2 SHIFT HAPPENS

Finding Strong Footing: The Future of Assessment in the Learning-to-Employment Landscape

As homeowners invite strangers into their homes for bed and breakfast, and our children ride from activity to activity in a stranger's vehicle, and we learn from wherever we can, we are witnessing a new currency of trust emerging all around us.

In just one short decade, we have chosen to look beyond big expensive brands of hotels, taxis, and universities while choosing beds, rides, and learning venues based on reputation and ratings. Navigating trust is at the epicenter of every relationship whether it's between a homeowner and guests, a college and a student, or employers and applicants.

Today's education and learning assessment protocols — which in many cases determines an individual's life path especially after high school - is one area where trust and trust services are yet to be re-defined. As a result of government and laws that require education assessments as proof of public dollars at work, combined with large industry sectors like colleges, universities, and employers that depend on applicants' test scores for admittance and consideration, change is even more difficult — and it's time for disruption.

The timing for this paper is perfect as it dives deep into the current state of assessment. It provides a thoughtful, insightful look into building a strong case for a new era of learning and hiring assessment and trust services while being concise and easy to read.

Parminder K. Jassal, Ph.D. | Work + Learn Futures | Institute for the Future

With mounting student debt and increasing need for job-related skills upon entering the workforce, learners are leaving the traditional degree-to-employment path and turning toward creative, online learning solutions, nationally recognized certifications, and digital badging. Educational institutions clearly need to evolve, and in Shift Happens 2, Dr. Merrilea Mayo and Jamai Blivin provide the basis for how to start that change. Mayo and Blivin focus on the need for competency-based assessment that tests what learners can do in addition to what they know and on the shift away from traditional, knowledge-focused, long-form degree education and toward shorter-form, skills-based certification and credentialing taught through practical, hands-on training. By making these shifts, educational institutions can increase return on investment for learners, who, as the authors point out, are largely looking to enter the workforce more quickly after high school and gain job-focused skills and credentials while working.

Frank Britt, CEO of Penn Foster

This paper creates an opportunity for researchers and assessment designers to develop new and innovative ways of measuring various facets of learning — such as the potential to learn, learning to learn, unlearning and relearning, and most importantly, demonstrated performance — that can happen anytime and anywhere. This new development work must be done in close collaboration with learning providers, the working learners, and employers to create a viable assessment and credentialing framework that supports working learners. To create a future of assessments that benefits all stakeholders, it will require that we challenge current assumptions and remove biases about what we think can and can't be done. It also means we must embrace controversy and debate about what we thought was impossible and take risks to create new possibilities so that working learners can succeed and prosper.

Dr. Hope Clark

LETTERS

JAMAI BLIVIN is Founder and CEO of Innovate+Educate, a nonprofit she started in 2008 with a vision for an organization that could pilot strategies in New Mexico that could impact those living in poverty and/or not able to complete college due to financial and life constraints. Within three years, the organization had received national recognition for their strategies in skills-based hiring and began their work nationally. Since then, I+E has been a national leader in workforce strategies to assure employment pathways for all.

DR. MERRILEA MAYO is the founder of Mayo Enterprises, LLC, a consultancy in the areas of innovation, workforce, technology, and the future of learning. Her most recent work focuses on skills-to-jobs matching. She performs analyses of public and private datasets to better understand what skills employers are looking for, what they mean by vague words like "communication" or "problem-solving," and how to measure these skills. She assists employers in understanding the assessment market, nonprofits in implementing new hiring models, and researchers in developing skills-based models of employment. Her prior work with Innovate+Educate led to Dr. Mayo's appointment as an ACT Fellow and brief recognition of the I+E effort on whitehouse.gov. Prior to her consulting career, Dr. Mayo served as Director of the Future of Learning Initiatives at the Kauffman Foundation, and prior to that, Director of the National Academies' Government-University-Industry Research Roundtable. She has launched two nonprofits, ASTRA and the University-Industry Demonstration Partnership. Dr. Mayo is a materials scientist and engineer by training, having received her doctorate in that field from Stanford University in 1988, publishing approximately 80 technical articles, and serving as the President of the Materials Research Society's in 2003.
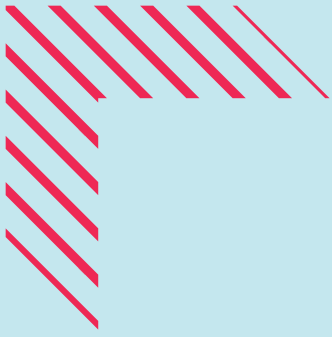
Experts now foresee a world in which working and learning will be joined — and the social needs accommodated — through the implementation of a competency-based framework.

ABOUT THE AUTHORS

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FOREWORD: A LOOK BACKWARD

In October 2006, I was working at the North Carolina Technology Association (NCTA). One of my projects was to launch and lead the "Knowledge Workforce Committee." Through this project, NCTA directed and facilitated roundtables with groups of large employers from the Research Triangle Park (RTP) area, including Cisco, IBM, SAS, Lenovo, Dell, HP and +30 more. The goal of the committee was to ensure that the higher education ecosystem in the region would provide the critical skills training necessary for the jobs of the rapidly changing technology space.

It is through this work that I met Dr. Merrilea Mayo, my co-author of this paper, who attended a large meeting we held with then-Chancellor of the UNC System, Erskine Bowles. Merrilea happened to be in town for a gaming conference and was invited to join us by a member of our committee.

After the meeting, over a cup of coffee, Dr. Mayo (who was then at the Kauffman Foundation) described her vision for a system in which people were hired on a "bar-code" framework, a system in which one was identified by one's skills and competencies, and one's "bar code" represented their knowledge, skills, and abilities," i.e., their competencies. I, of course, was amazed at Dr. Mayo's articulation on how this would work, but was an instant believer. This became our passion, working together (sometimes separately, but connected by our vision), and as we release *Shift Happens 2*, I believe we are closer now than ever before to Merrilea's vision becoming reality. In 2006, very few of the innovations we describe in the paper even existed. One decade later, SHIFT has happened.

In December 2016, Innovate+Educate released its first major publication, *Shift Happens.* The paper outlined the tremendous shifts impacting the degree-to-employment landscape. The paper provided an overview of new technologies in the education, training, and hiring domains — from so-called people analytics tools used by HR chiefs, to accelerated learning providers, to credentialing platforms, to social networks that assisted job applicants in show-casing their unique skills and talents. There was a lot of activity, moving in what seemed like random directions.

Over two years later, we now release *Shift Happens 2*. The key difference between 2016 and 2019 is that the new approaches have now been used long enough, they are starting to make trails in the mud — and where there are trails, there will soon be roads. The U.S. is still mired in marsh muck: employers can't find talent; job sites are sifting out good talent; degreed individuals remain under-employed and unemployed; and institutions are seeing a decrease in enrollment in traditional education. Nevertheless, it is now possible to trace out a route that leads from the original societal forces demanding better career pathways to a new competency-based education and workforce system. The route leads to new education structures arising in response to those demands, to some of the most significant final pieces — advances in assessment — needed to make the new structures function.

As a nonprofit focusing on assessment to ensure an equitable future for all, Innovate+Educate has seen more uptake of assessment in the last year than we have in the last decade. Multi-

ple scenarios have provided us with a lens to view use cases — from assessing learning, to assessing competencies for advancement, to assessing competencies for skills-based hiring. It is still an Oregon Trail and not yet Interstate 80, but the path to a better future, a competency-based future, is becoming clearer. SHIFT is happening.

Jamai Blum

Credential System: The "Bar Code"

Abilities & Competencies

Knowledge

9 781932 542042

COMMUNI-
CATION

PROBLEM
SOLVING

PHYS   MATH
     CHEM
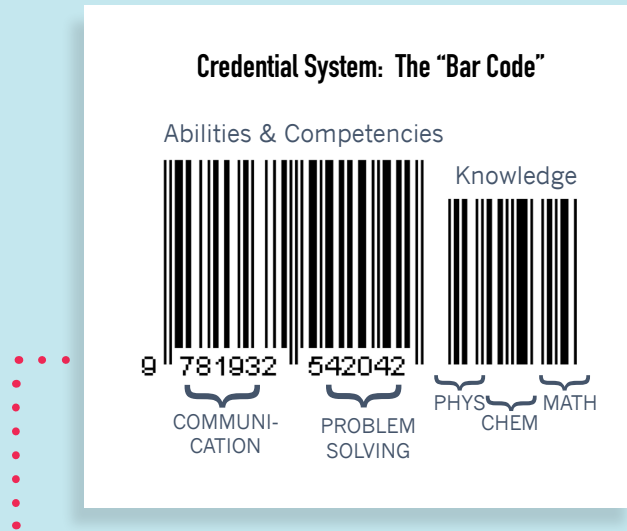
Dr. Mayo's original concept of bar-coding an individual as the sum of his or her competencies. The bar code imagery was chosen to imply a set of competencies that were objective, discrete, stackable, and machine-readable. Image taken from Dr. Mayo's 2006 presentation.

The new field-tested approaches are starting to make trails in the mud — and where there are trails, there will soon be roads.

EXECUTIVE SUMMARY

THE MASSIVE FORCE OF WORKING LEARNERS AND LEARNING WORKERS ARE DEFINING A NEW SYSTEM FOR HIGHER EDUCATION

Today, it is no longer a pathway from primary to secondary to postsecondary education leading to a job. That staid formula is no longer working, especially for most of America. Today, a learners' most pressing need is a greater connect between education and employment outcomes. Major societal issues — the student debt crisis and the economic stagnation of the middle class — can be traced to the inability of traditional postsecondary education to deliver the right skills, to the right people, at the right cost, in the right form factor. Practical issues, such as rigid class schedules and large up-front costs, prevented most adults, and many of their children, from pursuing the American Dream. The middle class, with no means of getting ahead, and no accessible ladder to climb has hollowed out. They have also begun to demand change. The consumer (the working learner) is saying "No more!"

Simply put, few Americans are able to afford four years of time and four years' worth of tuition money, especially at the SAME time.

With this new consumer shift, the largest demographics now engaging in higher education are a new massive force. Defined as "the working learners and learning workers," this combined group of higher education students is far larger than that of the traditional students. To meet their needs, the linkage between school and work, credential and employment, is tightening. Whether it is receiving credit for prior learning or getting a nanodegree, credentialing innovations that service this growing working learner population are now emerging everywhere. Nearly all have one thing in common: assessment.

It is because of this common technical underpinning (of assessment) that a new postsecondary learning-to-employment ecosystem is starting to knit itself together, patch-work-like, around and through the traditional degree-to-employment pathway. In this new ecosystem, learning has become incrementalized, increments of different sizes have become credentials, and each increment is both gated and signaled by passing an assessment, rather than a credit hour of seat time or a semester of enrollment.

Experts now foresee a world in which working and learning will be joined — and the social needs accommodated — through the implementation of a skills and competency-based framework.

Credentials, courses, people, and jobs will each be articulated as collections of fundamental units of knowledge ("know" competencies) and skill ("do" competencies). These competencies will need to be assessed to provide meaning to the end user (both the learner and the work i.e., employer.) *This paper examines the paradigm of this SHIFT that lies ahead.*
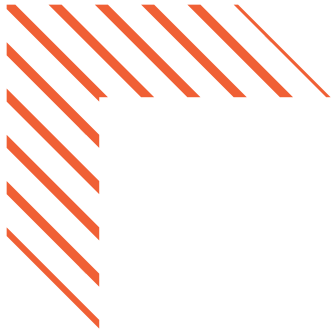
SHIFT: A HISTORY LESSON

ASSESSMENT'S ROLE IN THE TRADITIONAL DEGREE-TO-EMPLOY-MENT PATHWAY

Anyone who has progressed through the U.S. education system understands the role of assessments in school. Assessments are used as gateways to the next class (performing well enough on the final exam allows one to pass the class); gateways to a high school diploma (mandatory state exit exams); and as gateways from high school to college (SAT, ACT, and other college entrance exams). In each case, the assessments are knowledge-based, attempting to capture whether students "know" enough of the material previously taught to merit progressing to the next learning experience.

On the employer side of the degree-to-employment pathway, assessments are not consistently used as gateways to the next level. Promotion at work is typically based on either seniority or supervisor recommendation, and not by performance on objective company-wide assessments. Assessments are, however, quite heavily used before hiring, to sort candidates into those who might be acceptable to hire, and those who are not. Prehire assessments are still about a $1.25B industry[1] (compared to $4B, for educational assessments).[2] Cognitive assessments looking for English, math, vocabulary, critical thinking, or other school-like skills used to be the assessment of choice for prehire selection. By the early 1970s it had become clear that cognitive tests displayed score segregation by race.[3] Afterwards, their use for prehire selection became highly regulated. In 1978, the EEOC published its Uniform Guidelines on Employee Selection Procedures,[4] which restricted the use of such assessments for hiring purposes. Many employers transitioned away from cognitive tests when evaluating job candidates.

In lieu of cognitive assessments, employers began to rely increasingly on personality tests, built by psychologists, for prehire selection. Personality tests had been available since 1917,[5] but they came into vogue post 1978[6] because they had almost no score segregation by race,[7] and they were quick and cheap to administer. Personality tests contains items like: "Indicate how strongly you agree or disagree with the following statement: I do a lot in my spare time."

Personality tests' ability to predict job performance is admittedly low. Very well-designed personality assessments have, at best, an r of about 0.25[8,9] — meaning the assessment explains about 6% of job performance.

