and entrepreneurship, has resulted in over 200,000 individuals finding a new job or starting a business since its inception in 2015.[124]

IBM's partnership with the digital badging platform Acclaim is another flagship example. Individuals can earn IBM-recognized badges from the company or its education and training partners for achievements that matter to IBM, such as teaching and mentoring or complex product design.[125] Badges earned through the program are entirely portable and free to display across several platforms. Because they are verifiable and backed by IBM, they are valuable for workers to demonstrate their skills in the labor market. IBM has leveraged its badging program to incentivize talent development in the field, reward its own workers for staying current, and coordinate a global ecosystem of partner organizations in their learning and development activities.

Badging programs like IBM's allow jobseekers to understand what skills matter most to employers and focus their efforts on developing those skills. Individuals no longer have to wait until the end of a skills course or degree program to start displaying verified achievements. They can also match the right amount of investment in training for the role that they want, rather than spending more time and effort than necessary. IBM badges are becoming more recognized, not just at IBM but in postsecondary education as well. Northeastern University in Boston, Massachusetts, recently began issuing college credit toward graduate degree programs and certificates for earners of IBM badges.[126] As badges and other short-term credentials become more integrated into career pathway design, it will be possible for them to move beyond short-term gains to contribute to lifelong learning.
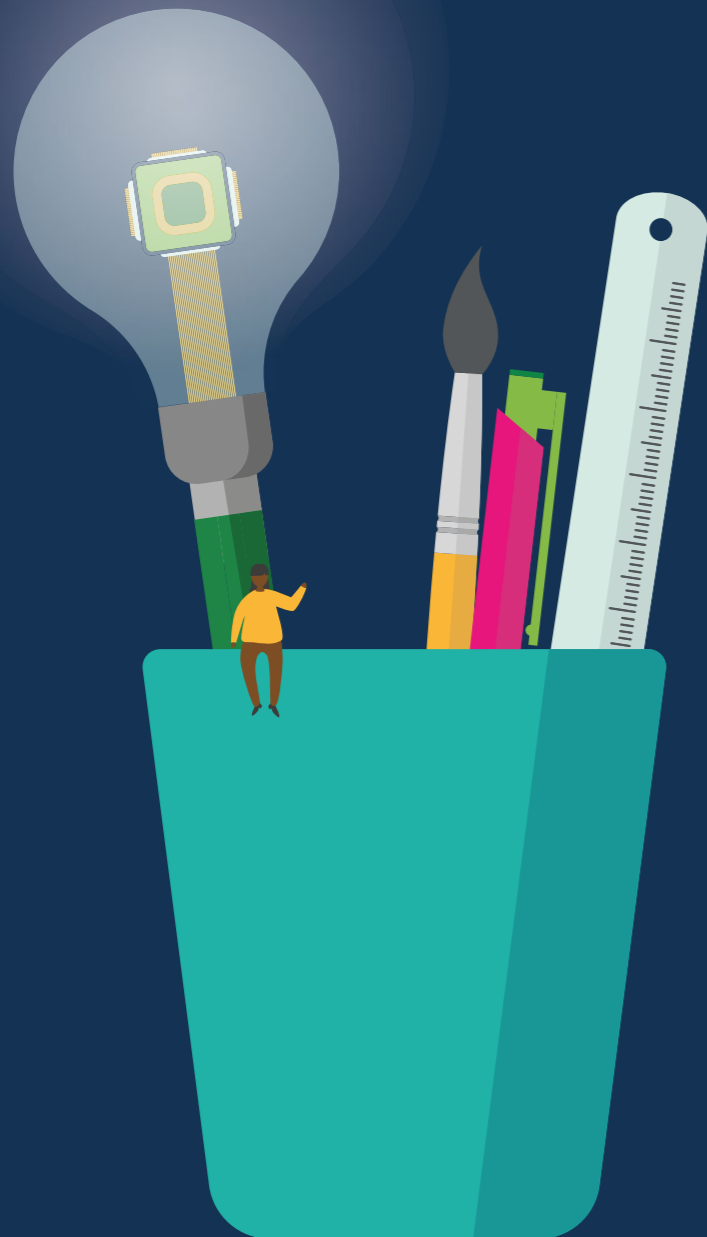
Managed Education Strategies

In the old system, employers were largely the end beneficiaries of an education and training supply chain, offering opportunities to qualified candidates who successfully navigated a series of institutions and experiences. As the landscape of work, education, and training becomes increasingly complex, employers will need to co-create talent pipelines tuned to their needs and the characteristics of their employees and recruits. They will use their own internal data and knowledge of the capabilities of education and training partners to fuse together multiple elements of the above models into coherent systems adapted to industry demands. Employers are already taking on this role and developing managed education systems — employer-led efforts at upskilling that combine the best features of current education and training to support employee success.

Brinker International, the company that owns Chili's Grill & Bar and Maggiano's Little Italy restaurants, partnered with Pearson to design a comprehensive, customized upskilling program for employees. The solution, called Best You EDU, is free to employees and adaptable to their goals. It includes three main components: a foundational program that provides English as a Second Language and basic skills development; an online GED (high school equivalency) program; and an online pathway to an associate's degree from a regional accredited college.[127] The program provides educational materials that are mobile friendly, and all participants are supported by Pearson coaches from end to end. A participant in the program can progress from the beginning of the foundational program through college enrollment in as little as one year. Brinker hopes that employees who upgrade their skills through the program will improve their performance and qualify for management roles. Best You EDU goes beyond previous industry-driven programs like JetBlue Scholars, which combines CPL and self-paced online coursework to benefit JetBlue employees with some college but no degree.

As education systems evolve to become more flexible, the zero-sum choice between learning and earning will cease to be a limitation. Yet this will only be possible if the right structural changes to the way that education is funded, organized, and led can take place in time. The following section broadly details what it will take to move from the current system to a postsecondary education landscape fit for the future of skills.

Developing managed education systems, employer–led efforts at upskilling that combine the best features of current education and training to support employee success

Landscape

The trends identified in The Future of Skills are influencing all aspects of the education landscape — that is, the network of philanthropists, policymakers, practitioners, providers, and programs that offer learning and credentialing opportunities. Though innovations are underway to make education work better for all learners, even the best technologies, assessments, and pedagogies cannot thrive without the right structures in place to undergird them.[131]

The need for reform is especially true for those traditional school and university systems that are set up within the constructs and institutional realities of the mid-20th century. These systems are increasingly outdated and need to evolve if they are to reliably prepare learners for what comes next. In order for our nation's education landscape to meet the challenges of 2030, shifts in culture, mindset, leadership, design, and back-end infrastructure are required. The future of work depends on this future of learning.

Reducing Inequities

The Future of Skills forecasts rising inequality as a dominant geopolitical trend through 2030. As the world of work becomes more technologically advanced and the demand for postsecondary credentials continues to grow, access to high-quality postsecondary education and credentialing opportunities is increasingly important — for all of society, and especially groups who are historically underserved and underrepresented. In both the US and the UK, education systems must acknowledge and dismantle longstanding inequities to ensure that all learners can benefit from the future of work. If not, the same innovations that purport to solve our most persistent inequities could exacerbate them.

Much like the US, the UK must face the dual challenges of increasing social mobility for low-income learners and adapting to an increasingly diverse society. Studies of educational inequality rank the UK closely behind the US in terms of the severity of educational opportunity gaps across other wealthy countries.[132] In the near future, demographic trends show that diverse and aging populations in the UK will continue to grow alongside a surge in younger people finishing secondary education, presenting new opportunities for education systems to involve learners from increasingly diverse backgrounds.[133] There are reasons to be optimistic. Youth apprenticeship and technical training models, some of which are profiled in this report, are keeping diversity and inclusion goals in the foreground for fast-growing occupations in the UK. Creating pathways like these that allow for simultaneous earning and learning, is critically important. A broader transformation, however, is warranted in order to meet the demands of the new economy — one in which global skills gaps will demand participation from millions more prepared workers.

In the US, the opportunity gap has continued to widen since 1990, creating what seems to be an unbreakable link between where a person grows up and his or her chance of economic success.[134] While educators and policymakers hope that the increased availability of reputable postsecondary credentials will start breaking down that

link, there is a risk that unequal systems of education will emerge to ossify existing divides.[135] As the options for achieving credentials become more varied and adaptive, educational institutions must be accountable for ensuring that vulnerable populations have clear pathways to them, and that those pathways and resulting credentials are valuable in the job market. This means establishing clear goals and progress measures around equity and economic advancement, mobilizing the strategies outlined in this report and others to build effective programs.