As recently as 2007, five former psychology journal editors published an open paper in *Personnel Psychology* arguing that self-report personality tests had such a low ability to predict future job performance, they should simply not be used for prehire selection.[10] These editors had collectively reviewed over 7000 scientific manuscripts in psychology during the course of their careers.[11] They were very well aware of the state of the art.

Employers, however, still use personality tests. Legally, the tests are much safer than the 4-5x more predictive[12,13] cognitive tests. While employers seem to be satisfied, personality tests do frustrate students who are used to the knowledge-based orientation of school tests.[14]

As Wilson, Kurzwei, and Alamuddin point out in their report, *Mapping the Wild West of Pre-Hire Assessment*,[15] inconsistency in the content and goals of educational vs. employment testing is a huge flaw that will need to be corrected if seamless learning-to-employment pathways are ever to be built. They recommend a single, unified, cradle-to-grave competency-based assessment system that seamlessly tracks one's development throughout education and career.[16]

Perhaps the most important fallout from the 1978 decisions was that many employers stopped using assessments altogether and simply turned to using college degrees as a proxy for the concrete knowledge and skill levels they could no longer test for directly.[17,18,19] **Figure 1** shows how the earning power of college graduates vs. those without a degree increased dramatically starting in 1978, when degrees started to be used as a resumé-sorting criterion. Ultimately, the discrepancy in earning power between degreed and non-degreed workers became so severe that Americans came to view a degree as the undisputed ticket to a job. With this as the new reality, American families became willing to mortgage their entire financial futures, so that their children might obtain a degree.

In 1995-1996, 17 years after the EEOC guidelines were passed, the babies born in 1978 began to attend college. That very same year, the student debt crisis began.[20]

Figure 1. Earning power discrepancy between degreed and non-degreed workers takes off after 1978, the year the EEOC Uniform Guidelines were passed. Figure adapted from Bryan O'Keefe and Richard Vedder.[21]

MEDIAN INCOME DIFFERENTIAL, COLLEGE VS. HIGH SCHOOL EDUCATED MALE WORKERS 25+ YEARS OLD

GREATER INCOME PERCENTAGE

EEOC UNIFORM GUIDELINES ISSUED

AFTER THE EEOC UNIFORM GUIDELINES

YEAR: 1958 1963 1965 1967 1969 1971 197 1975 1977 1979 1981 1983 1985 1987 1989 1991 1993 1995 1997 1999 2001 2003 2005
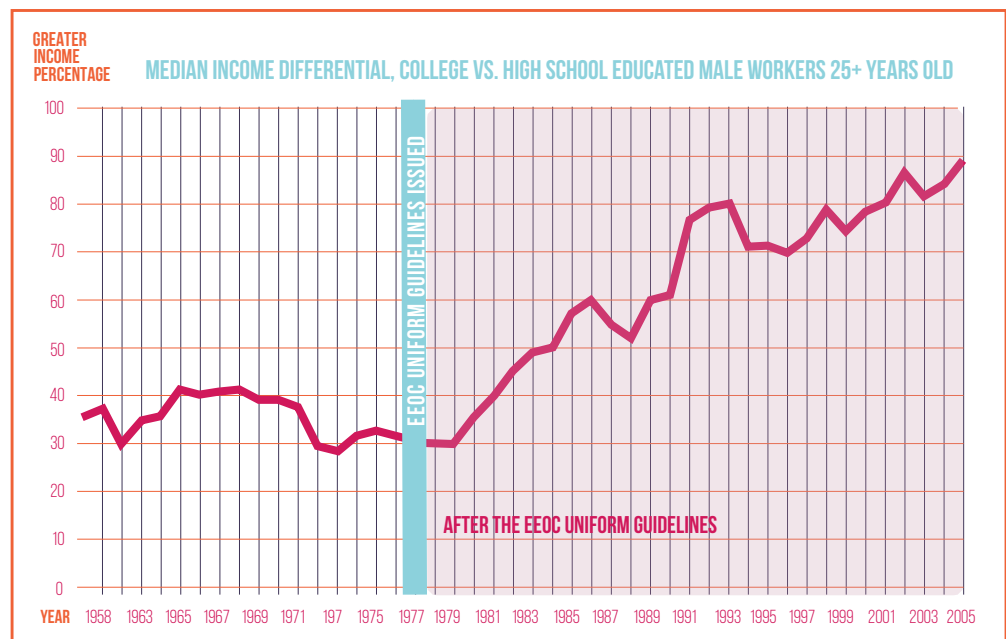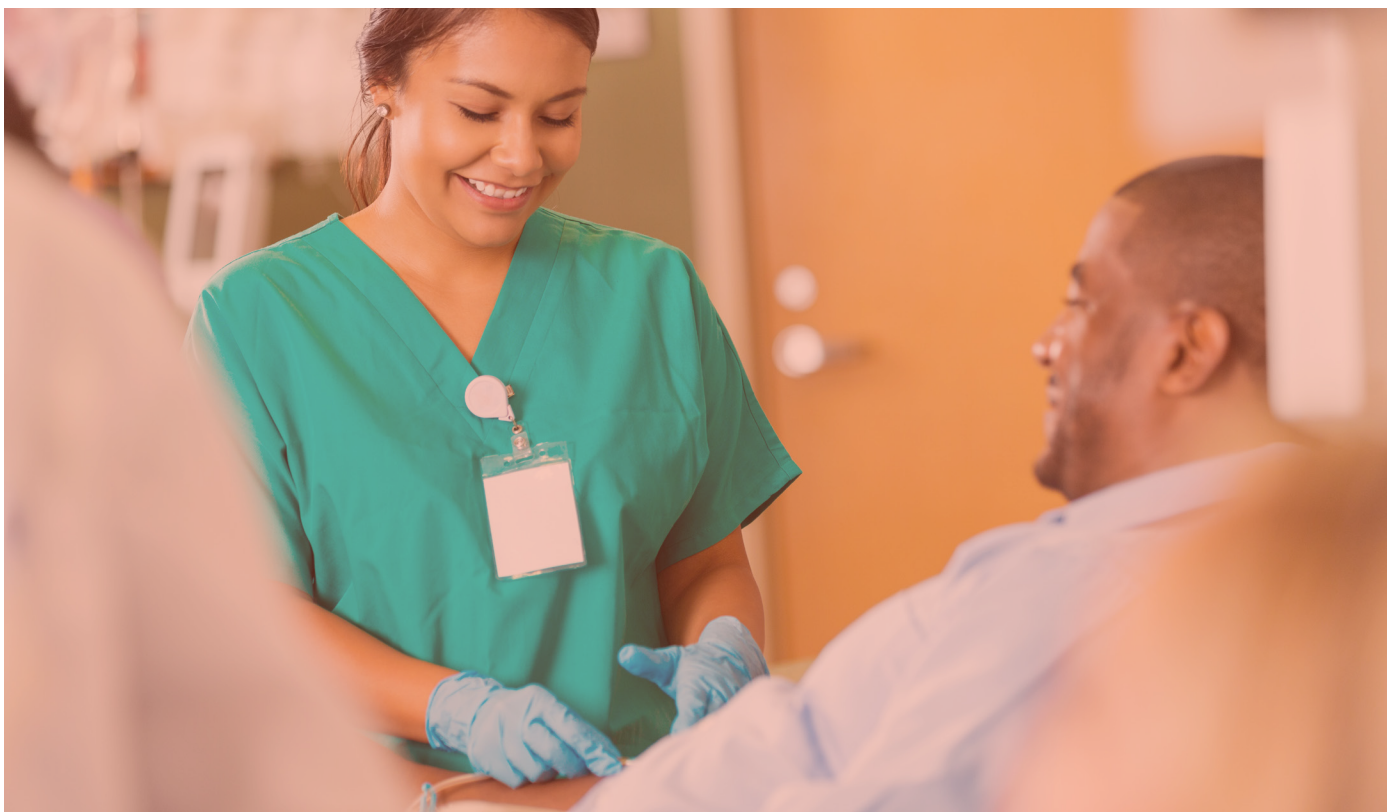
Legal constraints on prehire testing are not the only factor leading to today's emphasis on four-year degrees as a prerequisite to being hired. Licensure has also played a role, with multiple occupations — nursing, medicine, social work, primary education, secondary education, law, dentistry, pharmacy, and accounting — now requiring a degree before taking the assessment that allows one to legally practice the profession. On the other hand, one could argue that a four-year degree would not be today's must-have ticket to such a wide swath of jobs if only the 1970s psychometricians had known how to make cognitive prehire tests whose scores were race-agnostic. Experience alone or directly testing into many jobs might still be a possibility. Unfortunately, the requisite science needed to make cognitive tests race-agnostic still does not exist today, though there is tantalizing evidence that such a breakthrough could be possible, given a dedicated and well-funded research effort.[22]

Prehire assessment has remained tightly regulated for 40 years, even as public demand for better pathways to jobs has massively increased. As a result, the higher education portion of the degree-to-employment pipeline has seen more innovation and experimentation than employer hiring funnels. The next section of this paper describes some of the pressing societal forces needs that are altering the traditional four-year degree pathway.

SHIFT: SOCIETAL FORCES

Learners are now exerting substantial pressure on the traditional degree-to-employment pathway as middle-class stagnation has given rise to the working learner. Student debt has created even more pressure to the traditional pathway. Societal forces include:

• • • • • • **Avoiding Student Debt**

In 2016, the Federal Reserve estimated student debt at $32,371 per debtor.[23] By mid-2018, student debt in the U.S. totaled $1.53 trillion[24] (see **Figure 2**), about $500B more than U.S. consumer credit card debt.[25] Advancing one's career through further education adds even more debt to be repaid, as shown in **Figure 3**, for graduate degree holders.[26] With student debt so large, students and their families are beginning to question the need for a four-year degree.

Only four in ten Americans under 40 now believe college is necessary to get ahead in life, compared with seven in ten Americans over 40.[29]

Reddit, a social media forum, is filled with queries by young students wondering if they should stick with their degree plans, given the debt they are accumulating.[30] These "no debt" seekers are looking for a better, cheaper solution to reach the same end goal: a well-paying job. Their needs are partly driving the growth in employer-recognized credentials — ways to signal job-readiness other than a four-year degree. As one example, about 4.6 million individuals who have neither a two- nor four-year degree now have an exam-based certification instead.[31] Adding non-degree-requiring licenses to the mix brings this total to 14.7M individuals.[32]

• • • • • • **Working while Learning**

While some prospective students avoid incurring student debt by finding an employer-recognized credential outside of higher education, others try to make a go of higher education by working enough hours every week to offset the price of tuition. **Figure 4** shows the large population of "working learners" who have 20+ hour/week jobs (light blue, 14.5M) and are attending school simultaneously. Working learners now exceed the population of traditional learners in higher education (orange, 10.7M).

The only problem is, the format of traditional higher education is completely incompatible with work. A Gates Foundation and Public Agenda survey found that 54-71% of all students dropping out of college, were dropping out in order to keep their day jobs (see **Figure 5**).[34] Numerically, this represents the entirety of the working learner population with 20+ hour/week jobs and then some.

Working learners need classes that can be flexibly scheduled around work, preferably classes that are on-demand. Working learners also need higher education they can
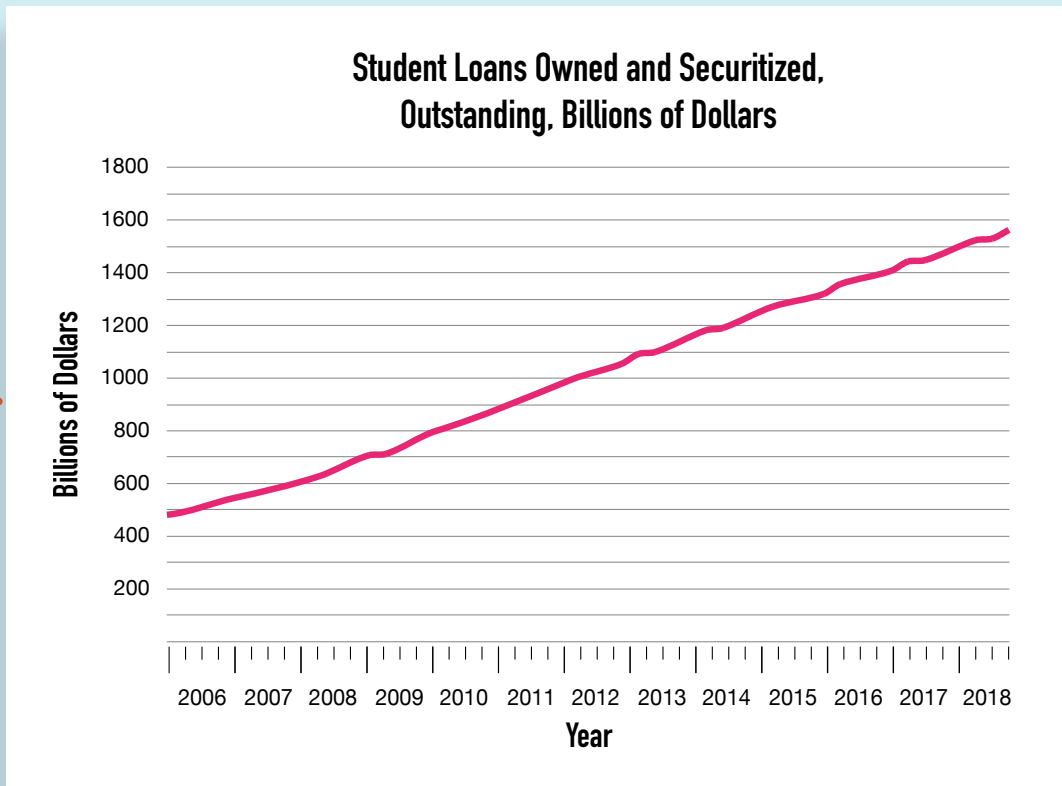
Student Loans Owned and Securitized, Outstanding, Billions of Dollars

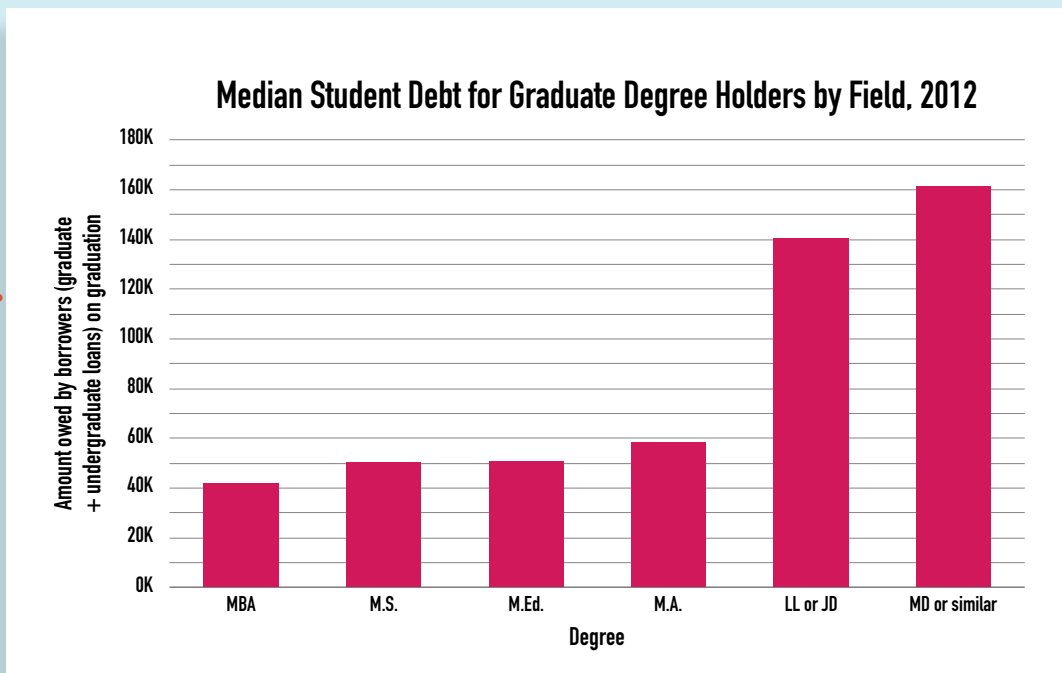## Median Student Debt for Graduate Degree Holders by Field, 2012

Figure 3. Median Student Debt, per debtor, for selected advanced degree holders.[28]

afford on the entry-level, non-degreed worker wages they are able to earn.

This is not a student debt issue: most working learners cannot even get federal loans. Federal student loans (Title IV funding) require students to be enrolled more than half-time each and every semester,[36] while many working learners take one or two courses at a time and are thus ineligible. (Note: When surveyed, making federal financial aid available to part-time students was working learners' top priority.) [37]

Now that they outnumber traditional leaners, working learners' needs have become a market force. Their needs are driving three additional credentialing pathway changes: online degrees, credit for prior learning, and competency-based degrees. Each consists of delivering a traditional degree, but in a way that relies less on scheduled seat time and decreases up-front costs.

• • • • • • **Middle Class Salary Stagnation**

The last societal issue compelling the creation of alternative credentialing pathways is middle class salary stagnation. This issue has given rise to yet another working+learning demographic: the "learning workers" (magenta bars in **Figure 4**). These are workers who already have steady jobs — and, for the most part, even degrees — but feel they are falling behind. They are looking for small bits of education to fuel incremental advancements in their careers. This demographic — at 50M, about 4.5 times larger than traditional learners (see Figure 4).

A 2018 Pew Research Center report shows the purchasing power of the middle class has not budged in five decades.[38] The lack of mobility within the middle class is now a major political and policy issue in the U.S.[39,40] Theoretically U.S. middle class workers could skill up continuously

Figure 4. A comparison of traditional learners: (orange), 20+ hour/week working learners: (light blue), already-degreed worker (magenta) and non-degreed workers: (purple) demographics in the U.S. as of 2017.[33] The already-degreed workers: (magenta) are sometimes referred to as "learning workers" in this paper because of evidence that this population actively pursues small increments of learning even after they are on the job.

Demographic School Attendance Comparison

Legend:
- Workers: Not attending school, working 20+ hrs/wk, less than bachelor's
- Learning Workers: Not attending school, working 20+ hrs/wk, bachelor's or higher
- Working Learners: Attending school and working 20+ hrs/wk
- Traditional Learners: Attending school, not working (or working less than 20 hrs/wk)

Y-axis: Number of People (0M to 5M)
X-axis: Age (18 to 98)

Having to work is the top reason young adults give for why they left school

Percent who say the following is a reason why they did not complete their program

■ Major reason   ■ Minor reason

I needed to go to work and make money
54% | 17% | 71%

I just couldn't afford the tuition and fees
31% | 21% | 52%

I needed a break from school
21% | 33% | 54%

I had to take too many classes that I did not think were useful
16% | 27% | 43%

I didn't have enough time for my family
16% | 25% | 41%

I thought many of the classes were boring
14% | 31% | 45%

All things considered, it just didn't seem to be worth the money I was paying
14% | 21% | 35%

I didn't like sitting in class
11% | 27% | 38%

Some of the classes were too difficult
10% | 24% | 34%

0   20   40   60   80   100

Figure 5. Survey analysis by Public Agenda's Jean Johnson, Jon Rochkind, Amber N. Ott, and Samantha Dupont. Results from over 600 young adults across the U.S. show that the primary reason students dropped out of college had to do with keeping their jobs, rather than difficulties with coursework.[35]

throughout their lives and acquire ever higher wages as a result of ever higher skills. Realistically, traditional higher education is ill-equipped to take on this challenge. **Figure 5** has already illustrated that working is functionally incompatible with a seat-based, tuition-intensive learning model. Many workers have resorted instead to job-hopping, hoping to get a small (typically around 5%) [41] increase in wages as a result of leaving one job for the next. As a recent Glassdoor study showed, salary is a predictable factor in employee turnover (1.5% increased chance of retention for every 10% increase in salary).[42]

Because workers' average job tenure is now down to 4.2 years,[43] a 4-year degree pathway to skill up for the next opportunity becomes untenable. Instead — as will be seen — incumbent workers' demand for learning increments just large enough to land the next job/next raise is driving the tsunami-sized increases in massive open online courses (MOOCs). MOOCs do not offer a degree, but they offer access to useful job skills one can either demonstrate in one's current job and/or add to one's resumé in search of the next job.

Demands for Work-Compatible Learning

Large numbers of degree pathway alternatives are now becoming available, thanks to the societal pressures exerted by the following:

1. "No-more debt!" seekers: those attempting to bypass student debt by bypassing the degree itself. These people have helped give rise to non-degree/alternative credentials.

2. Working learners: enrolled students attempting to combine working hours with a full degree program. These students have been the primary drivers for innovations that reduce fixed seat time and fixed scheduling requirements — innovations such as online degree programs, credit for prior learning schemas, and competency-based degrees. The same innovations also decrease up-front costs.

3. Learning workers: adult learners who typically are working full time and may or may not have a degree. Their need for small increments of continuing education to gain job mobility is responsible for the rising popularity of small increments of job-relevant education, such as those found in MOOCs.
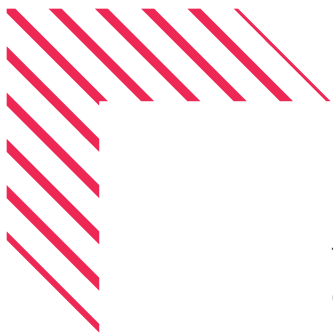
SHIFT: AWAY FROM A TRADITIONAL DEGREE

The SHIFT away from the traditional degree has advanced the world of credentials. The term credentials include degrees but also certificates, certifications, nanodegrees, microcredentials, badges -- and in some cases, even pre-hire assessments. We explore several non-degree options here:

• • • • • • **Certifications — Third-Party Assessments of Specific Job Skills**

Certifications are credentials earned by jobseekers upon taking a third-party exam. Most certification exams are occupation-specific and typically quite specialized. Because the exams are authored by subject matter experts in a professional organization or industry-dominating company, they tend to be rigorous. Certifications can be earned almost anywhere in the U.S., since they are typically delivered through commercial testing center networks having many hundreds of testing outposts. The assessments can also be self-scheduled at the examinee's convenience. Because the examinee, and not the employer, owns the exam score and decides what to do with it, certifications do not fall under the existing EEOC uniform guidelines.

The differences between prehire assessments and certifications are outlined further in **Table 1. Table 2** outlines the difference between certificates and certifications. These two terms are commonly confused because of similarities between the two words, but they represent two entirely different credentials.

Learner demand for non-degree pathways has made certification of occupational expertise an emerging market force. About 4% of U.S. residents who do not have an associate's degree or higher, now have a work-relevant certification to help gain employment.[46] (By comparison, 8-9% of U.S. residents have a terminal associate's degree).[47] Sixty percent of individuals who have a certificate claim their certificate was "very useful" in finding them a job; another 26% claim it was "somewhat useful."[48]

CareerOneStop, a website operated by the U.S. Department of Labor, currently documents over 5700 certification exams.[49,50] Subjects range from early childhood education, to cybersecurity, to cable wiring, to restaurant food preparation — virtually every occupation-specific skill or knowledge set one can envision. Certifications are slowly being picked up by employers as potential proxies for degrees, in terms of signaling job readiness. It is now possible to find job ads, such as that shown in **Figure 6**, where there is no college degree necessary, only one or more certifications required. As another example, the Army directly accepts certifications for "promotion points." Their COOL database[51] lists over 1600 certifications and indicates, for each, which military occupations the certification is relevant to; whether GI Bill reimbursement is available to cover the cost of the exam; and whether gaining the certification results in promotion points[52] (see **Figure 7**).

	Prehire Assessment	Certification
What is the Typical Subject Matter?	General employability skills (cognitive, personality)	Occupation-specific specialized skills
Who Decides what the Test Should Cover?	Employer (though they typically buy premade tests matching their content and delivery needs from commercial test vendors)	Professional organization or dominant company in the field
Who Owns the Score?	Employer	Jobseeker/Examinee
Who Sees the Score?	Employer Only	Jobseeker and anyone else the jobseeker authorizes
What can the Score be used for?	Gaining Access to one Job	Gaining Access to Multiple Jobs
When is the Test Taken?	During Job Application Process	Anytime the Jobseeker Chooses
Are Retakes Allowed if the Examinee Wishes to Improve His Score?	No	Yes
Regulatory Constraints	Subject to 1978 EEOC Uniform Guidelines	None (yet)

Table 1. Differences between prehire assessments and certifications.

	Certificate	Certification
How is the Credential Earned?	Passing a year or so of classes in a higher education institution, typically a community college	Taking a nationally offered standardized exam at a third party, proctored testing site
Who Offers the Credential?	Higher education institution	Professional organization or dominant company in the field
What is the Typical Cost?	$4,000 – $5,000	$100 – $500

Table 2. Differences between certificates and certifications.