Georgia State University (GSU) in Atlanta is the flagship example of how this might work in practice. By implementing a sophisticated data analytics system connected to high-quality advisement and a scholarship fund, GSU nearly doubled its graduation rate for African American students (29 percent to 57 percent) in 12 years, and now awards more bachelor's degrees to African American students than any nonprofit institution in the US.[136] The institution has managed to close the achievement gap within its student body.

Georgia State University (GSU) succeeded because it dedicated major resources to improving graduation rates for low-income students and students of color, and embraced a data-driven advising and support strategy to do so. GSU's advisement infrastructure, called GPS Advising, relies on a predictive analytics engine that analyzes student performance and issues alerts to advisors when potentially adverse events happen with students. Advisors then help students address these problems. The system, which has over 700 intelligent alerts at its disposal, knows which kinds of trouble events are most problematic for a given student based on historical data.[137] For example, low attendance in the first week of a gateway course for STEM students might greatly predict academic difficulty later, while a few absences in another kind of course or at another time of year might not. The more data the system collects, the more effective it can be at predictive analyses. Built in 2012, it represents the capstone of GSU's long commitment to equity, sitting atop many years of smaller, entrepreneurial student success initiatives.[138] GSU's strategy demonstrates how human capabilities (advising, decision making) can work in concert with technology to solve complex problems. It is a 21st-century approach to educational inequity.

Education systems in both countries must accomplish equity goals against the head winds of political divisiveness and social and economic disruption. Debates over immigration and nationalism in both countries are changing the nature of policy discourse, creating uncertainty for education, business, and the economy. Despite gains

> The same innovations that purport to solve our most persistent inequities could exacerbate them

in public attitudes of tolerance in recent decades in both places, many policy questions are becoming polarized along racial and class lines.[139] Education leaders must work with governments and investors to power a more inclusive approach to education, where the best-quality tools and pedagogies are available to all learners.

Public-Private Partnerships

With the capacity to remove policy barriers, direct funding, and unite innovators, governments have a major role to play in the evolving education landscape. Governments in both the US and the UK are using their convening and organizing power to accelerate the pace of innovation in their education and training systems. In the US, this is most prominent at the state level, while the UK directs regional and sector strategies across the nation.

The Skillful State Network, sponsored by 20 governors of US states, aims to multiply the success of Skillful, a pilot initiative to improve the success and transparency of digital skills training in Colorado. Powered by the Markle Foundation, Skillful engaged workforce systems, employers like Microsoft and LinkedIn, and community colleges to align education and industry in rapidly evolving sectors like manufacturing.[140] The Skillful Playbook provides a roadmap to scale skills-based training and connect skill seekers to high-quality opportunities, and contains open-source tools and resources so these practices can be adapted to new labor markets.[141] Participating states are taking a leadership role in reconfiguring the relationships between education and industry to achieve more for learners.

The UK has a long-term industrial strategy which incorporates a number of mechanisms for accessing and identifying labor market intelligence and needs at both a national and a local level. These include the creation of an Industrial Challenge Council, a Strategic Priorities Fund, a number of Sector Deals, Local Industrial Strategies, Local Enterprise Partnerships, and Advisory Panels.[142] Each will be mining local skill and labor market data for intelligence, and driving greater collaboration between governments, industry, and education systems. The strategy aligns strategic investments in infrastructure and research with the activities of public-private collaboratives at multiple levels, exemplifying the level of complexity required to power widespread reforms in skills training.

To fill the rapidly shifting skill needs of their economies, governments can no longer function as mere regulators and funders, but must lead the transformation that education and industry demand. As the examples above demonstrate, cross-sector partnerships that leverage the convening power of government offer the potential to

align efforts much more quickly than siloed approaches. Government can bridge the divide between regional responsiveness and national comprehensiveness, driving transformation from both directions.

Supporting Experimentation

At the level of educational institutions, governments will have to find new ways to encourage experimentation in large postsecondary institutions supported by public funding. Too often, models are designed to increase accountability by rewarding narrow performance metrics (such as immediate job placement rates), which perpetuate traditional learning.[143] Leaders within these systems are less willing to take risks with new models that require several iterations before they are effective. The metrics themselves — such as degree attainment or immediate job placement — often exempt forms of learning that don't fit more nimble designs or effective training for incumbent workers; not every effective program leads to a degree, or to placement in a new job. Fortunately, in both the UK and the US, the traditional postsecondary system, which still serves most learners, has become more open to testing new models. Continued experimentation, with sensible guidelines to ensure quality and reduce inequities, will be critical to achieving innovation at scale.

In the UK, the Institutes of Technology (IoTs) Initiative is creating a new class of employer-led postsecondary institutions to increase access to STEM jobs across Britain. IoTs will include the participation of colleges, universities, and anchor employers to deliver high-quality training tuned to regional industry demands.[144] These institutions, which require more employer participation and investment than colleges, will launch beginning in 2019. A capital fund will be used for IoTs to revamp existing facilities and connect with their local enterprise partnerships, regional employer consortia that help to identify economic priorities across the country. The creation of IoTs signals a desire to close skills gaps through innovation in the traditional postsecondary system, which has struggled to move beyond conventional forms of learning and employer engagement in recent decades.

In the US, the Experimental Sites Initiative, a federal grants program from the United States Department of Education, provides opportunities to waive rigid guidelines around the disbursing of federal student aid to new kinds of postsecondary programs, as long as participating institutions meet evaluation requirements.[145] To date, experiments have included competency-based education, prior learning assessment, and more. The purpose of the program is to create data and proof points to justify radical changes to federal education policy, all while allowing pioneering postsecondary institutions to jumpstart their models.

> Too often, models are designed to increase accountability by rewarding narrow performance metrics

How Institutions Enable and Encourage Innovation

Instructional design must be re-configured to support nimbler program design, and so should educational systems and structures reflect the need for thoughtful risk-taking, including the space for continuous reflection and improvement. Author Jeffrey Selingo argues that the emerging paradigm of the "networked university" in the US — an institution broadly allied with other institutions and organized to support intelligent problem solving — will be core to the model of modern postsecondary education.[146] The emergence of innovation units within some college and university systems illustrates the need for such structural shifts on a smaller scale. A 2014 survey of member institutions of the American Council on Education found that 10 percent of those surveyed have established an academic innovation unit serving the whole institution.[147] Flagship innovation incubators include: Georgetown University's Designing the Future Initiative, the Digital Innovation Group at Arizona State University, and the University of Michigan's Office of Academic Innovation, whose 42-person staff focuses on personalized learning models, new curricular designs, and novel applications of learning analytics.[148] These organizational structures attract talent from within the institution and help to drive greater awareness of new models of teaching and learning that have the potential to drive both quality and equitable opportunity.

Innovation units on college campuses vary widely, but most serve several core functions. As internal reformers, members of such units can help examine internal policy and practice barriers to change. They can also identify champions, generate funds to power new models, and speed the process of adaptation when new technology or practices emerge.[149] In a majority of cases, the use of innovation units is considered exceptional, but similar structures at either the college or system level are more and more necessary as the need for unconventional solutions to a rapidly changing world and workforce continues to rise.

New Ways to Pay

Innovations in model design must go beyond revolutionizing teaching and learning. The education and training business and delivery models will have to become more agile to support the pace of adaptation. Even though providers, employers, and policymakers have begun to lower barriers to education through managed pathways, scholarship funding, and need-based financial aid, it will be necessary to enhance — and in some cases replace — tuition-driven models. Upfront tuition and tuition inflation place a burden on learners and their sponsors, and where cost barriers may be lower for

learners (such as in the UK), there are still significant opportunity costs of investing time and energy into education programs. Even performance-based allocations of public funds, which reward institutions with better outcomes such as increased graduation rates, do not completely align financial incentives with individuals' success, and result in increasing student debt that follows graduates well into adulthood.

Income-sharing agreements (ISAs) represent an important change in the way education might be financed. ISA programs require little or no upfront investment from learners, depending instead on an investment from a third party which then collects a portion of a graduate's income over a specific time period to recoup the investment. For example, the nonprofit coding academy Coalition for Queens, whose stated goal is to increase diversity in the digital economy, provides digital training to low-income and underrepresented learners at no upfront cost. Participants agree to contribute 12 percent of their salaries in the first two years of employment, and if they are unable to secure a job, they are not obligated to pay back Coalition for Queens.[150]

ISAs align the incentives for success between the learner/graduate and the program, which shares in the risk of financing each individual's education and has a significant incentive to set up effective job placement services. They also create a funding stream for alternative providers, such as data bootcamps, which may not qualify for public education funding. The idea is not without its pitfalls. Investors need ways to accurately forecast learner performance and future earnings, and the legal framework around such models and how they relate to taxes and bankruptcy is not fully developed. Though the concept is old, the idea has not been implemented widely, requiring more research to determine if ISAs will work at scale.[151]

Other innovations are less drastic. Subscription models, where a learner pays a flat fee to pass as much coursework as he or she can in a given time period, work in flexibly paced programs, providing incentives for learners to take more courses and lower the overall cost for completion.[152] US community colleges, which have found that students taking at least 15 credits (five full-time classes) per semester graduate at higher rates and have lower costs per degree, have begun to incentivize taking more classes by making the cost of five classes the same as four.[153] Rather than overhauling the tuition system, these changes can still align the business model of the institution with student success. Given the importance of accelerated pathways, solutions like these will provide educators with yet another tool to encourage learners to maintain momentum toward completion.