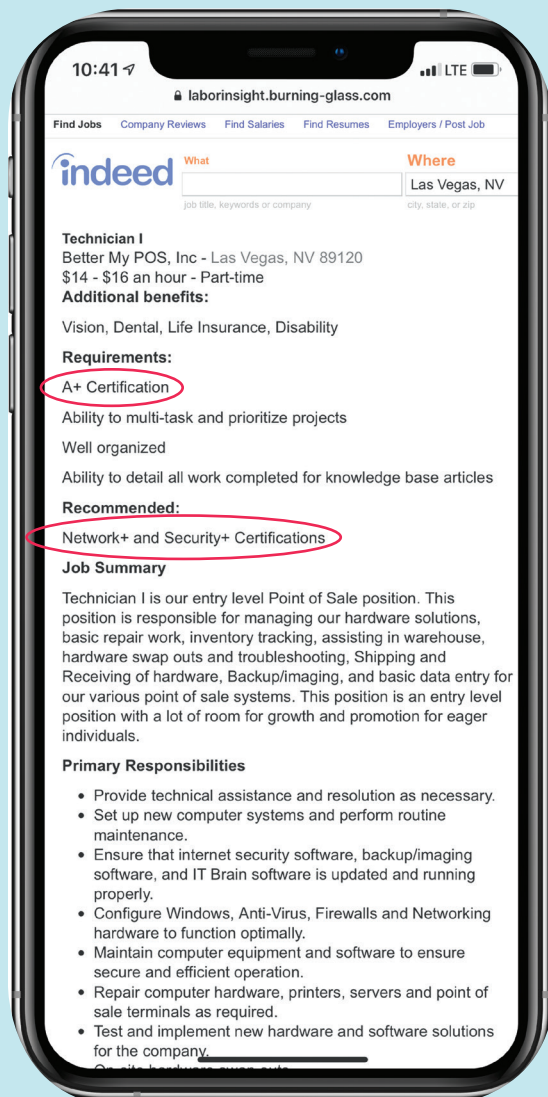**Figure 6.** Job advertisement for an entry-level technician, citing CompTIA A+ Certification as the sole requirement. Job ad originally posted on Indeed[53] and later retrieved via Burning Glass' Labor Insights.[54]

Figure 7. Army COOL database[55] showing how over 1600 existing professional certifications map to Army occupations, GI Bill reimbursement, and the attainment of promotion points.
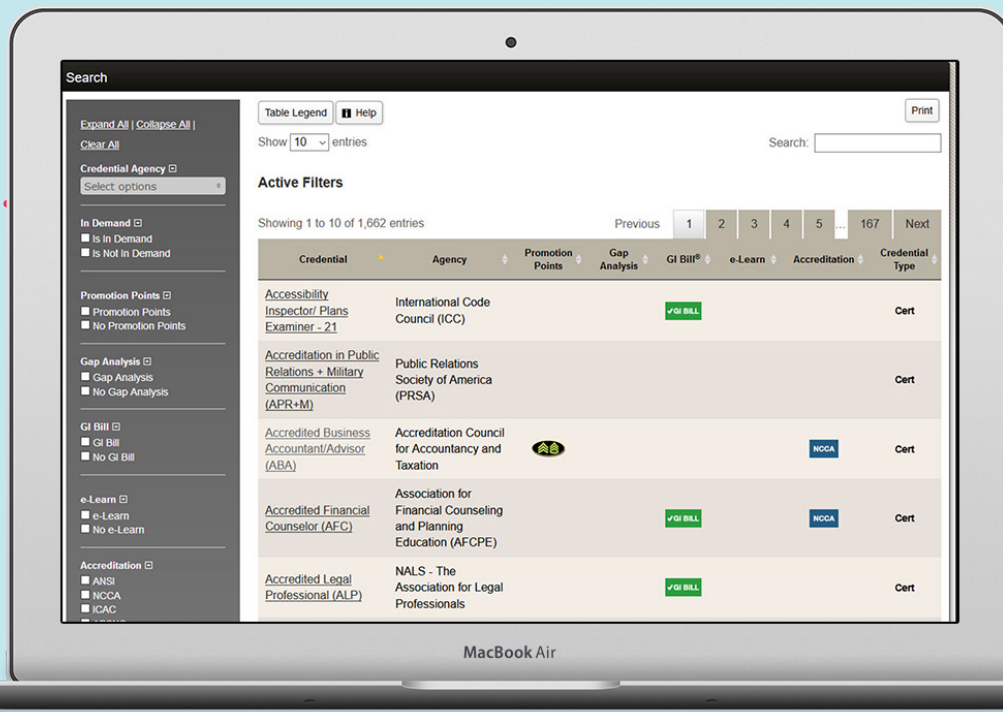
An interesting feature of the certification assessment landscape is the separation between the credential owner, the assessment provider, and the learning provider. In traditional higher education, these three entities are one and the same: the college or university. For certifications, they are separate. As mentioned earlier, professional organizations and industry-dominating companies typically author an exam and use their brand to back the certification. For example, the American Culinary Association provides certification for executive chefs' skillsets,[56] while Microsoft provides certification of Microsoft Office proficiency.[57] Meanwhile, the exams themselves are delivered to learners via third party testing center operators, such as PearsonVUE, PSI Exams, Certiport, or Prometric. Learning providers comprise the third leg of the certification stool, independent from the other two. Students can use any learning provider they wish. They can watch a video course, hire a tutor, study a textbook, or learn on the job in advance of taking an exam. The learning providers have no fixed relationship with the credential owners or assessment providers.

This three-party system, with each of the three branches independent of each other, is a new structure for higher education that will require new consumer navigation tools in order to function effectively.

Certifications represent a new kind of learning assessment: nationally offered, highly specialized, self-schedulable, work-aligned subject matter exams. More importantly, they have ushered in an era where professional societies and corporations are now authoring exams, in competition with established assessment providers who serve either the higher education or prehire testing markets.

• • • • • • Prehire Assessment — Now Offered as a Portable Credential

Certifications help individuals gain initial employment (or advance their careers) by giving them a portable credential that signifies occupation-specific specialized knowledge or skills. However, at its core, a certification is a test, and employers' conventional prehire tests are tests as well. A few forward-thinking nonprofits, employers, and assessment providers have begun to realize that what was formerly a prehire test could be used by jobseekers as a much more widely recognized credential of basic employability skills, if only the scores were given to the jobseekers and allowed to be shared with other employers. This reframing helps to make the prehire exam more useful to the jobseeker, as he walks away with a credential even if he does not walk away with a job.

As one example, Innovate+Educate's 10-15 minute Core Score[58] exam is being piloted by employers in Albuquerque as a prehire exam. Anyone taking the multiple-choice, mobile-centric exam immediately sees their score (**Figure 8a**) and can authorize the re-release of that score to other employers who may wish to see evidence of the same basic skillset. As a result, an ecosystem around the assessment has developed in which multiple employers use the same exam, and examinees are free to share previously obtained scores with any of them. The score report comes with recommendations for related study material from Penn Foster's Career Readiness Bootcamp[59] in such areas as communication, critical thinking, and adaptability. Learners and jobseekers may retake the assessment after "skilling up." Efforts to launch the exam in Dallas, Phoenix, and San Diego, focusing on the retail and hospitality industries, have resulted in uptake outside of New Mexico.[60] Both Core Score and the Pymetrics assessment are also part of a pilot by Hyatt

and its NGO partners as part of Hyatt's "RiseHy" initiative for opportunity youth.[61] Users there can see their scores — and if they are high enough, apply for a Hyatt job. In Nigeria and elsewhere, Core Score is being used as a learning diagnostic for soft skills.

At least one commercial prehire assessment company, Criteria,[62] has also begun to offer pre-hire tests as portable credentials. With the tagline, "Play Games. Get Hired.", they recently launched JobFlare,[63] a series of 6 two-minute interactive games available via mobile app. Each game assesses one or more basic cognitive skills such as memory, math, and English. Upon completing the suite of 6 tests, the examinee receives their individual scores, which are also stored in a database for later retrieval and sharing. The jobseeker sees their overall score of 1 to 5 stars (**Figure 8b**), which is the metric shared with employers, if job-seekers choose to make their score visible to employers. As with Core Score, jobseekers can take and retake JobFlare's game-like assessments anytime they choose. A second tab of the app shows a list of job openings meeting the jobseeker's search criteria, with icons next to employers who currently accept JobFlare scores as evidence of basic employ-ability skills. As of early 2019, JobFlare is in beta with free access provided to jobseekers (who can download the app from iOS and Android app stores) and employers (who need to request access through Criteria). Eventually, the business model will focus on employer subscriptions to access the app's database of qualified and willing job candidates with career landing pages and targeted recruiting outreach options.

Despite their short, interactive, mobile formats, Core Score and JobFlare are designed with the rigor that much longer and more conventional prehire tests of general skills are usually designed. Specifically, they are designed by psychometricians paying a great deal of attention to how well the test scores correlate with onsite measures of job performance, such as supervisor ratings, sales volume, or scores earned during on-the-job training.[64] Both assessments also attempt to minimize adverse impact through careful test design, but ulti-mately the power of controlling one's own score, and to keep increasing it through retest-ing, should makes it possible for this new prehire assessment-cum-credential to overcome many of EEOC's objections to prehire assessments. (Note: Adverse impact is the technical term for score segregation by race/ethnicity.)

• • • • • • **Nanodegrees and Microcredentials — Short-term College Coursework Sequences, Offered and Assessed Outside Higher Education**

Nanodegrees are credentials issued for passing a year or less of coursework. The commer-cial online learning provider Udacity is the only provider of nanodegrees *per se*, but only be-cause Udacity trademarked the term.[65] Other providers refer to the same kind of experience as a microcredential.

Within Udacity's nanodegrees, the course sequences are structured to take one from raw beginner status to job-ready in 7-12 months. Online reviews[66,67,68] suggest Udacity's nano-degrees do result in job placement for technical areas (e.g., data science) where demand is much higher than supply. What seems to impress recruiters, however, is the portfolio that students complete during the classes, rather than the nanodegree itself.[69] For a commit-ment of less than $2000,[70] nanodegrees are a cost-effective option for highly motivated students wishing to enter a technical discipline without college-sized debt. Indeed, Udaci-ty's own website plays to this theme: "Nanodegrees are for aspiring programmers and data

SKILLS-BASED ASSESSMENT
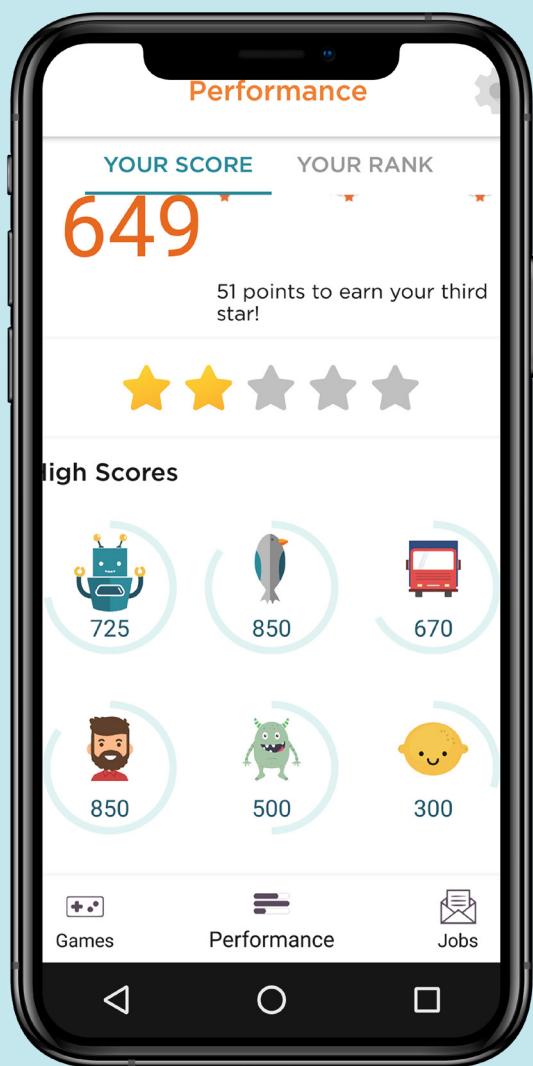
Figure 8b.

Figure 8a.

Figure 8. Score display for a) Core Score and b) JobFlare. Overall scores can be shared with employers to signify the learner's attainment of fundamental employability skills.
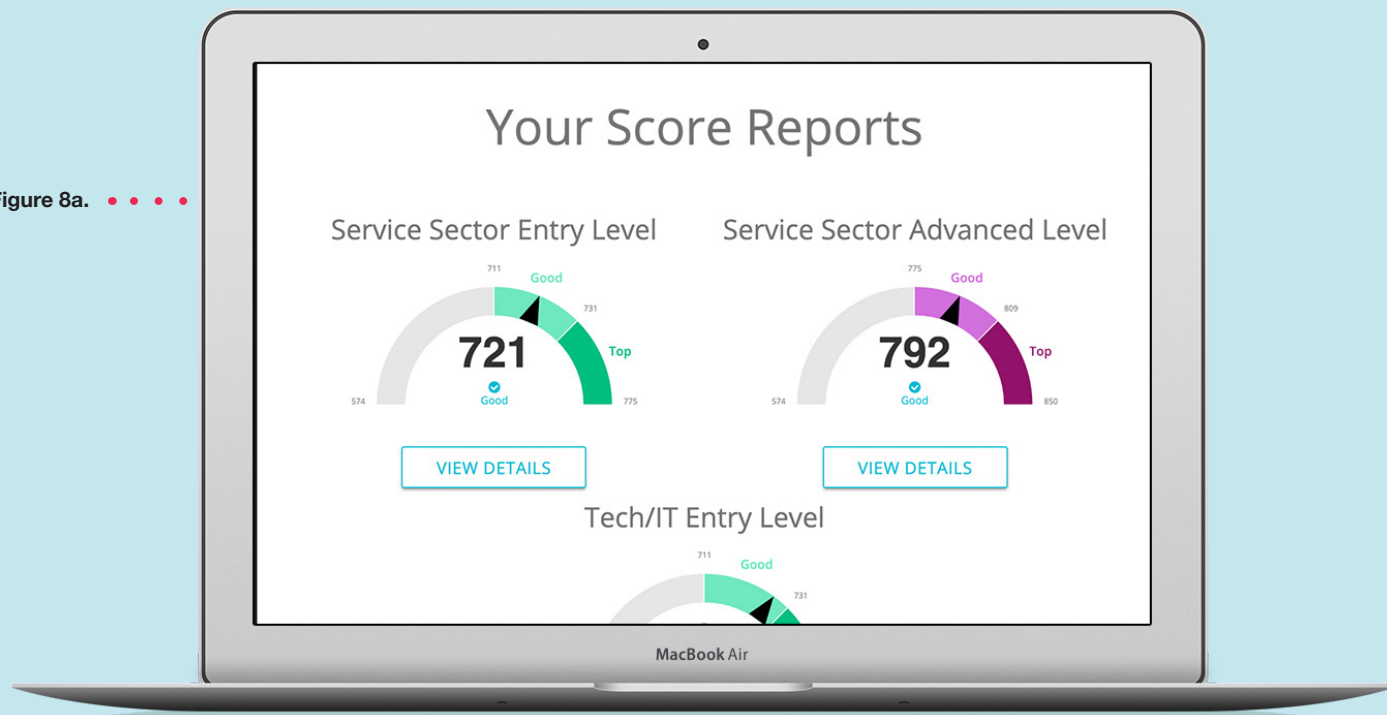
analysts who don't want to get saddled with debt and waste time with the traditional college experience. It's for people who can't even afford a decent college education in the first place."[71]

Udacity uses a slightly different approach to assessment than most colleges because it has to keep down costs, to compete with colleges' certificate programs. To do so, it does not ask the subject matter experts whose videos form the instruction to do double duty as overpaid graders for their own courses. Instead, open-ended projects have their own human graders, operating on an Uber/Lyft freelance contractor model, who get paid $50/hour when they take on a grading assignment.[72] These give a pass/fail grade for each project: does the project meet the rubric criteria, or does it need to be changed and resubmitted? Use of a flexible, on-demand contractor workforce, with no benefits, plus a pass/resubmit assessment mentality, short circuits some of the time, effort, and cost related to assessing student work.

To further reduce costs, most homework, tests, and quizzes are computer-graded. Multiple-choice quizzes and tests are integrated into the video lessons, which pause to deliver the questions and immediately render a grade once the learner has selected her answers. Students in software courses are given programming assignments, but these are also automatically graded by computer. A student enters her code into a code editor interface and hits "submit." A remote computer then runs several pre-chosen test cases through the student's code to determine whether the code works or not. The combination of low-paid human graders and machine grading helps keep the cost of Udacity's nanodegrees down to less than a tenth of the cost of a four-year degree.

• • • • • • **Digital Badges — New Conventions for Sharing Assessment and Course Success**

Digital badges are graphics with embedded digital information that can represent anything from showing up to a conference lecture, to completing a course, to passing a test. To confuse matters though, degrees, certificates, certifications, and licenses can all be represented by digital badges, but badges can also be separately issued for passing an assessment underlying one of these. At present, badges are mostly used to display accomplishments in the same way that resumé text displays accomplishments.

Open badges[73] are a subset of digital badges. These adhere to a set of software requirements that makes the information inside the badge portable and interoperable amongst a substantial body of badge storage, communication, and display platforms, such as Credly[74] or Badgr.[75] Microsoft, for example, gives out open badges for individuals passing its certifications. Before, students might have brought home a graded test as evidence of passing an assessment. In today's world, that grading ink on a paper test is increasingly being replaced by awarding a digital badge in one's digital backpack.
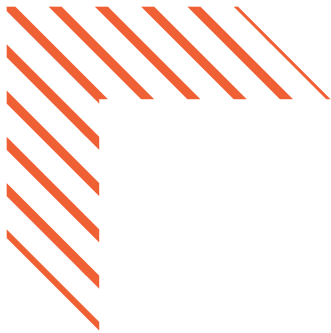
SHIFT: INNOVATIONS WITHIN THE DEGREE

Credential innovations that serve the working learner demographic still assume the student is working towards a traditional degree. However, new approaches make it much easier to combine that degree pathway with a job reality. Innovations like online degree programs, credit for prior learning, and competency-based degrees reduce seat time and give more flexibility in how learning is delivered and credited. As before, assessment plays a key role in making the innovations possible.

• • • • • • **Online Instruction and Online Assessment**

Of the three seat-time alternatives discussed herein, the most eye-popping market trend is currently online education. Clay Christensen[76] was the first to popularize the idea that online education would begin to overtake traditional education, but the prediction has become reality. Indeed, schools that have doubled down on offering online degrees for working learners have experienced amazing growth, as shown in **Figure 9.**

Enrollment statistics prove it is primarily nontraditional students driving online growth: at Southern New Hampshire University, 79.6% of students are over age 25, and 38.5% of students are over age 35.[79] The average student age at Western Governor's University is 37, and 73% of their students work full-time.[80] At Liberty University, 42% of students are over age 35, and 72% are over age 25.[81]

Figure 9. Enrollment growth for 4 accredited universities focusing on online education programs.[77] Percentages of undergraduate students who are online-only: 70.5% at Liberty University, 66% at Grand Canyon University, 100% at Western Governor's University, and 92% at SNHU.[78]

National Center for Education Statistics – Total Enrollment by Year

Liberty University · Grand Canyon University · Western Governors University · Southern New Hampshire University
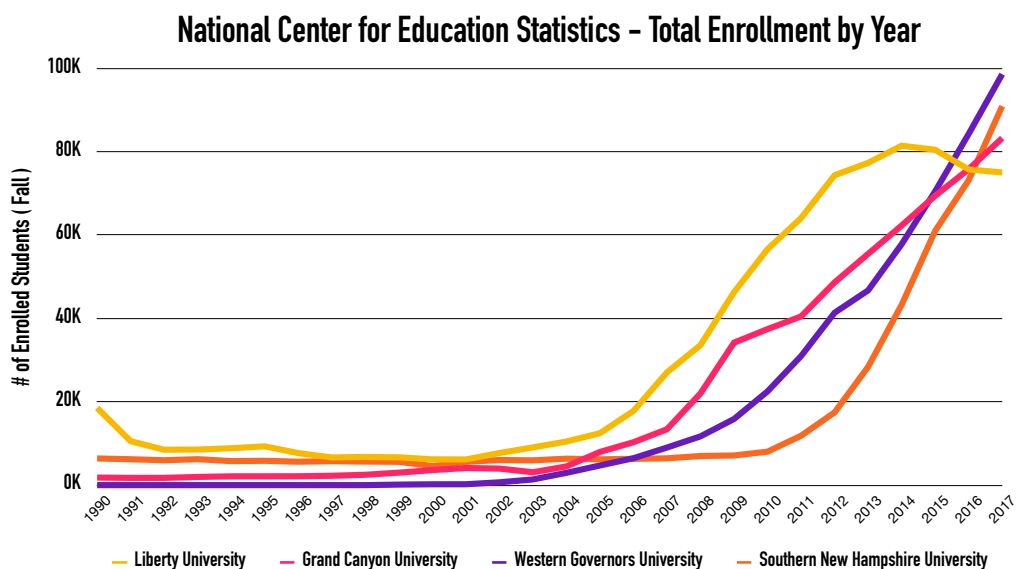
Online instruction is made possible by remote assessment. The ability to submit work and receive commentary by email; the ability to post graded assignments on a learning management file system; the ability to deliver exams proctored through webcam and locked-down browsers — these all allow students to engage with instructors without leaving their homes. It is the assessment piece that differentiates online education from earlier models of distance education. In the "old days," students could watch a remote video feed of professors giving lectures, in a specially equipped room with video play-back, but they then had to arrive in person to take exams when exam day came. This limited the reach of distance education to a much smaller geographic radius.

With online assessment, a single higher education institution can reach an entire nation of students.

• • • • • • **Competency-Based Degrees and Mastery-Based Assessment**

Propelled by the evident disruption and market potential of online learning, leading educators have become even more motivated to meet working learners' needs proactively. One credential-related outcome is a rethinking of the seat-time-based philosophy surrounding degree attainment. Two of the nation's largest online providers, Western Governor's University and Southern New Hampshire University, now offer competency-based degrees, where progress through the curriculum is gated by passing assessments rather than spending time in class lectures. WGU does so throughout all its programs;[82] SNHU does so only for its "College for America" program, which caters to employees of established partners.[83] An excellent resource on competency-based education, and how it works, can be found in the Competency-Based Education Network's (C-BEN's) document, "Quality Framework for Competency-Based Education Programs."[84]

In a competency-based degree program, students are permitted to move on to the next assignment, lecture, or class as soon as they've demonstrated mastery of the subject or skill being taught. The student need not sit through instruction on tasks she can already perform: by passing an assessment, she receives immediate credit for the work, up to an entire course's worth. This requires, however, assessments that are designed to provide pass/fail proof of a specific (typically high) level of mastery in targeted tasks. This is a far cry from traditional school tests, which are designed to yield a broad grading curve by assessing the percentage of material learned to date. To design a mastery-based assessment, the assessment tasks have to be designed with the end objective in mind: which tasks would yield direct evidence of a specific level of competence? This is not always easy to do. At WGU, assessment design has become a sophisticated endeavor requiring subject matter experts and psychometricians to work hand in hand.[85]

A mastery-based assessment in a sport, like basketball, might include a progression that looks like:

- First assessment: dribbling

- Second assessment: combining passing with dribbling

- Third assessment: demonstrating passing, dribbling, and shooting in varying sequences

- Fourth assessment: successfully alternating between passing, dribbling, and shooting while opponents block one's path

- Fifth assessment: demonstrating all the above skills during a live game and materially aiding one's own team in scoring

A mastery-based (cognitive) assessment for a biology or history class might include a sequence that looks like:

- First assessment: asks student to "define" a new concept

- Second assessment: asks student to "compare/contrast/explain" the new concept

- Third assessment: asks student to apply the new knowledge or skill to solve a (rehearsed/standard) problem

- Fourth assessment: asks student to apply the new knowledge or skill in an entirely new context

OR

- Fourth assessment: asks student to deploy the new knowledge or skills in combination with other knowledge or skills in pursuit of a complex systems problem

The goal for basketball is to move students up the mastery chain until they can perform all the functions needed to be a successful player and team contributor. The goal for biology or history is for students to reach the highest level of thinking in that topic according to Bloom's Taxonomy[86] or a similar cognitive progression,[87] so that they can function more like independent scholars than passive students. Students who pass a summative mastery-based assessment will not only "know" the new knowledge or skill, but will have mastered it well enough to use it proficiently under the most challenging of circumstances.

For working learners, mastery-based assessments and competency-based education have a lot to offer. Taking assessments in lieu of classes that repeat what the learner already knows, can substantially cut down on the time and cost of obtaining a degree. At the same time, assessment's role has been unexpectedly elevated from simply providing a grade to dictating the duration and cost of the college experience.

• • • • • • Credit for Prior Learning—Assessment of Pre-Existing Skills for College Credit

Online education and competency-based degrees (with mastery-focused assessments) are two higher education disruptions that were designed to assist working learners. The third is credit for prior learning.

Driven by the idea that working learners should be able to get academic credit for skills already learned on the job, a number of education-focused organizations have begun to offer third-party services for doing so. Credit for prior learning differs from competency-based education in that the credit determination is made by an organization that is typically not the learner's own institution. However, the learner's own institution needs to agree to accept the third party credit determination.

...A NEW ASSESSMENT REALITY THAT HAS BEEN CREATED BY THE FRACTURING OF THE DEGREE-TO-EMPLOYMENT PATHWAY
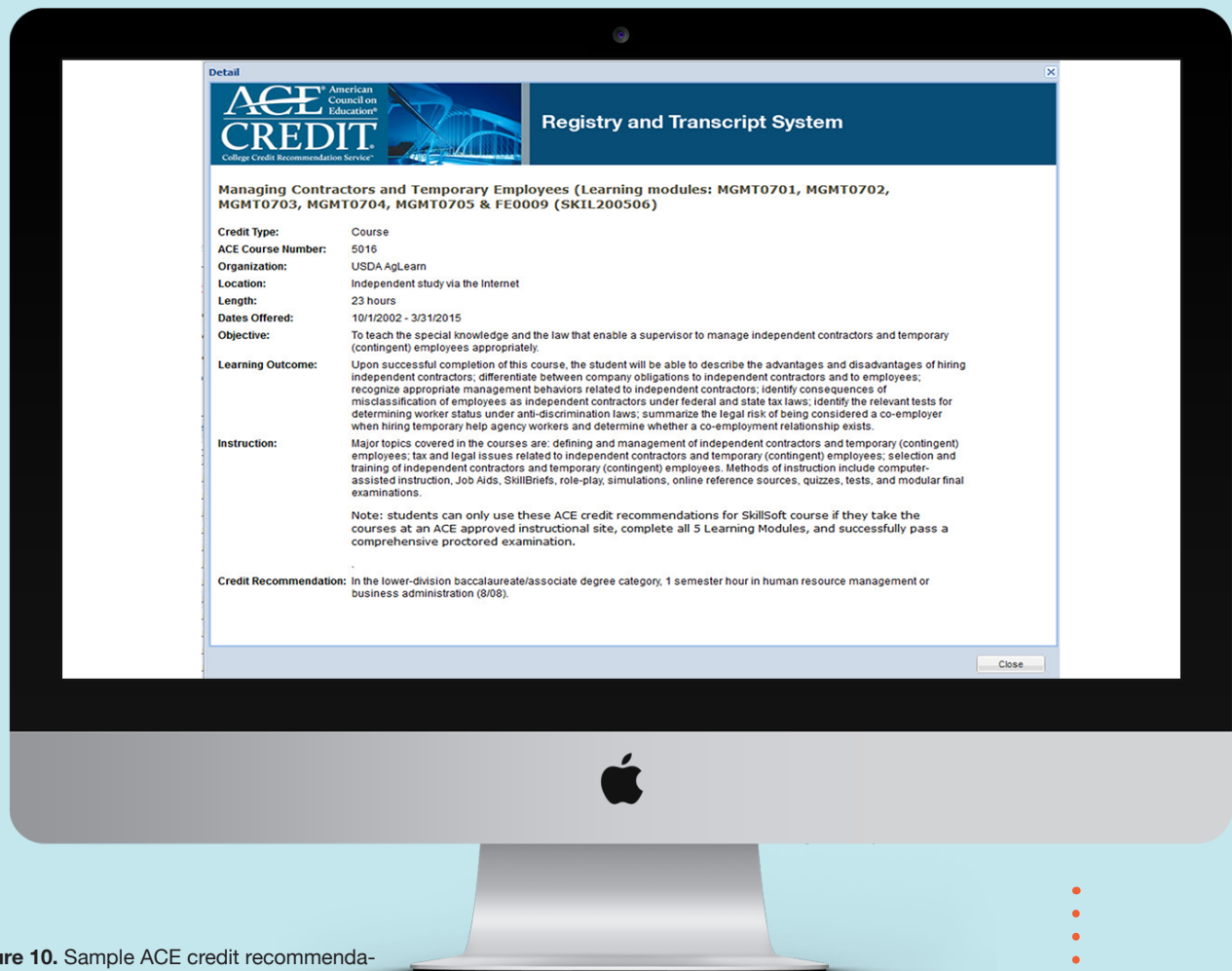

Figure 10. Sample ACE credit recommendation. [99] In this case, individuals who took an independent study course offered by the U.S. Department of Agriculture are recommended to receive one semester hour of lower division credit in a human resource management or business administration class.