Cost barriers may be lower for learners (such as in the UK), there are still significant opportunity costs of investing time and energy into education programs

Regardless of the business and delivery model, connecting the investment in education to its labor market value will be a new minimum standard. In the past, educators relied on surveys or aggregated unemployment insurance wage data to validate whether or not a program was effective. A new generation of return on investment strategies are making this cumbersome approach obsolete. Digital training provider General Assembly created an open-source outcomes reporting framework for its full-time immersive programs in partnership with major accounting firms, communicating the detailed outcomes of its programs that are verified by independent audit.[154] Labor market data provider Emsi and credit monitoring firm Equifax also offer services to collect data on graduates' employment and earnings for education providers that don't have this capability in-house. The movement toward transparent connections between learning and earning will continue to create further alignment between the interests of learners seeking to maximize their earning potential and the programs that sell them skills.

Evolving Data Infrastructure

Data flows tie together all of the elements of the education landscape. The information asymmetries that exist between elements of the current system must be reduced in order for new efficiencies to emerge. All stakeholders should have access to data on the effectiveness of programs and strategies to achieve their stated goals for learners. This is especially true for alternative credentials, the increasing value of which will lie in their interconnectedness between employers, educators, learners, and workers. Efforts are underway to connect storehouses of learner data and enable learners themselves to have greater control over their own information, or, at the very least, to make that data much more accessible and transparent. Doing so would allow systems to better understand what works, and more quickly respond to changes. Meeting the challenges of the future economy will require major reductions in the noise and missed connections that define the current credentialing marketplace.

Lumina Foundation's Connecting Credentials Action Plan lays out the initial prerequisites for this reality, defining seven priority areas for action. Creating an "open, interoperable data and technology infrastructure" is just one component of this plan, but it lies at the core of the overall effort.[155] It calls for building connections between disparate units and departments within a postsecondary system or network of providers, ranging from social media, to human resources information systems, to state and national wage data systems. For these systems to truly work together would require no less than a

global, public-private effort from all areas of the education landscape. The challenges associated with interoperability are as varied and significant as the future of education as a whole, including policy and regulatory barriers, privacy concerns, technical feasibility, and cost.

A leading example of how interoperability might work is a US project led by the National Association of Manufacturers (NAM) in partnership with the Manufacturing Institute. These partners have created the NAM Data Matching System for Education Outcomes, which will incorporate data from third-party credentialers, the United States Census Bureau, the National Student Clearinghouse, and the Internal Revenue Service to provide detailed outcomes data for a range of manufacturing training programs.[156] This sector strategy has the potential to show how to build broad data interoperability, demonstrating the value and necessity of a next-generation data infrastructure. As the NAM Data Matching System moves forward, the field can learn valuable insights on how to achieve interoperability at scale.

Increasingly, data will be the foundation of the education landscape. As systems become less siloed, it will be easier to capture and spread effective practices, and learners themselves will be more empowered to understand how occupations are being redesigned around them. In the same way that education systems will have to become more sophisticated in receiving and analyzing labor market signals, they will also have to become more efficient at signaling to each other and to learners and workers in real time.

Moving Forward

The Future of Skills enhanced our understanding of how global changes in the economy are driving demand for specific skills in the US and the UK. This report showcases innovative practitioners from several sectors that are already responding. But there is much work to be done to set education systems on a path toward optimal practice at scale — producing postsecondary learning that is dynamic, relevant, and inclusive of all learners.

As education systems continue to evolve, there are steps that individuals, education leaders, and employers can take to align their efforts with the future of skills.

For Individuals

1. **Build a future-facing skill set.** A new set of digital tools — many of which are free or low cost — are empowering individuals to better understand their assets and enhance them. Combined with insights from The Future of Skills, it is now possible to set one's own course for upskilling, seeking out learning and development opportunities that align with the capabilities that will continue to be useful through 2030.

2. **Utilize the principles of dynamic pedagogy in your workplace communication.** Learning that is active and contextualized shows promise for developing the complex, human skills that individuals and teams must build to adapt to the changing nature of work. Design learning experiences for new workplace systems, policies, or projects with those principles in mind, avoiding rote learning and encouraging problem solving wherever possible.

3. **Understand the skills and occupations most in demand in your regional economy.** Take advantage of the latest labor market information to build a long-term career plan and be prepared to transition into a new role or redesign your current one as demands change.

4. **Think beyond degree programs to build and demonstrate competency.** The rise of short-term education and training is reducing the tradeoffs between learning and working. Consider pursuing short-term credentials to showcase the skills you have already mastered and build the ones you need to develop.

5. **Explore new ways to finance lifelong learning.** Just as delivery models like competency-based education, bootcamps, and digital learning are making upskilling more feasible for incumbent workers, so are innovations in education financing. Explore the role that employer sponsorship or income-sharing agreements might play in powering your learning plan.

For Education Systems

1. **Advance new research about, and practices for, building interpersonal skills and the capacity for systems thinking.** Researchers must pursue a more detailed understanding of how these critical skills develop in individuals. At the same time, the field must overcome challenges of validity, reliability, and access in order to fully harness the power of digital solutions, while broadening the use of performative and other authentic assessment modalities.

2. **Commit to making postsecondary pedagogy dynamic, work-based, and skills-focused.** Realizing the potential of the best emerging models — and the most effective traditional ones — will require testing, refining, and spreading innovation across all education and training sectors. It will also mean training educators in new ways and inviting deeper collaboration with industry in designing and delivering learning experiences.

3. **Demystify labor market demand using digital solutions and employer collaboration.** Analytical approaches are more accessible than ever, requiring little data expertise to gain maximal insight into skill gaps. Educators and industry can come together like never before to address the most pressing needs of the economy.

4. **Embrace strategies that allow individuals to advance rapidly and convert learning to earning.** The career pathways of the future may include smaller, incremental "steps," as alternative credentials, bootcamps, and digital badges allow learners to maximize their returns on investment in education. At the same time, employers can play a more prominent role in braiding together multiple strategies to ensure broader access to economic advancement.

5. **Reform the business and delivery model of postsecondary education to better align incentives, reduce inequity, and eliminate data siloes.** Moving postsecondary education systems forward from a 20th-century paradigm will require a shift in mindset toward innovation — and the budgetary, data, and organizational structures to enable it. In both the US and the UK, stakeholders must be willing to reconfigure their institutions to support change while maintaining rigor. The future of learning must be entirely inclusive in order to meet the future demand for skills.

For Industry

1. **Leverage digital solutions to map the skills of incumbent workers and prospective employees.** New assessment techniques are making it easier than ever to understand the skill profiles of workers, and spot opportunities for investments in upskilling. Those same assessments can also help screen job candidates.

2. **Support the expansion of work-based learning.** By acting as a work-based learning provider at any point along the work-based learning continuum, an employer can help build a talent pipeline to fill existing skill gaps, and build valuable teaching and learning competencies among existing staff. Seek out ways to partner with education systems to co-create career exposure experiences, internships, apprenticeships, and on-the-job training models for new employees and incumbent workers.

3. **Collaborate with educators to share insight on skill gaps and validate education strategies.** The role of industry in designing education programs must expand in order for learners to adequately prepare for the complexity of the future economy. Increasingly, employers will need to participate in program design in meaningful ways as educators test hypotheses and build new models for teaching and learning.

4. **Provide opportunities for incumbent workers to enhance their skills.** Managed education pathways and other forms of employer-sponsored learning have the potential to increase access to high-quality credentials for large portions of the population, while allowing employers to benefit from a more skilled and committed workforce. More refined analysis methods about return on investment (ROI) may also be needed to justify the expansion of such programs.

5. **Commit to building equity.** Employers can play a significant role in ensuring equal access to opportunities for both jobseekers and skill seekers. Meeting the current and future demand for skills will require broad inclusion of individuals from all sectors of society, and the meaningful support for them to be successful.