How to assess what a student has learned "on the job" or "in life" is an interesting problem. At least three major assessment solutions have emerged.

The first approach is for students to submit a portfolio of their work and to be rated by human experts. This is the process used by the Council for Adult and Experimental Learning (CAEL), in their "LearningCounts"[88] initiative. The student enrolls in a special "CAEL" course section at her existing college, pays reduced tuition, and submits a portfolio for grading to CAEL experts. The CAEL experts return a credit recommendation to the college, which places the credits on the student's transcript. A searchable list of institutions accepting CAEL credit recommendations can be found online at http://learningcounts.org/schools.[89]

A second approach to earning credit for prior learning is offered by the College Board, Chauncy International, and Excelsior College. Each of these organizations provides a suite of exams corresponding to common introductory college courses. Successfully passing one of the exams allows a student to place out of the corresponding course. The approach is similar to the well-known Advanced Placement exams that one takes in high school to obtain college credit, but the set of available exams is broader. The College Board offers 33 College Level Examination Program (CLEP) exams, whose credit equivalencies are accepted at 2900 colleges and universities.[90] Their exams include topics such as American Government, Introductory Psychology, and French Language Levels I and II.[91] Chauncy International specializes in providing credit to military personnel through its DANTES Subject Standardized Test (DSST) examinations. Their exams cover academic subjects more tightly tied to military occupations[92] — for example, criminal justice, organizational behavior, cybersecurity, and A History of the Vietnam War.[93] The Defense Activity on Non-traditional Education Support (DANTES) reimburses the cost of service members taking DSST exams, as well as CLEP exams.[94] Excelsior College offers exams that are meant to provide college credit equivalency not only for their own college but also for other colleges.[95] Their UExcel exams cover about 53 college subjects, ranging from physics to ethics.[96]

A third approach to receiving credit for prior learning gives credit without a direct assessment of student knowledge. In their CREDIT initiative, the American Council on Education (ACE) has researched 35,000 concrete learning experiences such as workshops, online courses, and training exercises and issued course equivalency recommendations for them. An example is shown in **Figure 10**. A searchable list of courses for which ACE has provided course equivalency and credit recommendations can be found online at http://www2.acenet. edu/credit/?fuseaction=browse. main. It is, of course, up to each individual higher education institution as to whether they will offer ACE's recommended credit to their own students. As of 2018, 440 institutions accepted ACE credit recommendations.[97] ACE's course equivalency database makes it much easier for institutions to give credit for outside learning experiences, since institutional personnel don't have to review the content or quality of the outside instruction to determine equivalency. ACE has already done that work for them.

The ACE effort also demonstrates a new assessment reality that has been created by the fracturing of the degree-to-employment pathway into a plethora of new learning pathways. It is now becoming necessary to assess credentials, and credential proxies, against each other, in addition to testing knowledge and skill directly.

In closing, it should be noted that a similar service to ACE's CREDIT initiative has been offered by the National College Credit Recommendation Service since 1973. Their recommendations are accepted by about 1500 colleges but largely omit online and self-study learning options, focusing instead on more traditional classroom-based learning opportunities.[98]

SHIFT: BITE-SIZED & JUST-IN-TIME

Learning workers (as opposed to working learners) need just enough new job skills to move on to the next promotion or new employer. This need is primarily satisfied by on-demand, bite-sized bits of education. While nanodegrees, microcredentials, and certifications can all also be used by this demographic to attain upward job mobility, massive open online courses (MOOCs) are by far the fastest growing product class serving this demographic. Yet again, assessment plays a key technical role in the innovation. It is only because of ingenious assessment practices that MOOCs are able to deliver bite-sized learning at such a massive scale.

• • • • • • Massive Open Online Courses (MOOCs), with Peer Assessment

MOOCS are individual online classes with enrollments in the thousands or tens of thousands. Lectures are typically stored as videos for the student to play back on demand. Homework and project assignments are posted online; when students complete an assignment, they self-grade work or pass their work to 3-4 classmates for peer grading. Students who have questions post them in online discussion forums where any other MOOC student, or an instructor, can volunteer to answer them. Quizzes and exams are delivered, and instantly graded, by computer. Because of the constraints inherent in automatic grading, the computer-delivered assessments are typically short answer or multiple choice.

Figure 11 shows the global growth in a) MOOC offerings and b) MOOC students. MOOCs began in 2011 with 3 courses and now feature courses from some 900 universities.[100] Over the last 5 years, MOOC enrollments have grown 910%[101] and are only now slowing down somewhat, adding 20M new students/year globally.[102] Within the US, major MOOC platforms include Coursera,[103] EdX,[104] Udacity,[105] and Udemy.[106]

In 2013, six University of Pennsylvania researchers surveyed students taking U Penn's MOOC courses offered on Coursera.[109] This study provided initial insight into who takes MOOC courses and why. At the time, U Penn's courses comprised 20% of Coursera's total student body, or around 409,000 students.[110] The survey found 80% of UPenn's MOOC enrollees already had a bachelor's degree or higher, and 62% or more worked.[111] About 61% of students were using MOOC courses to learn job-related skills.[112]

This brings us to two conclusions. First, the traditional degree experiences had well prepared these individuals for continuing to pursue lifelong learning once they arrived on the job. They had "learned how to learn" and were able to apply that ability on their own in MOOCs. Secondly, the primary market for MOOCs is not the first-time student but the already-degreed worker trying to advance his career through small increments of education — the "learning worker," as opposed to the "working learner," or even the "traditional learner."

What is significant about the learning worker demographic is how large it is: 50M individuals comprise the already-degreed worker demographic shown (in magenta bars) on **Figure 7**. This market is 3 times larger than the traditional learner market.

A rough estimate — centered on the facts that 33% of MOOC enrollees are U.S.-based[113] 74- 80% of MOOC enrollees have bachelor's degrees,[114,115] and 86% of U.S. bachelor's degree recipients

are employed[116] — suggests that over 40% of these 50M "learning workers" have already tried a MOOC.

MOOCs have reinforced some assessment trends begun in the smaller courses associated with online degree programs. Automated grading of quizzes by computer is common to both. The human graders used to assess open-ended work, however, have now been replaced by other students doing the grading.[117] Peer grading now works adequately well, largely because of clear grading rubrics and the fact that each assignment's grade is the median grade from amongst 3-4 other students' evaluations.[118] Thus, no one peer evaluation determines a student's fate. There is also an appeals process if students are not happy with their peer-assigned grades. Finally, grading other students' papers turns out to be its own learning experience, a feature MOOC students have commented on favorably.[119,120]

Just as online assessment delivery made distance learning courses available without geographic constraint, peer grading has made it possible to provide online courses at massive scale, attracting a vast swath of already-employed, already-degreed workers in search of a course or two that will help them advance in their jobs and careers.

Figure 11a. Growth in course offerings[107] across major MOOC platforms.
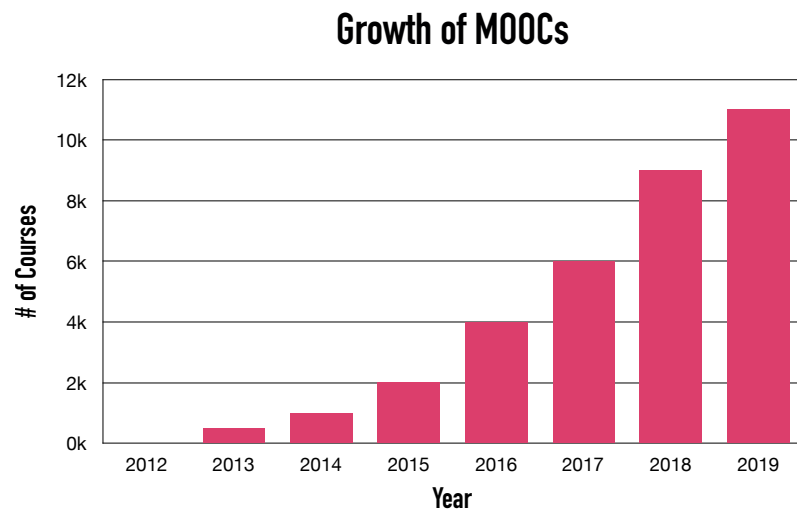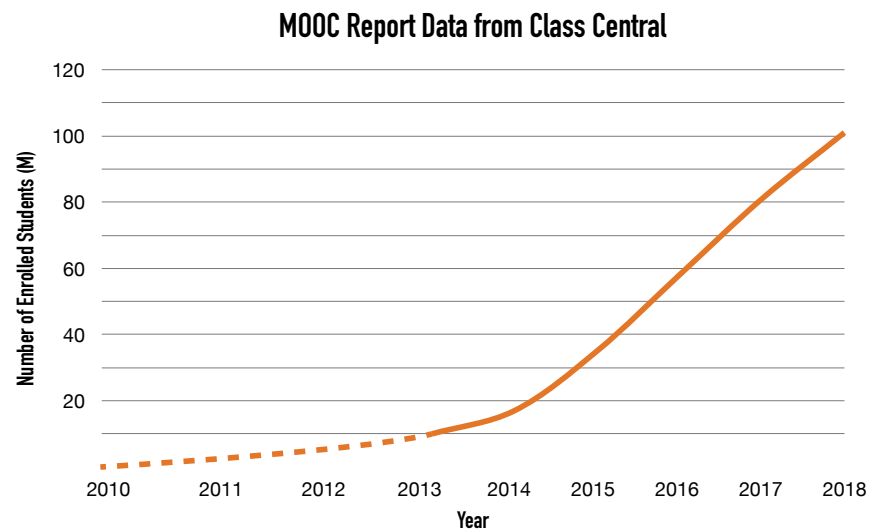

Figure 11b. Growth in enrollment[108] across major MOOC platforms.

SHIFT: COMPETENCIES & THE FUTURE

Thus far, this paper has described a series of tsunami-sized social pressures that has led learners to demand alternatives to the traditional four-year degree. A common theme amongst all the social trends — and the credential innovations they've spawned — is a tighter content connection and more rapid turnaround time between credentials and job entry/advancement. The faster turnaround has been enabled largely through the use of assessments and assessment-related innovations.

The tighter linkage, on the other hand, is a product of the disappearing distinction between learners and workers. The two largest trends in credentials — the rise of online degrees (520% growth in 10 years, for the four universities in **Figure 9**)[121] and the rise of MOOCs (910% growth in the last 5 years)[122] — are being driven by working learners in the first case and learning workers in the second. Of the four demographics shown in **Figure 4** (worker, learning worker, working learner, traditional learner), the traditional learner is the smallest. However, even traditional learners are feeling an increased need for a degree-to-employment connection: without a job after that first degree, there is no way to pay off potentially staggering student debt.

• • • • • • **Towards a Competency-Based Ecosystem**

The cumulative demand for faster, tighter linkages between school and work has an endpoint that is relatively easy to foresee: competency-based credentials. Competencies are observable, measurable units of knowledge or skill. They are the fundamental building blocks of what people know (knowledge) and can do (skill).

The number of organizations advocating for, and conceptualizing, competency-based credentials is large. They include the Corporation for a Skilled Workforce,[123] the Center for Law and Social Policy (CLASP),[124] Workcred,[125] Jobs for the Future,[126] the American Council on Education,[127] the National Governors Association,[128] the American National Standards Institute,[129] the Center for American Progress,[130] the New America Foundation,[131] the Manufacturing Institute (which deserves credit for popularizing the idea that credentials could be composed of smaller units and be stackable)[132] the Georgetown Center on Education and the Workforce,[133,134] the Lumina Foundation[135] (in particular, their Connecting Credentials initiative), CareerOneStop (U.S. Department of Labor),[136] the Workforce Data Quality Campaign,[137] the IMS Global Learning Consortium,[138] and many more.

As a result of the numerous thought pieces, proposed data structures, blogs, articles, and meetings orchestrated by these organizations, a concept of competency-based credentials has emerged, as shown in **Table 3**.

Credentials of the future will reflect what learners can know and do. Every credential will be able to be articulated as mixtures of more fundamental "know" competencies and "do" competen-

Learner Ecosystem of the Future

Every credential will be able to be articulated as mixtures of more fundamental "know" competencies and "do" competencies.	Knowledge => "know" competencies Skills => performance"do" competencies
Learners' measured skills will include not only hard skills but also the "soft" interpersonal and intrapersonal skills not traditionally taught in school.	Soft skills are in very high employer demand, as documented in a large number of employer surveys and policy reports.[139,140,141,142,143] The corresponding curriculum changes will require better soft skills assessment tools — ones aligned with employer-desired competencies and yielding enough precision and repeatability to be used as growth measures.
Learners will have a portable, personal competency record, used for documenting progression in both school and work.	Learners will add to their record by demonstrating mastery of specific tasks to their employers, instructors or third party professionals, who will validate each attained competency. [144]
Competencies will be machine-readable.	This is necessary for student data exchange amongst/ within institutions as well as for automated applicant sorting by employers' applicant tracking systems.