Endnotes

1 This includes Carl Frey and Michael Osbourne's seminal research on *The Future of Employment*, David Autor's studies of the impact of automation, and the World Economic Forum's exploration of the coming "Fourth Industrial Revolution." See: Carl Benedikt Frey and Michael A. Osborne, "The future of employment: How susceptible are jobs to computerization," *Technological Forecasting and Social Change* 114 (January 2017): 254-280, https://doi.org/10.1016/j.techfore.2016.08.019; David H. Autor, "Why Are There Still So Many Jobs? The History and Future of Workplace Automation," *Journal of Economic Perspectives* 29, no. 3 (Summer 2015): 3-30, DOI: 10.1257/jep.29.3.3; Klaus Schwab, Nicholas Davis, and Satya Nadella, *Shaping the Fourth Industrial Revolution* (Cologny, Switzerland: World Economic Forum, 2018).

2 Hasan Bakhshi et al., *The Future of Skills: Employment in 2030* (London: Pearson and Nesta, 2017).

3 Stephanie Krauss, *The Competency-Based Education Ecosystem Framework* (C-BEN, 2015), http://www.cbenetwork.org/sites/457/uploaded/files/CBE_Ecosystem_Report.pdf; Stephanie Krauss and Erin Knepler, "Shared Design Elements and Emerging Practices of Competency-Based Education" (presentation, CBExchange, Phoenix, Arizona, 2015).

4 Andy Powell, *Apprenticeship Statistics: England* (Briefing Paper Number 06113) (London: House of Commons Library, 2018, https://researchbriefings.parliament.uk/ResearchBriefing/Summary/SN06113.

5 Jim Fong, Peter Janzow, and Kyle Peck, Demographic Shifts in Educational Demand and the Rise of Alternative Credentials (London: Pearson, 2016), https://upcea.edu/wp-content/uploads/2017/05/Demographic-Shifts-in-Educational-Demand-and-the-Rise-of-Alternative-Credentials.pdf.

6 John Fielden and Robin Middlehurst, *Alternative providers of higher education: issues for policymakers* (Oxford: Higher Education Policy Institute, 2017), http://www.hepi.ac.uk/wp-content/uploads/2017/01/Hepi_The-alternative-providers-of-higher-education-Report-90-04_01_17-Screen2.pdf; John Elmes, *"One in five alternative providers seeking degree-awarding powers," Times Higher Education*, July 13, 2017, https://www.timeshighereducation.com/news/one-in-five-alternative-providers-seeking-degree-awarding-powers.

7 *Global Digital Badges Market in Education Sector 2018-2022* (London: TechNavio, 2017), https://www.wiseguyreports.com/reports/2694870-global-digital-badges-market-in-education-sector-2018-2022.

8 Michael Kirst and Mitchell Stevens, eds., *Remaking College: The Changing Ecology of Higher Education* (Palo Alto: Stanford University Press, 2015).

9 Hasan Bakhshi et al., *The Future of Skills: Employment in 2030*.

10 David Deming, *The Growing Importance of Social Skills in the Labor Market (NBER Working Paper 21473)* (Cambridge, MA: National Bureau of Economic Research, 2015).

11 Gillian Tett, "An anthropologist in the boardroom," *Financial Times*, April 21, 2017, https://www.ft.com/content/38e276a2-2487-11e7-a34a-538b4cb30025.

12 Lauren B. Resnick, "Learning In School and Out," *Educational Researcher* 16, no. 9 (December 1987): 13-20; Frank Levy and Richard J. Murrane, *Teaching the New Basic Skills: Principles for Educating Children to Thrive in a Changing Economy* (New York: Free Press, 1996).

13 For a complete listing of the top skills referenced in *The Future of Skills*, complete with definitions, please see: *Glossary of Skills* (London: Pearson, 2017), https://futureskills.pearson.com/research/assets/pdfs/glossary-of-skills.pdf.

14 For a detailed matrix organizing employability skills, see: "Employability Skills Matrix," Pathways to Prosperity, n.d., http://ptopnetwork.jff.org/network/resources/employability-skills-matrix; Other prominent 21st-century skills frameworks: *A State Leaders Action Guide to 21st Century Skills* (Tucson: Partnership for 21st Century Skills, 2006); *enGuage 21st Century Skills for 21st Century Learners: Literacy in the Digital Age* (Chicago: NCREL; Los Angeles: Metiri Group, 2003); *The Definition and Selection of Key Competencies: Executive Summary* (Paris: OECD, 2005); *Education Program Strategic Plan* (Menlo Park: Hewlett Foundation, 2010), http://www.hewlett.org/uploads/documents/Education_Strategic_Plan_2010.pdf; Education for Life and Work: *Developing Transferable Knowledge and Skills in the 21st Century* (Washington, DC: National Academies Press, 2012).

15 Buck Institute for Education. 2010. *21st Century Skills Framework*. Available at https://www.bie.org/object/document/21st_century_skills_framework.

16 *Helping the UK Thrive: CBI/Pearson Education and Skills Survey 2017* (London: Confederation of British Industry, 2017), http://www.cbi.org.uk/index.cfm/_api/render/file/?method=inline&fileID=DB1A9FE5-5459-4AA2-8B44798DD5B15E77.

17 *Falling Short? College Learning and Career Success* (Washington, DC: Hart Research Associates, 2015).

18 For a full skills glossary, see: *Glossary of Skills*, https://futureskills.pearson.com/research/assets/pdfs/glossary-of-skills.pdf.

19 Esther Care and Alvin Vista, "Education assessment in the 21st century: New skillsets for a new millennium," *Brookings Institute Blog*, March 1, 2017, https://www.brookings.edu/blog/education-plus-development/2017/03/01/education-assessment-in-the-21st-century-new-skillsets-for-a-new-millennium/.

20 "IDEO's Ten Tips for Creating a 21st–Century Classroom Experience," *Metropolis*, February 2009, https://www.ideo.com/news/ideos-ten-tips-for-creating-a-21st-century-classroom-experience.

21 Dr. Kristen DiCerbo, vice president, Learning Research and Design, Global Product Organization at Pearson, interview with author.

22 Randy Bennett and Drew Gitomer, "Transforming K–12 Assessment: Integrating Accountability Testing, Formative Assessment and Professional Support," in *Educational Assessment in the 21st Century*, eds., Claire Wyatt-Smith and Joy Cumming (New York: Springer, 2009), 43-61.

23 David T. Conley and Linda Darling-Hammond, *Creating Systems of Assessment for Deeper Learning* (Stanford: Stanford Center for Opportunity Policy in Education; Eugene: Education Policy Improvement Center, 2013), https://edpolicy.stanford.edu/sites/default/files/publications/creating-systems-assessment-deeper-learning_0.pdf.

24 David T. Conley, *A New Era for Educational Assessment* (Boston: JFF, 2014), https://jfforg-prod-prime.s3.amazonaws.com/media/documents/A-New-Era-for-Educational-Assessment-092414_0.pdf.

25 Conley and Darling-Hammond, *Creating Systems of Assessment for Deeper Learning.*

26 Kristen E. DiCerbo and John T. Behrens, *Impacts of the Digital Ocean on Education* (London: Pearson, 2014), https://www.pearson.com/content/dam/one-dot-com/one-dot-com/us/en/pearson-ed/downloads/DigitalOcean.pdf; Diego Zapata-Rivera and Malcolm Bauer, "Exploring the Role of Games in Educational Assessment," in *Technology-Based Assessments for 21st Century Skills: Theoretical and Practical Implications from Modern Research*, eds., Michael C. Mayrath et al. (Charlotte: Information Age Publishing Inc., 2012).

27 Valerie J. Shute, Matthew Ventura, Malcolm I. Bauer, and Diego Zapata-Rivera, "Melding the Power of Serious Games and Embedded Assessment to Monitor and Foster Learning: Flow and Grow," in *Serious Games: Mechanisms and Effects*, eds. Ute Ritterfeld, Michael J. Cody, and Peter Vorderer (Mahwah, NJ: Routledge, 2009), 295-321.

28 DiCerbo and Behrens, *Impacts of the Digital Ocean on Education*.

29 Amar Musheer, Oleg Sotnikov, and Sharham Shah Heydari, "Packet Tracer as an Educational Serious Gaming Platform," ICNS 2011: *The Seventh International Conference on Networking and Services*, 2011, https://www.thinkmind.org/download.php?articleid=icns_2011_15_10_40005.

30 Rose Luckin and Wayne Holmes, *Intelligence Unleashed: An Argument for AI in Education* (London: Pearson, 2016), https://static.googleusercontent.com/media/edu.google.com/en//pdfs/Intelligence-Unleashed-Publication.pdf.

31 Alex Hern, "Can Duolingo's chatbot teach you a foreign language?," *The Guardian*, October 7, 2016, https://www.theguardian.com/technology/2016/oct/06/duolingo-chatbots-learning-language.

32 Roumen Vesselinov and John Grego, *Duolingo Effectiveness Study: Final Report* (Pittsburgh: Duolingo, 2012), http://static.duolingo.com/s3/DuolingoReport_Final.pdf.

33 Niko Canner et al., *Impact Hiring: How Data Will Transform Youth Employment* (New York: Incandescent; San Francisco: Knack; New York: The Rockefeller Foundation, 2015), https://www.rockefellerfoundation.org/report/impact-hiring-how-data-will-transform-youth-employment/.

34 Ophir Tanz and Cambron Carter, "Why the future of deep learning depends on finding good data," *Tech Crunch*, July 21, 2017, https://techcrunch.com/2017/07/21/why-the-future-of-deep-learning-depends-on-finding-good-data/.

35 Hannah Devlin, "Could online tutors and artificial intelligence be the future of teaching?," *The Guardian*, December 26, 2016, https://www.theguardian.com/technology/2016/dec/26/could-online-tutors-and-artificial-intelligence-be-the-future-of-teaching.

36 "Mobile Fact Sheet," Pew Research Center, February 5, 2016, http://www.pewinternet.org/fact-sheet/mobile/; *State of the smart: Consumer usage patterns of the smartphone* (London: Deloitte, 2017), https://www.deloitte.co.uk/mobileuk/assets/img/download/global-mobile-consumer-survey-2017_uk-cut.pdf.

37 Rip Empson, "After Deals With Pearson & McGraw Hill, Pathbrite Adds $4M To Take Digital Portfolios Beyond The Campus," *TechCrunch*, March 4, 2013, https://beta.techcrunch.com/2013/03/04/after-deals-with-pearson-mcgraw-hill-pathbrite-adds-4m-to-take-digital-portfolios-beyond-the-campus/.

38 "Recommendations – Overview," LinkedIn Help, LinkedIn, last updated February 2018, https://www.linkedin.com/help/linkedin/answer/90/recommendations-overview?lang=en.

39 See "Landscape" section of this report for more about data interoperability.

40 Kristen DiCerbo, "Current state of game-based assessment," *Pearson* (blog), November 10, 2015, https://www.pearsoned.com/current-state-of-game-based-assessment/.

41 Tayne Ryall, Belinda K. Judd, and Christopher J. Gordon, "Simulation-based assessments in health professional education: a systematic review," *Journal of Multidisciplinary Healthcare* 9, (February 2016): 69-82, http://doi.org/10.2147/JMDH.S92695.

42 "Assessment & Selection," United States Office of Personnel Management, n.d., https://www.opm.gov/policy-data-oversight/assessment-and-selection/other-assessment-methods/assessment-centers/.

43 Charles Leadbeater, *The Problem Solvers* (London: Pearson, 2016), https://www.pearson.com/content/dam/corporate/global/pearson-dot-com/files/learning/Problem-Solvers-Web-.pdf.

44 "What Is Work-Based Learning?," Center for Apprenticeship & Work-Based Learning, JFF, 2018, https://center4apprenticeship.jff.org/work-based-learning/.

45 Joseph A. Raelin, "A Model of Work Based Learning," *Organization Science* 8, no. 6 (December 1997): 563-578.

46 Tim Kautz et al., *Fostering and Measuring Skills: Improving Cognitive and Non–Cognitive Skills to Promote Lifetime Success (Working Paper 20749)* (Cambridge, MA: National Bureau of Economic Research, 2014).

47 Charlotte Cahill, Making Work-Based Learning Work (Boston: JFF, 2016), http://www.jff.org/sites/default/files/publications/materials/WBL%20Principles%20Paper%20062416.pdf.

48 "James Dyson launches new university to bridge engineering skills gap," *The Guardian*, November 4, 2016, https://www.theguardian.com/technology/2016/nov/04/james-dyson-addresses-engineering-skills-gap-with-university-launch.

49 Cahill, *Making Work-Based Learning Work*.

50 JFF, "What Is Work-Based Learning?"

51 Kalonji Martin, executive director, Partnership and Sales, Nepris, interview with author.

52 Glenn Hollis, "The Impact of Nepris on my Rural Students," *Nepris* (blog), 2016, https://www.nepris.com/blog/stories/details/the-impact-of-nepris-on-my-rural-students.

53 "Research Base for Virtual Reality Simulations for Learning," Mursion, 2018, https://www.mursion.com/research.html.

54 "Mursion Debuts Immersive Learning Training Simulator for Educators at the ASU + GSV Conference," The Business Journals, April 6, 2015, https://www.bizjournals.com/prnewswire/press_releases/2015/04/06/MN72797.

55 "+Acumen Corps," +Acumen, n.d., https://www.plusacumen.org/corps.

56 Amy Ahearn, associate director, +Acumen, interview with author.

57 "Twelve Weeks @ Basecamp: A Summer Tale," *Medium* (blog), August 9, 2016, https://m.signalvnoise.com/twelve-weeks-basecamp-a-summer-tale-b6c181fa925.

58 "Creating a Digital Built Britain: what you need to know," Gov.uk, August 2, 2017, Available at https://www.gov.uk/guidance/creating-a-digital-built-britain-what-you-need-to-know.

59 Vivian Murinde, senior regeneration manager at Queen Elizabeth Olympic Park, interview with author.

60 "US Labor Department Amazon to Establish Registered Apprenticeship Program to Train Veterans for Technical Careers," United States Department of Labor, January 19, 2017, https://www.dol.gov/newsroom/releases/eta/eta20170119-0.

61 "NOVA Announces Amazon Apprenticeship Program," Northern Virginia Community College, November 2, 2017, http://www.nvcc.edu/news/press-releases/2017/amazon-program.html.

62 "Amazon Web Services' re:Start programme," ManpowerGroup, October 17, 2017, http://www.manpowergroup.co.uk/the-word-on-work/aws-restart-programme/.

63 *A Quick-Start Toolkit: Building Registered Apprenticeship Programs* (Washington, DC: United States Department of Labor, 2018), .

64 *What is a BTEC?* (London: Pearson, 2018), https://qualifications.pearson.com/content/dam/pdf/btec-brand/BTECbrand/W984_a%20BTEC%20ICB%20what%20is%20btec%20ipdf.pdf.

65 "Work-Based Courses Toolkit: Bringing College to the Production Line," JFF, June 27, 2016, https://www.jff.org/resources/work-based-courses-bringing-college-production-line/

66 *What Will the Technical and Professional Education Provider of the Future Need To Be Successful?* (London: Collab Group, 2018), http://www.collabgroup.co.uk/system/resources/download_files/000/000/025/original/Collab_PubliCo_Booklet2_SinglePages_Digital.pdf?1526461099.

67 "How It Works," Pearson, n.d., https://www.pearson.com/us/higher-education/products-services-institutions/career-success-program/how-it-works.html.

68 Rebecca E. Wolfe and Jennifer Davis Poon, *Educator Competencies for Personalized, Learner-Centered Teaching* (Boston: JFF, 2015), https://files.eric.ed.gov/fulltext/ED560785.pdf.

69 Thomas Ehrlich and Ernestine Fu, "College Professors: Before You Teach, Learn How!" (NY: Forbes, 2013), https://www.forbes.com/sites/ehrlichfu/2013/11/12/college-professors-before-you-teach-learn-how/#4afca0ee26d8.

70 Ian Nash et al., eds., *Challenge and change in further education* (London: TLRP, 2008), https://warwick.ac.uk/fac/soc/ier/people/abrown/publications/fe_commentary_final.pdf; Carl Strikwerda, "Why Community Colleges Are Good for You," *The Chronicle of Higher Education*, January 28, 2018, https://www.chronicle.com/article/Why-Community-Colleges-Are/242359.

71 John Dorrer, *Using Real-Time Labor Market Information to Achieve Better Labor Market Outcomes* (Indianapolis: Lumina Foundation, 2016), https://www.luminafoundation.org/files/resources/using-real-time-labor-market-information-full.pdf.

72 "Labor Market Advisory Group Emsi to Join Strada Education Network," *Cision PR Newswire,* April 24, 2018, https://www.prnewswire.com/news-releases/labor-market-advisory-group-emsi-to-join-strada-education-network-300635420.html.

73 Anthony P. Carnevale, Tamara Jayasundera, and Dmitri Repnikov, *Understanding Online Job Ads Data* (Washington, DC: Georgetown University Center on Education and the Workforce, 2014), https://cew.georgetown.edu/wp-content/uploads/2014/11/OCLM.Tech_.Web_.pdf.

74 *A New Career Map Methodology: Using Data from Online Work Histories* (New York: CUNY Graduate Center, Labor Market Information Service, 2015), https://www.gc.cuny.edu/CUNY_GC/media/365-Images/Uploads%20for%20LMIS/Reports%20and%20Briefs/September-2015-NYCLMIS-CCP-Methods-Final.pdf.