Table 3.

Table 4.

Potential Impacts of a Competency Based Ecosystem

Job postings will no longer be limited to vague English language descriptions. They will include competency profiles with quantitative information on which competencies are sought and at what level of mastery.

An individual's competency profile will serve as the 2020's version of a resume. Unlike a resume, however, this profile will allow job seekers to immediately see how well qualified they are for any given job, by comparing their profile to the job's.

Educational programs will advertise what competencies each course or credential delivers so that students know what to take, in order to build up the missing pieces of their competency profile.

- Competencies will be stackable: Assignments' competencies will feed into course-level competencies, and course-level competencies will aggregate to a credential-level competency profile.
- A competency tracking system, much like current credit tracking systems, will need to be implemented at the institutional level.

At the end of any credential pathway, the educational institution, the employer, and the student/jobseeker will all know — by comparison of the student's competency record to job competencies — which job openings the students are qualified for, or which additional piece of learning is needed. This understanding will be shared amongst all parties and (mostly) unambiguous.

The popularity of seat-time based degrees will fade.

The concept of a "terminal" degree will disappear.

The new focus for assessment will be demonstration of mastery.

cies. The ecosystem of the future will be one in which learners will add competency "units" to their own profile throughout life, whenever they demonstrate mastery of specific "know" and "do". These additions will be validated by professors, employers, 3rd party assessment centers, and others who add their seal to the "notarized" skill. Competencies, because they include "do" (performance skills) and not just "know" - will become the universal language that allows educational programs to be clearly and unambiguously mapped to job requirements, and vice versa. The electronic systems that publish job announcements, sort job applicants, track students' matriculation requirements, and collect higher education data will all eventually change to meet the new world described in **Table 4**.

A competency-based ecosystem very easily accommodates every major trend discussed in this paper: credentials of various length; credentials that value mastery over seat time; credentials that are consistent with learners' desire to get a job (or advance in one); credentials that can be directly translated to employers' hiring needs; credentials that don't have to be delivered in a physical place or on a set schedule. The fact that competency-based credentialing can satisfy nearly every requirement of nearly every major constituency in both education and the workforce is the reason it has become so compelling.

• • • • • • **Competency Frameworks**

If a competency-based system comes to pass, then the implication for education or workforce assessments is that assessments themselves will need to be articulated in terms of competencies. Every item or related group of items on an assessment will need to be associated with a specific number of points towards a specific competency. The points are likely to be mastery-based — that is, items requiring a demonstration of in-depth expertise using that competency will be given more points towards a given competency than items that require only superficial knowledge about that competency. As students pass individual test items, submit work assignments, or complete team projects, they will receive a pre-specified number of competency points towards their own competency profile.

A number of organizations have issued competency models. For example, Connecting Credential's rubric contains 9 skills at 8 levels of mastery.[145] Examples of other models are shown in Figure 12. These models are borne of different groups' discussion and consensus-building activities. Not surprisingly, they have all resulted in different frameworks.

The elephant-sized question now is, which framework? Which organization has the right universal set of all competencies that encompasses everything a student might learn in school or do on the job?

The riddle of "whose framework?" and "which competencies?" turns out to be solvable. The answer is that any set of competency definitions will do, as long as they are research-backed,

objectively defined, reproducibly measurable, and cover enough hard and soft skills that they can uniquely and adequately define an occupation, person, or learning experience. This then allows the taxonomy to be consistently applied across resumés, courses, exams, job analyses, job pro-

files, job ads, and every other application one can imagine.

Basically, this is similar to the question of whether one should go with Windows or MacOS. The answer is that either universe will work, as long as all the needed applications exist and can talk to each other within the same universe. In a self-contained competency market-place, these applications will need, at a minimum, to separately identify the competencies within people, jobs, and learning experiences, then be able to provide two- and three-way comparisons between them. At this point in time, very few of the current competency frame-works have enough detail to support automated competency extraction and comparisons. One exception appears to be the Department of Labor's O*NET framework.[151]

• • • • • • O*NET-Based Competency Frameworks

Technological innovation on top of the O*NET framework is surprisingly close to giving us the first iteration of "competency operating systems" needed to fuel a competency-based marketplace of products. Skills Engine[152] (originally SkillsNET) was the first to demonstrate, with Texas State Technical College, the ability to take a community college curriculum, feed it into their skills parser, and generate a list of competencies that could then be directly compared to competencies affiliated with the Texas Workforce systems' job database.[153] The same parser could deconstruct resumés and compare them to live job openings.[154] The foundation of the Skills Engine competency taxonomy was the Department of Labor O*NET taxonomy, which SkillsNET greatly embellished with needed detail at the gener-alized task (detailed work activity, or DWA) level.[155] Natural language processing made it possible to take unstructured text descriptions of people's work histories or colleges' course descriptions and turn these into competency profiles consistent with the O*NET taxonomy.

The importance of Skills Engine/SkillsNet as an unsung technological pioneer cannot be overstated. Its visionaries, Michael Brown and Richard Froeschle, were the first to recognize the bottom line that *"employers need workers who know how to do cer-tain things"* (emphasis from original document).[156] With this conviction, they went about buttressing the DOL taxonomy with vast numbers of employer inputs on detailed work activities. Incorporating DWA's into the existing DOL occupational taxonomy meant that skills, or "do" competencies, finally became embedded in a deep, detailed, usable frame-work.[157] Because of this advance, Skills Engine/SkillsNET was able to build the first useful tools for detecting and parsing competencies. Equally important, they fed a number of lessons learned back to the Department of Labor[158] so that the O*NET database itself became stronger and more capable of handling competency-based data exchanges.

Today that buttressed O*NET framework is usable for new tool development, including the deconstruction of exams, courses, and resumés into competencies, and the map-ping of those competencies to jobs, courses, and people. One caveat is that all current competency-parsing algorithms require inputs containing verbs indicating what the user/student/examinee can *do*, rather than just nouns indicating a subject or topic. This is because a complete competency framework must include not only "know" competencies

SCANS Foundation Skills

Basic Skills

Reading

Writing

Arithmetic

Mathematics

Listening

Speaking

Thinking Skills

Creative Thinking

Decision Making

Problem Solving

Seeing Things in the Mind's Eye

Knowing How to Learn

Reasoning

Personal Qualities

Responsibility

Self-Esteem

Social

Self-Management

Integrity/Honesty

PERSONAL SKILLS
- Integrity
- Initiative
- Dependability & Reliability
- Adaptability
- Professionalism

PEOPLE SKILLS
- Teamwork
- Communication
- Respect

APPLIED KNOWLEDGE
- Reading
- Writing
- Mathematics
- Science
- Technology
- Critical Thinking

COMMON EMPLOYABILITY SKILLS

WORKPLACE SKILLS
- Planning & Organizing
- Problem Solving
- Decision Making
- Business Fundamentals
- Customer Focus
- Working with Tools & Technology

National Network of Business and Industry Associations, Common Employability Skills

Applied Academic Skills

Critical Thinking Skills

Interpersonal Skills

Personal Qualities

Applied Knowledge

Effective Relationships

Employability

Workplace Skills

Tech Use

Systems Thinking

Communication Skills

Information Use

Resource Management

Department of Education Employability Skills

Figure 12. Examples of different competency models/skills taxonomies. Included are those from the Department of Labor's seminal SCANS report[146] the National Network of Business and Industry Associations' Employability Skills,[147] the Center for Curriculum Redesign's 4-Dimensional Education framework,[148] the Department of Education's Employability Skills,[149] and P21's 21st Century Skills.[150]
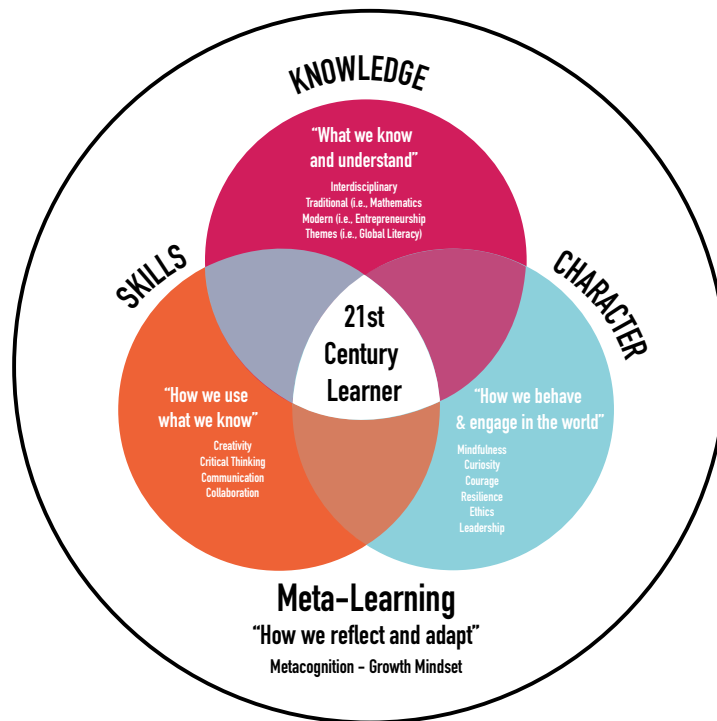
Center for Curriculum Redesign, 4 Dimensional Education

KNOWLEDGE

"What we know and understand"

Interdisciplinary
Traditional (i.e., Mathematics
Modern (i.e., Entrepreneurship
Themes (i.e., Global Literacy)

SKILLS

CHARACTER

21st Century Learner

"How we use what we know"

Creativity
Critical Thinking
Communication
Collaboration

"How we behave & engage in the world"

Mindfulness
Curiosity
Courage
Resilience
Ethics
Leadership

Meta-Learning

"How we reflect and adapt"

Metacognition – Growth Mindset

Learning & Innovation Skills – 4Cs
Critical Thinking – Communication
Collaboration – Creativity

Key Subjects – 3 Rs
& 21st Century Themes

Life &
Career Skills

Information,
Media &
Tech Skills

Standards & Assessments

Curriculum & Instruction

Professional Development

Learning Environments

P21.org, Framework for 21st Century Learning

(knowledge) but also "do" competencies (skills). For educational institutions, this translates to requiring inputs — e.g., course descriptions — phrased as learning objectives rather than topics covered. For assessment providers, this translates to pulling together a set of exam objectives describing skills or activities.

A second caveat is that none of the automated competency tools can yet detect depth of mastery within a given competency. They can only classify which competencies are present in a set of statements describing a person, course, credential, or job. Automated detection of mastery levels within a competency remains as future work. However, such a breakthrough will be needed in order to assess both the quality of credentials and the expertise level of individuals.

When relevance numbers are shown next to a competency (as in some of the figures that follow), these represent the algorithm's assessment of how likely this competency is to be present in the statements provided as inputs. They do not reflect depth of mastery within a competency.

Mapping Assessments to a Competency-Based Framework — An Example

As the gatekeepers for students' attainment of a credential, it is important that future assessments should be able to function in a competency framework. To demonstrate how an O*NET-based competency framework can be applied to an assessment, this paper's authors submitted the activity statements for the "Management of Care" section of the national nursing exam, the NCLEX-RN, to Dorothy, a competency mapping algorithm (still in beta) produced by Innovate+Educate.[159] The input shown in **Figure 13** can be found in the educator's guide to the 2016 NCLEX-RN exam.[160] Directly copying and pasting this input, and hitting "enter" causes Dorothy to generate a list of skills ("do"

MANAGEMENT OF CARE

Related Activity Statements from the *2014 RN Practice Analysis: Linking the NCLEX-RN Examination to Practice*

- Integrate advance directives into client plan of care
- Assign and supervise care provided by others (e.g., LPN/VN, assistive personal, other RNs)
- Organize workload to manage time effectively
- Participate in providing cost effective care
- Initiate, evaluate, and update plan of care (e.g., care map, clinical pathway)
- Provide education to clients and staff about client rights and responsibilities
- Advocate for client rights and needs
- Collaborate with interprofessional health care members in other disciplines when providing client care (e.g., language interpreter, health care professionals)
- Manage conflict among clients and health care staff
- Maintain client confidentiality and privacy
- Provide and receive hand off of care report on assigned clients (e.g., standardized hand off communication)
- Use approved abbreviations and standard terminology when documenting care
- Perform procedures necessary to safely admit, transfer or discharge a client
- Prioritize the delivery of client care
- Recognize ethical dilemmas and take appropriate action
- Practice in a manner consistent with a code of ethics for registered nurses
- Verify that the client received appropriate procedure education and consents to care and procedures
- Receive and/or transcribe health care provider orders
- Utilize valid resources to enhance the care of provided to a client (e.g., evidenced-based research, information technology, policies and procedures)
- Recognize limitations of self/others and seek assistance
- Report unsafe practice of health care personnel and intervene as appropriate (e.g., substance abuse, improper care, staffing practices)
- Provide care within the legal scope of practice
- Participate in performance improvement/quality improvement process
- Recognize the need for referrals and obtain necessary orders

Figure 13. List of activity statements describing the 2016 NCLEX-RN exam's first section, "Management of Care."[162] Because these statements are phrased as "dos", they can be deconstructed by natural language and AI processing in order to make comparisons to the O*NET database's hard and soft skill competencies.

competencies) as an output (**Figure 14**). Other diagnostics are also possible. **Figure 15** shows the occupations that the exam items maps to, per Dorothy. **Figure 16** shows the disciplinary fields Dorothy associates with these items. **Figure 17** shows how Dorothy can be used by instructors to determine which additional activities might be assigned to students, so that they can develop the primary soft skill Dorothy identifies within the nursing exam's "Management of Care," section — namely, social perceptiveness. Social perceptiveness is an O*NET-defined soft skill meaning "being aware of others' reactions and understanding why they react as they do."[161]

While not every technical solution needs to adhere to an O*NET framework, the early work of Skills Engine and the current development of Dorothy has resulted in at least one approach that can be used to perform much of the competency dissection and comparison that will be needed to integrate assessments into the competency-based ecosystem of the future. In turn, competency-based credentialing will transform higher education into a much more flexible enterprise capable of meeting the full breadth of current economic imperatives and learner needs.