75 *High-Impact People Analytics* (Oakland: Deloitte Development LLC, 2017); *Rewriting the rules for the digital age: 2017 Deloitte Global Human Capital Trends* (Oakland: Deloitte Development LLC, 2017); Josh Bersin, Karen O'Leonard, and Wendy Wang-Audia, *High-Impact Talent Analytics: Building a World-Class HR Measurement and Analytics Function* (Oakland: Bersin by Deloitte, 2013).

76 David A. Garvin, "How Google Sold Its Engineers on Management," *Harvard Business Review*, December 2013, https://hbr.org/2013/12/how-google-sold-its-engineers-on-management.

77 Garvin, "How Google Sold Its Engineers on Management."

78 Melissa Harrell and Lauren Barbato, "Great managers still matter: the evolution of Google's Project Oxygen," *re:Work*, February 27, 2018, https://rework.with google.com/blog/the-evolution-of-project-oxygen/.

79 Carla Arellano, "Using people analytics to drive business performance: A case study," *McKinsey Quarterly*, July 2017, https://www.mckinsey.com/business-functions/mckinsey-analytics/our-insights/using-people-analytics-to-drive-business-performance-a-case-study.

80 For a discussion of employer engagement beyond the scope of this report, see: Randall Wilson, *A Resource Guide to Engaging Employers* (Boston: JFF, 2015), https://www.accs.cc/default/assets/File/DPE_AED/Resources/WIOA/A-Resource-Guide-to-Employer-Engagement-011315.pdf.

81 *Counting the Hidden Assets: First Steps in Assessing the Impact of Community College Noncredit Education Programs on the Workforce and Local Economies* (Washington, DC: Business Roundtable, 2009), https://ccrc.tc.columbia.edu/media/k2/attachments/noncredit-education-workforce-economies.pdf.

82 Jonell Sanchez, *Global Employability Competencies: The Ultimate Measure* (London: Pearson, 2016), https://www.pearsoned.com/global-employability-competencies-the-ultimate-measure/.

83 Max Alexander, director of instructional design, General Assembly, interview with author.

84 "About Pearson College London," Pearson College London, n.d., https://www.pearsoncollegelondon.ac.uk/about-us/about-pearson.html.

85 Mark Liberman, "Instructional Design Teams: Beyond the Numbers," *Inside Higher Ed,* December 6, 2017, https://www.insidehighered.com/digital-learning/article/2017/12/06/instructional-designers-weigh-benefits-and-drawbacks-team-sizes.

[86] Liberman, "Instructional Design Teams: Beyond the Numbers."

[87] *Quality Principles and Standards for Competency-Based Education Programs* (n.p.: Competency-Based Education Network, 2017), http://www.cbenetwork. org/sites/457/uploaded/files/CBE17__Quality_Standards_FINAL.pdf.

[88] Sally Johnstone and Thad Nodine, "Competency-Based Education Giving Colleges Accelerated, Flexible Options," *National Skills Coalition*, June 9, 2015, https://www.nationalskillscoalition.org/news/latest/competency-based-education-giving-colleges-accelerated-flexible-options.

[89] Anthony P. Carnevale, Nicole Smith, and Jeff Strohl, *Recovery: Job Growth and Education Requirements through 2020* (Washington, DC: Georgetown Public Policy Institute, 2013), https://cew.georgetown.edu/wp-content/uploads/2014/11/Recovery2020.FR_.Web_.pdf.

[90] "Goodbye to the job for life — we take nine jobs over 50 years," Liverpool Victoria, November 14, 2014, https://www.lv.com/about-us/press/article/job-for-life; "Economic News Release: Employee Tenure Summary," United States Department of Labor, Bureau of Labor Statistics, September 22, 2016, https://www.bls.gov/news.release/tenure.nr0.htm; Brhmie Balaram, Josie Warden, and Fabian Wallace-Stephens, Good Gigs: *A fairer future for the UK's gig economy* (London: RSA Action and Research Centre, 2017), https://www.thersa.org/globalassets/pdfs/reports/rsa_good-gigs-fairer-gig-economy-report.pdf.

[91] "Help sharpen adult learners' skills for the workplace," Pearson, n.d., https://www.pearson.com/us/0/adult-learners/survey-form.html.

[92] The concept of credit for prior learning is defined differently according to the region and academic institution awarding credit. Related concepts include prior learning, prior learning assessment, and recognition of prior learning, among others. For more information, see: Mary Beth Lakin et al., *Credit for Prior Learning: Charting Institutional Practice for Sustainability* (Washington, DC: American Council on Education, 2015), http://www.acenet.edu/news-room/Documents/Credit-for-Prior-Learning-Charting-Institutional-Practice-for-Sustainability.pdf; *Facilitating the Recognition of Prior Learning: Toolkit* (Glasgow: Scottish Credit and Qualifications Framework, 2010), http://scqf.org.uk/wp-content/uploads/2014/03/RPL-Toolkit-Updated-v2-FINAL-December-2010-with-updated-Framework.pdf.

[93] *Making the Case for Credit for Prior Learning (CPL)* (London: Pearson, 2014), https://www.pearson.com/content/dam/one-dot-com/one-dot-com/us/en/pearson-ed/downloads/cpl-briefing-doc.pdf.

[94] Rebecca Klein-Collins and Rick Olson, *Customized, Outcome-based, Relevant Evaluation (CORE) at Lipscomb University: A competency-based education case study* (Chicago: Council for Adult and Experiential Learning, 2014), http://cdn2.hubspot.net/hubfs/617695/premium_content_resources/CBE-Publications/PDF/CAEL_Lipscombe_Case_Study.pdf?submissionGuid=27da7971-8246-4e46-b4f4-e69d1f6a7841.

[95] Rebecca Klein-Collins, *Fueling the Race to Postsecondary Success: A 48-Institution Study of Prior Learning Assessment and Adult Student Outcomes* (Chicago: Council for Adult and Experiential Learning, 2010), https://eric.ed.gov/?id=ED524753.

[96] Kelle Parsons, Jessica Mason, and Matthew Soldner, *On the Path to Success: Early Evidence About the Efficacy of Postsecondary Competency-Based Education Programs* (Washington, DC: American Institutes for Research, 2016), https://www.air.org/sites/default/files/downloads/report/Path-to-Success-Postsecondary-Competency-Based-Education-Programs-Oct-2016.pdf.

[97] Ann Person, *Best Practices in Competency-Based Education: Lessons from Three Colleges* (Oakland: Mathematic Policy Research, 2015), https://www.mathematica-mpr.com/our-publications-and-findings/publications/best-practices-in-competencybased-education-lessons-from-three-colleges.

[98] Klein-Collins and Olsen, *Customized, Outcome-based, Relevant Evaluation (CORE) at Lipscomb University.*

[99] "Holiday Inn Club Vacations Develops Its General Managers Into Business Leaders," College for America, January 2015, http://go.collegeforamerica.org/Holiday-Inn-Case-Study.

[100] Person, Jaime Thomas, and Lisbeth Goble, *Implementation and Outcomes of Competency-Based Education in Three Community Colleges: Findings from the Comprehensive Evaluation of a TAACCCT Grant* (Oakland: Mathematica Policy Research, 2016), https://www.mathematica-mpr.com/download-media?MediaItemId=%7B684E8B73-D94B-489E-A954-C5F0393974B7%7D.

[101] *Shireland Collegiate Academy Inspection Report* (Manchester: Ofsted, 2010), http://reports.ofsted.gov.uk/provider/files/2457080/urn/135170.pdf; Leadbeater, The Problem Solvers.

[102] Joe Deegan, *Next-Generation CBE: Supporting Success for Underprepared College Learners* (Boston: JFF, 2018), https://jfforg-prod-prime.s3.amazonaws.com/media/documents/CBE-4-030218.pdf.

[103] Bakhshi et al., *The Future of Skills: Employment in 2030.*

104 *Developmental Education: A Barrier to a Postsecondary Credential for Millions of Americans* (New York: MDRC, 2013), https://www.mdrc.org/publication/developmental-education-barrier-postsecondary-credential-millions-americans.

105 "Community College FAQs," Community College Research Center, n.d., http://ccrc.tc.columbia.edu/Community-College-FAQs.html.

106 Nick Collins, "Top universities forced to introduce remedial maths classes," *The Telegraph*, July 24, 2012, https://www.telegraph.co.uk/education/educationnews/9420771/Top-universities-forced-to-introduce-remedial-maths-classes.html.

107 Nate Anderson, *Building on a Strong Foundation: Linking CBE with Innovations in Developmental Education Redesign* (Boston: JFF, 2017), https://jfforg-prod-prime.s3.amazonaws.com/media/documents/CBE-2-080417.pdf.