Figure 14. List of skills ("do" competencies) embodied in the section of nursing exam shown in **Figure 13** above. Note the first skill is a soft skill, "social perceptiveness." These skills are ranked in descending order of likelihood of being affiliated with the inputs given.

SKILLS   WORK ACTIVITIES   KNOWLEDGE   ABILITIES   INTERESTS   WORK CONTEXTS   WORK STYLES   WORK VALUES

Skill Relevance

Relevance (%)

Skills: Social Perceptiveness, Coordination, Service Orientation, Active Listening, Speaking, Negotiation, Science, Learning Strategies, Persuasion, Writing
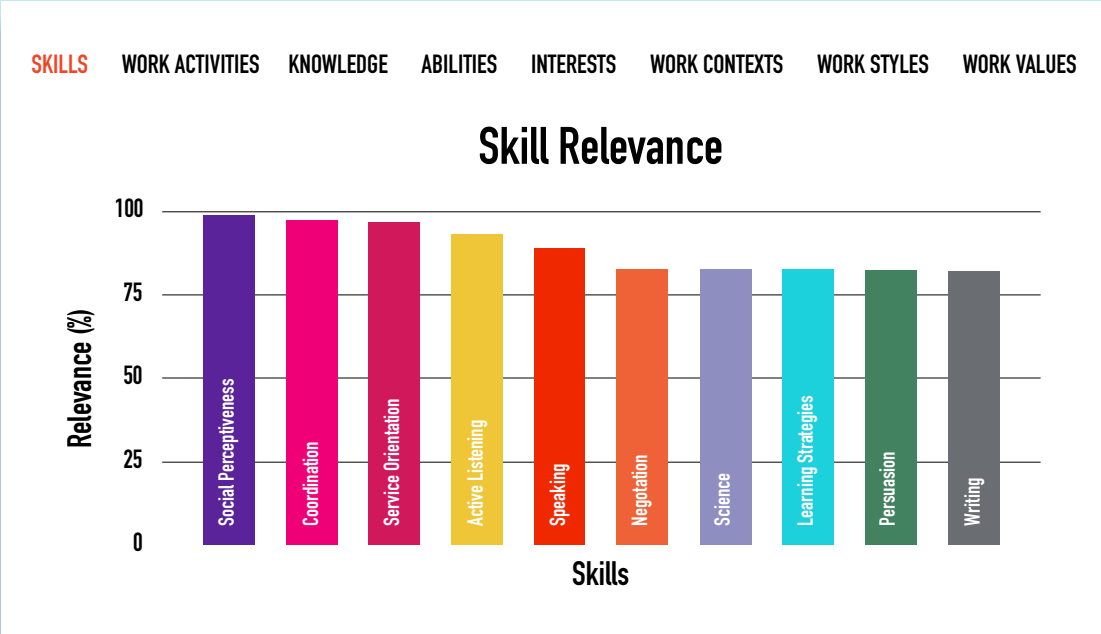
Figure 15. Occupations typically associated with the items in the Management of Care section of the NCLEX-RN exam. This result also comes from feeding the exam's activity statements (from **Figure 13**) into Dorothy. Note that because this subset of items deals primarily with patient care, they map equally well onto mental health/social workers as onto nurses.

Occupations

Mental Health and Substance Abuse Social Workers (21-1023.00)	68
Registered Nurses (29-1141.00)	67
Healthcare Social Workers (21-1022.00)	66

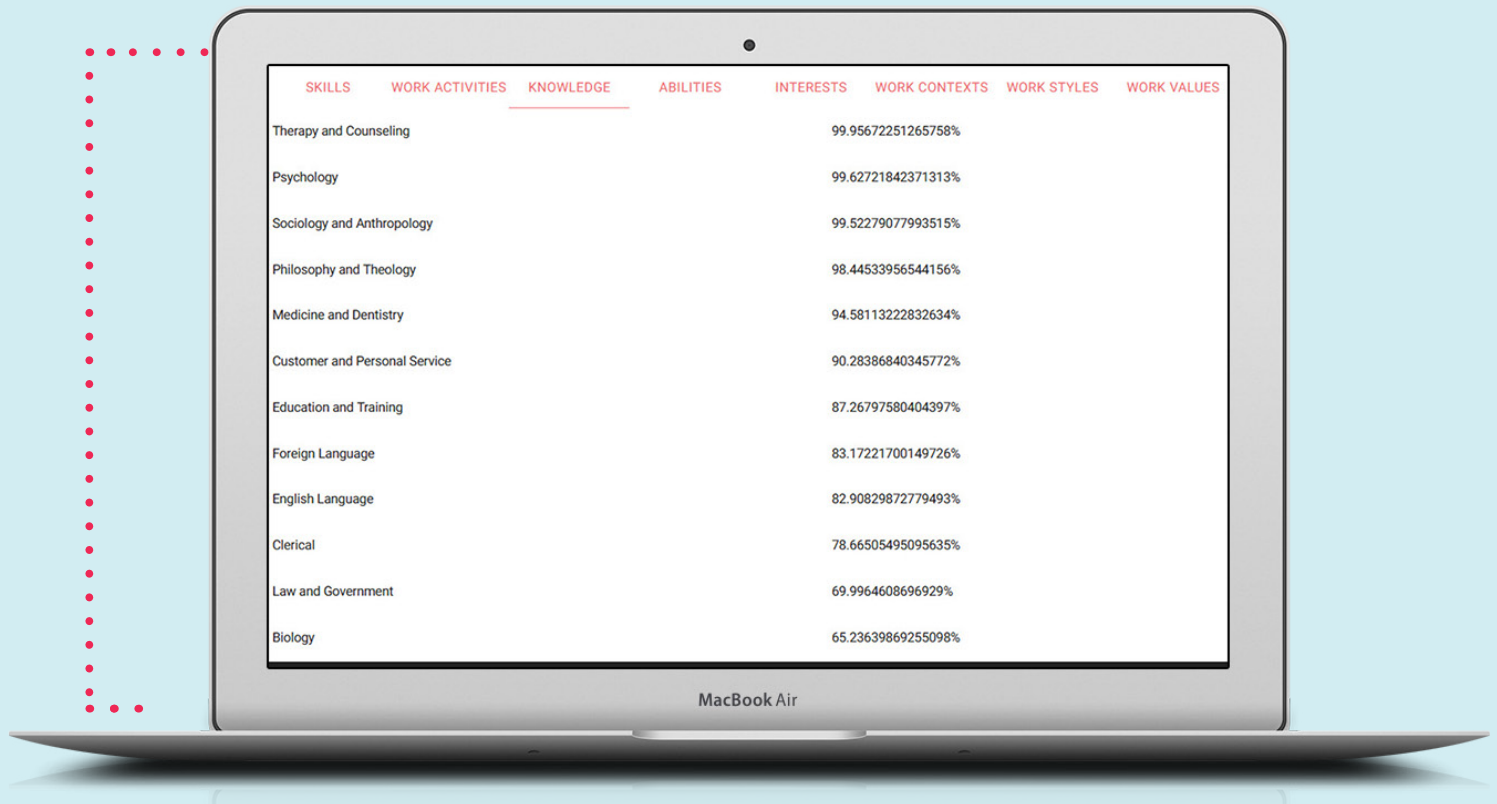|	
Therapy and Counseling	99.95672251265758%
Psychology	99.62721842371313%
Sociology and Anthropology	99.52279077993515%
Philosophy and Theology	98.44533956544156%
Medicine and Dentistry	94.58113222832634%
Customer and Personal Service	90.28386840345772%
Education and Training	87.26797580404397%
Foreign Language	83.17221700149726%
English Language	82.90829872779493%
Clerical	78.66505495095635%
Law and Government	69.9964608696929%
Biology	65.23639869255098%

MacBook Air

Figure 16. Knowledge (disciplinary fields) in which the Management of Care items are likely to fall. Note that the patient care part of the nursing exam has much more in common with the therapy and counseling field than biology.
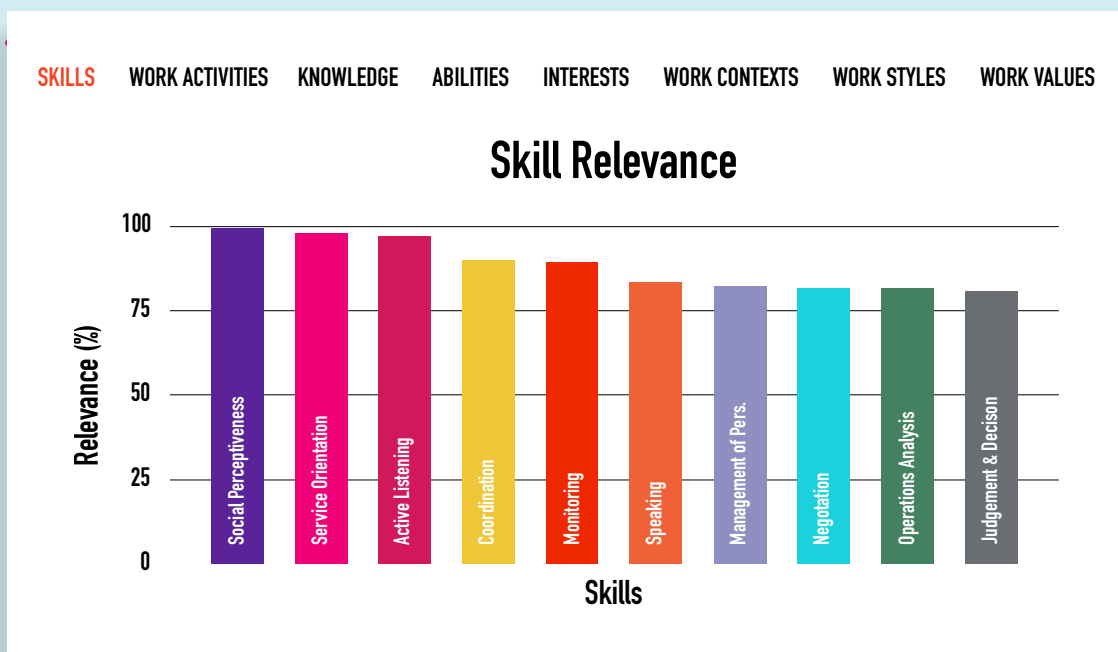
Skill Relevance

Figure 17. Users' attempts to think of some community service activities that could develop social perceptiveness skills yields success when the items "assist elderly patients in walking," "moderate group discussions," and "counsel suicidal teens" are input into Dorothy's algorithm. The resulting output, in this figure, identifies social perceptiveness as the skill best affiliated with the three input activities.

CONCLUSION

This paper has outlined the plethora of new credential types, uses, and modes of delivery. It also has highlighted advancements in assessment. In terms of assessment content, the progression of mastery-based assessments is a distinct departure from the traditional knowledge-based assessment approaches. New assessments are likely to enter the market, as companies see the tremendous growth of competency-based assessments that will be critical and necessary in the future ecosystem described.

Assessments are no longer just a source of grades for gradebooks. They have forged two meaningful bypass routes to seat time in higher education. In the first, competency-based education assessments gate the pace of student progress through the curriculum. In the second, certification by an exam delivers not a grade, but a degree-like credential in a relevant occupation, indicating skill and expertise. For some occupations, this exam-as-credential has already been market validated by employers' willingness to require it, hire by it, and pay a salary premium for it.

All of these innovations are driving towards a common end. The future learning-to employment ecosystem will be heavily reliant on credentials and assessments. We see:

- A future in which credentials will no longer be limited to degrees, but will come in varying shapes and sizes, offered by many organizations, training providers, and employers;

- A future in which credentials will, however, be able to articulate a set of underlying "know" knowledge and "do" performance skill competencies;

- A future in which a credential's scope will be described by the set of competencies it covers, and measured via assessment;

- A future in which a credential's quality will be indicated by evidence of mastery within each competency before it is awarded;

- A future in which quality metrics, such as consumer reviews or employer use of credentials will come into play, bringing the best and most usable credentials and assessments to the forefront.

And, finally, the future ecosystem will depend heavily on online and technology-enabled strategies and solutions. The working learner will turn away from those stringent solutions that require seat time and offer little flexibility. They will drive the market hard for innovations that will lead to consumer-facing marketplaces that allow them a "one-stop shop" approach for working, learning, and living.

The massive market of the working learner/the learning worker is here to stay. The future *is* that learner. Credentials and assessment will find their own strong footing to help successfully meet both the learners' needs and the employers' needs. We applaud this SHIFT. For, it will be an ecosystem that services many more learners than today's education to employment system serves.

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