108 Liz Eggleston, "2016 Coding Bootcamp Market Size Study," Course Report, June 22, 2016, https://www.coursereport.com/reports/2016-coding-bootcamp-market-size-research.

109 Tom Ogletree, director of Social Impact, General Assembly, interview with author.

110 *Measuring What Matters* (Boston: General Assembly, 2016), https://blog-pantheon-prod.global.ssl.fastly.net/blog/wp-content/uploads/2016/10/GA_OutcomesReport_161025.pdf.

111 "Schools With a Mission," About, Council on Integrity in Results Reporting, n.d., https://cirr.org/about.

112 Liz Eggleston, "2017 Coding Bootcamp Outcomes & Demographics," *Course Report*, December 19, 2017, https://www.coursereport.com/reports/coding-bootcamp-job-placement-2017.

113 Eggleston, "2017 Coding Bootcamp Outcomes & Demographics."

114 Sophie Beyer, "4 million training places offered with new Digital Strategy," *Education Technology*, March 1, 2017, https://edtechnology.co.uk/Article/4-million-training-places-offered-with-new-digital-strategy-1488362867.

115 Ruth Reader, "A Year Ago This Guy Was A Janitor. Now He's Coding For A Hot Startup," *Fast Company*, October 25, 2017, https://www.fastcompany.com/40482796/a-year-ago-this-guy-was-a-janitor-now-hes-coding-for-a-hot-startup.

116 Reader, "A Year Ago This Guy Was A Janitor. Now He's Coding For A Hot Startup."

117 Reader, "A Year Ago This Guy Was A Janitor. Now He's Coding For A Hot Startup."

118 "Be In Demand. Learn A New Skill.", CodeBridge, n.d., https://perscholas.org/apply/codebridge#overview.

119 Jake MacIntosh, "David Hannigan, Chief Cyber Risk Officer for Capital One Named to Per Scholas National Board," *Per Scholas*, February 20, 2018, https://perscholas.org/press/releases/david-hannigan-chief-cyber-risk-officer-for-capital-one-named-to-per-scholas-national-board.

120 Veronica Buckwalter, *Four Ways to Increase the Value of Short-Term Credentials: A Guide for Community Colleges* (Boston: JFF, 2017), https://jfforg-prod-prime.s3.amazonaws.com/media/documents/A_Guide_for_Community_Colleges-SB-041818.pdf.

121 Knapp & Associates International Inc., "Microcredentials: Is Small the Next Big Thing?" (PowerPoint presentation, October 2014 Town Hall Proceedings), http://www.knappinternational.com/assets/uploads/pages/Microcredentials-Is%20Small%20the%20Next%20Big%20Thing.pdf

122 Margaret Andrews, "The Future of On-Campus Higher Education?," *Inside Higher Ed*, March 31, 3015, https://www.insidehighered.com/blogs/stratedgy/future-campus-higher-education.

123 Buckwalter, *Four Ways to Increase the Value of Short-Term Credentials*; Steve Beasler, head of UK Policy, Pearson, interview with author.

124 Jacqueline Fuller, :$100 million for skills and opportunity in Europe, Middle East, and Africa," *The Keyword* (blog), Google, May 23, 2018, https://www.blog.google/topics/google-europe/100-million-skills-and-opportunity-europe-middle-east-and-africa/.

125 I*BM employs digital badges to attract, engage and progress talent across the globe* (London: Pearson, 2017), https://blog.youracclaim.com/uploads/5/3/5/3/53532919/ibm_case_study_acclaim_sept_2017.pdf.

126 "Northeastern University and IBM Partnership Fist to Turn Digital badges into Academic Credentials for Learners Worldwide," *News@Northeastern*, September 25, 2017, https://news.northeastern.edu/2017/09/25/northeastern-university-and-ibm-partnership-first-to-turn-digital-badges-into-academic-credentials-for-learners-worldwide/.

127 "Brinker International and Pearson Partner to Offer No Cost Education to Chili's and Maggiano's Employees," *Best You EDU*, January 22, 2018, https://www.multivu.com/players/English/8246351-brinker-pearson-education-chilis-maggianos-best-you-edu/.

[128] "Building a Movement: How a New Initiative Empowers Workers Through Education," Pearson, January 22, 2018, http://www.pearsonlearningnews.com/building-a-movement-how-a-new-initiative-empowers-workers-through-education/.

[129] Kevin Capitani, "Hungry for an economic future," *TribTalk*, March 5, 2018, https://www.tribtalk.org/2018/03/05/hungry-for-an-economic-future/.

[130] "JetBlue Takes Fresh Approach to Employer-Sponsored Education with Launch of JetBlue Scholars, *Business Wire*, April 18, 2016, https://www.businesswire.com/news/home/20160418006299/en/JetBlue-Takes-Fresh-Approach-Employer-Sponsored-Education-Launch.

[131] Michael Fullan and Katelyn Donnelly, *Alive in the Swamp: Assessing Digital Innovations in Education* (London: Nesta, 2013), https://www.nesta.org.uk/sites/default/files/alive_in_the_swamp.pdf.

[132] Sean Reardon and Jane Waldfogel, *Research Brief: International inequalities: Learning from international comparisons* (London: The Sutton Trust, 2016), https://www.suttontrust.com/wp-content/uploads/2016/12/International-inequalities_FINAL.pdf.

[133] Home page, Association of School and College Leaders, n.d., https://www.ascl.org.uk/.

[134] Corydon Ireland, "The costs of inequality: Education's the one key that rules them all," *The Harvard Gazette*, February 15, 2016, https://news.harvard.edu/gazette/story/2016/02/the-costs-of-inequality-educations-the-one-key-that-rules-them-all/.

[135] Tressie McMillan Cottom, *Lower Ed: The Troubling Rise of For—Profit Colleges in the New Economy* (New York: The New Press, 2017).

[136] Nick Chiles, "At Georgia State, more black students graduate each year than at any U.S. college," *The Hechinger Report*, November 25, 2016, http://hechingerreport.org/at-georgia-state-black-students-find-comfort-and-academic-success/.

[137] *GPS Advising at Georgia State University* (Atlanta: Georgia State University, 2014), https://oie.gsu.edu/files/2014/04/Advisement-GPS.pdf.

[138] Martin Kurzweil and D. Derek Wu, *Building a Pathway to Student Success at Georgia State University* (New York: Ithaka S+R, 2015), http://www.sr.ithaka.org/wp-content/uploads/2015/08/SR_Case_Study_Building_Pathway_Student_Success_042315_0.pdf.

[139] Maria Sobolewska, "More tolerant, yet more divided? UK-US parallels in the wake of Brexit and Trump," *The London School of Economics and Political Science*, December 12, 2016, http://blogs.lse.ac.uk/politicsandpolicy/more-tolerant-yet-more-divided-uk-us-parallels-in-the-wake-of-brexit-and-trump/.

[140] "Skillful: Providing Opportunity in the Digital Economy," Skillful, n.d., https://www.skillful.com/about.

[141] "Colorado Governor John Hickenlooper, the Markle Foundation," and 20 States Launch the Skillful State Network; Introduce Skillful State Playbook," Markle, February 14, 2018, https://www.markle.org/about-markle/media-release/skillful-state-network.

[142] *Industrial Strategy: Building a Britain fit for the future* (London: HM Government, 2017), https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/664563/industrial-strategy-white-paper-web-ready-version.pdf.

[143] Steve Besley, head of UK education policy, Pearson, interview with author.

[144] *Institutes of Technology Prospectus* (London: United Kingdom Department for Education, 2017), https://www.lepnetwork.net/media/1491/dfe_iot_prospectus_nov17.pdf.

[145] "Experimental Sites," Federal Student Aid, United States Department of Education, last updated April 12, 2018, https://experimentalsites.ed.gov/exp/index.html.

[146] Jeffrey Selingo, *The Networked University: Building Alliances for Innovation in Higher Education* (London: Pearson, 2017), https://www.pearson.com/content/dam/one-dot-com/one-dot-com/global/Files/about-pearson/innovation/the-networked-university/Pearson_The_Networked_University_v22-1_WEB.pdf.

[147] "Paper Addresses How Institutions Can Leverage Innovation to Improve Student Success," American Council on Education, March 25, 2015, http://www.acenet.edu/news-room/Pages/Paper-Addresses-How-Institutions-Can-Leverage-Innovation-to-Improve-Student-Success.aspx.

[148] "About Academic Innovation," University of Michigan, n.d., http://ai.umich.edu/about-ai/#thefocus.

[149] Christina M. Sax, "Five Steps to Building an Academic Innovation Engine," The Evolllution (blog), August 1, 2016, The https://evolllution.com/managing-institution/operations_efficiency/five-steps-to-building-an-academic-innovation-engine/.

[150] Sarah Kessler, "This coding school is set up to fail if its students don't get jobs," *Quartz*, June 14, 2017, https://qz.com/1004018/non-profit-coding-bootcamp-c4q-links-its-funding-model-to-whether-or-not-its-graduates-find-good-jobs/.

[151] Ethan Pollack and Shayna Solomon, "The Opportunities and Challenges of Income Share Agreements," *The Aspen Institute*, August 28, 2017, https://www.aspeninstitute.org/blog-posts/the-opportunities-and-challenges-of-income-share-agreements/.

[152] Krauss and Knepler, "Shared Design Elements and Emerging Practices of Competency-Based Education."

[153] *The Power of 15 Credits: Enrollment Intensity and Postsecondary Student Achievement* (Indianapolis: Complete College America, 2017), https://completecollege.org/wp-content/uploads/2017/11/CCA-Intensity-Brief-April3-1.pdf.

[154] General Assembly, *Measuring What Matters*.

[155] *Connecting Credentials: From National Dialogue to Collective Action* (Indianapolis: Lumina Foundation, 2016), http://connectingcredentials.org/wp-content/uploads/2016/09/Action-Plan.pdf.

[156] *Training to Win: Talent Solutions for the New Economy* (Washington, DC: The Manufacturing Institute, 2017),

[157] "Assumptions," Employment Projections: Concepts, United States Department of labor, Bureau of Labor Statistics, last modified February 13, 2018, https://www.bls.gov/opub/hom/emp/concepts.htm#assumptions.

[158] The BLS projections will be referred to as "projections" or "conventional projections" and cover the period from 2017-2027. *The Future of Skills* methodology is referred
to as "Employment in 2030" or "Future of Skills" methodology.

[159] "About Us," O*NET Resource Center, O*NET, last modified May 29, 2018, https://www.onetcenter.org/about.html.

[160] Alexis C. Madrigal, "Could Self-Driving Trucks Be Good for Truckers?," *The Atlantic*, February 1, 2018, https://www.theatlantic.com/technology/archive/2018/02/uber-says-its-self-driving-trucks-will-be-good-for-truckers/551879/.

Appendix

LABOR MARKET DATA COMPARISONS

Using new kinds of data to drive investments in educational program design

This report showcases the value of emerging forms of labor market data that will become increasingly accessible to educators over the next decade. Education systems must start to employ these data in order to make wise investments in occupational training that will meet business needs. Existing projections, which are based on decades of historical hiring patterns and demographic trends, may not always predict the skills and jobs that will be in highest demand in the future. Certain new data sources can identify potential misalignments of supply and demand, adding important detail to the information available to education leaders planning new programs.

To explore how incorporating this powerful new data can improve education planning, JFF compared the predictions resulting from the innovative approach used in The Future of Skills with standard labor market projections. In this case, the standard data were 10-year growth measures from the United States Bureau of Labor Statistics. Both measures project changes in the demand for jobs, but it's important to note the distinctions between them.

The Future of Skills used a novel methodology to project the likelihood of increased demand for individual occupations by 2030. This approach built on standard labor market projections by first gaining the insights of experts about the megatrends that will affect the global economy well into the future, and then analyzing these insights using an AI.

Each occupation was assigned a probability factor ranging from 0 to 1, with scores closer to 1 indicating a more likely rise in demand for that occupation. The Future of Skills factor denotes a measure of likelihood — i.e., that the occupation has an expected probability of increasing in demand by 2030 based on future trends. (See "2030 High Probability of Increased Demand" in tables 1 and 2 below.)

In contrast, the BLS figure is a measure of magnitude of growth within a specific time frame, i.e. that the occupation is expected to grow by a certain number of jobs within 10 years. (See "BLS 10-year increase" in Tables 1 and 2 below.)

For example, in Table 1 below, psychiatric technicians show a Future of Skills factor of 0.65, meaning that there is a 65 percent probability that the occupation will experience increased demand by 2030. Meanwhile, the Bureau of Labor Statistics (BLS) figure for the same occupation shows a projected increase of 33 percent, meaning that the total number of jobs within that occupation category is expected to grow by 33 percent in the next 10 years. By understanding likelihood, magnitude, and time frame, the analyst can create a more nuanced model of projected change in occupational demand.

JFF focused its analysis for this exercise on middle-skill jobs. These jobs require some kind of postsecondary education — less than a college degree, but more than a high school diploma. They include roles such as human resources assistants, insurance appraisers, dental assistants, and web developers. These are the type of occupations that colleges (UK) and community colleges (US) are already targeting for accelerated education models, as illustrated in this paper.

In some cases, the outlook for a given middle-skill occupation is similar using both the Future of Skills methodology and the BLS projections. (See Table 1.) This alignment suggests that investment in training for these occupations is likely to lead to future stable employment for those who complete the training. For example, occupational therapy assistants show both a high probability of growth according to the Future of Skills methodology, and are projected by BLS to increase by 35 percent in the next 10 years.

Table 1. Select Middle-Skill Occupations with Similar Outlooks Using Different Methodologies

Middle-Skill Occupation	2017 US Employment	2030 High prob. Incr demand	BLS 10 year increase	BLS Annual openings	Median hourly wage
Occupational Therapy Assistants	39,913	0.67	35%	7,137	$28.37
Psychiatric Technicians	64,531	0.65	10%	6,177	$14.89
Physical Therapist Assistants	88,092	0.64	33%	15,049	$27.21
Licensed Practical and Licensed Vocational Nurses	713,586	0.61	16%	65,643	$21.20
Emergency Medical Technicians and Paramedics	246,489	0.57	22%	21,884	$15.71
Diagnostic Medical Sonographers	67,797	0.56	24%	5,514	$33.49
Web Developers	135,455	0.55	27%	14,313	$31.79
Computer User Support Specialists	613,415	0.53	15%	57,270	$23.74

Heating, Air Conditioning, and Refrigeration Mechanics and Installers	303,784	0.52	15%	36,204	$22.07
Medical Assistants	636,286	0.51	21%	87,950	$15.17

Medical and Clinical Laboratory Technicians	163,251	0.41	17%	$18.73
Surgical Technologists	108, 181	0.37	15%	$21.71
Dietetic Technicians	33,168	0.37	13%	$12.67
Heavy and Tractor-Trailer Truck Drivers	1,721,316	0.34	10%	$19.87
Medical Records and Health Information Technicians	204,183	0.26	15%	$18.29

The similarities in projected demand may be related to the underlying skills required for each occupation. The Future of Skills analysis calculated correlations between their probability of increased demand and Occupational Information Network (O*NET) job characteristics — officially coded job attributes published by the United States Department of Labor that include knowledge, skills, and abilities. In addition, the occupations with more positive outlooks based on The Future of Skills are less likely to be easily automated.

There were some occupations in the analysis, however, where the results of the two methodologies are contradictory. Some of the occupations represent a relatively small number of the overall workforce, such as embalmers or air traffic controllers. In other cases, there are occupations that have a larger share of the labor market, and the differences in projected outlook reflect more complex changes in technology or automation. (See Table 2 below.)

Table 2 Select Middle-skill Occupations with Contradictory Outlooks Using Different Methodologies

Middle-Skill Occupation	2017 US Employment	2030 High prob. Incr demand	BLS 10 year increase	Median hourly wage
Embalmers	3,585	0.62	-4%	$19.30
Air Traffic Controllers	25,133	0.54	-2%	$58.85
Respiratory Therapy Technicians	10,717	0.54	-6%	$23.93
Desktop Publishers	12,485	0.49	-13%	$19.76
Wind Turbine Service Technicians	5,503	0.41	91%	$25.13

This list suggests areas where training investments might not be wise, and more analysis and research should be conducted to better understand the contradictory findings. Some of the underlying factors are likely related to automation and changes in the nature of work. For example, Heavy and Tractor-Trailer Truck Drivers (employing over 1.7 million nationwide) show only about a 34 percent probability of growth according to The Future of Skills, and yet are projected to grow by 10 percent according to BLS. This reflects the more nuanced debate that is currently going on in the trucking industry, where predictions about the effects of automation on trucking jobs are mixed. The list also includes three types of medical technicians, in stark contrast to the growing medical fields appearing in Table 1.

This brief analysis illustrates how, as additional forms of labor market data become available, analysts will be able to add nuance to existing skill projections and make meaning of the latest demand signals. Just as traditional labor market information (LMI) is regularly supplemented with real-time LMI "scraped" from current online job postings, so too will demand measures such as those created in The Future of Skills add to the toolkit that educators will have at their disposal. More important, using a combination of several methodologies can better identify sound opportunities for new investment in education programs and drive the creation of better models of labor market change.