Policy Report

Buttressing the Middle:
A Case for Reskilling and Upskilling America's Middle-Skill Workers in the 21st Century

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THE ETS CENTER FOR RESEARCH ON HUMAN CAPITAL AND EDUCATION

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Preface

As this report was being written, the tragedy of COVID-19 unfolded. Hundreds of thousands in the United States lost their lives to the virus, many more lost loved ones, jobs, and homes, and the U.S. economy plummeted. The path forward will demand much of our nation. We believe that one of the many critical challenges confronting us is to ensure that American workers are better insulated from future disruptions. For today's—and by all estimates—tomorrow's middle skill labor force, that insulation will be significantly improved through opportunities to acquire quality education and skills.

This new report from the ETS Center for Research on Human Capital and Education argues that the education and skills individuals possess have become increasingly important to their overall quality of life. As technology and automation continue to alter the workplace and the nature of work, the ability of individuals to acquire and augment their skills will remain a key challenge. Changes in the nature of work over this period have led to what economists refer to as "employment polarization." The share of employment in well-paid, middle-skill occupations such as manufacturing has declined while the share in the upper and lower ends of the occupational skill distribution has increased. In addition, the relative earnings around the middle of the wage distribution have declined precipitously, leaving these workers with relatively small wage gains. The important question raised here—and one that has become even more urgent due to the COVID-19 pandemic—is what to do about this phenomenon.

This paper begins with a discussion of data and reports that identify future job skills and places them in the context of current skill distributions in the United States. Using data from a recent international assessment of adult populations, the Programme for the International Assessment of Adult Competencies (PIAAC), the authors show that large segments of our adult population fail to demonstrate levels of literacy and numeracy that are associated with important social and labor market outcomes. Further analyses of these data reveal that adequate levels of literacy and numeracy skills are also associated with strong performance on the PIAAC problem-solving tasks. We note that although there are increasing calls for upskilling higher-order skills such as critical thinking and problem-solving for America's middle-skill workers, literacy and numeracy skills are the foundations on which these higher-order skills depend.

The final section of this paper advances a theory of action to address this skills challenge that involves the development of a learning and assessment system. Based on evidence centered design principles, this system can be used in a variety of workplace and educational contexts to significantly improve the literacy, numeracy, and digital skills of tens of millions of adults who are being left behind. The proposed theory of action is intended to provide policy makers, researchers, funders, and other stake-holders with a strategy that reimagines the approach to improving essential skills so that those adults who need upskilling and reskilling are better able to adapt and thrive in a rapidly changing world—one where education and skills are likely to play an increasingly important role.

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The ETS Center for Research on Human Capital and Education

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Introduction

There is clear agreement by now that the role of education and skills in relation to work has undergone dramatic shifts over the last 40 years. The Council on Foreign Relations® summed up the issue well in a recent report, noting that the "most important challenge facing the United States—given the seismic forces of innovation, automation, and globalization that are changing the nature of work—is to create better pathways for all Americans to adapt and thrive."[1]

Myriad policy reports document how technological advances, changes in global supply and demand chains, and public policies have altered the world of work for many adults currently in the U.S. labor market and for young adults entering the labor market for the first time.[2] The Organisation for Economic Co-operation and Development (OECD®) recently warned that the COVID-19 crisis will likely speed up changes in global economies as more automation is introduced into the production process to offset economic downturns.[3] Middle-skill workers, particularly those in traditionally blue-collar and semiskilled white-collar industries such as manufacturing and clerical work, are being displaced or asked to upskill or retrain at rates not witnessed since the industrial revolution more than a century ago.[4] The Council on Foreign Relations estimates that, by 2030, as many as a third of American workers will either need to change occupations or acquire new skills.[5]

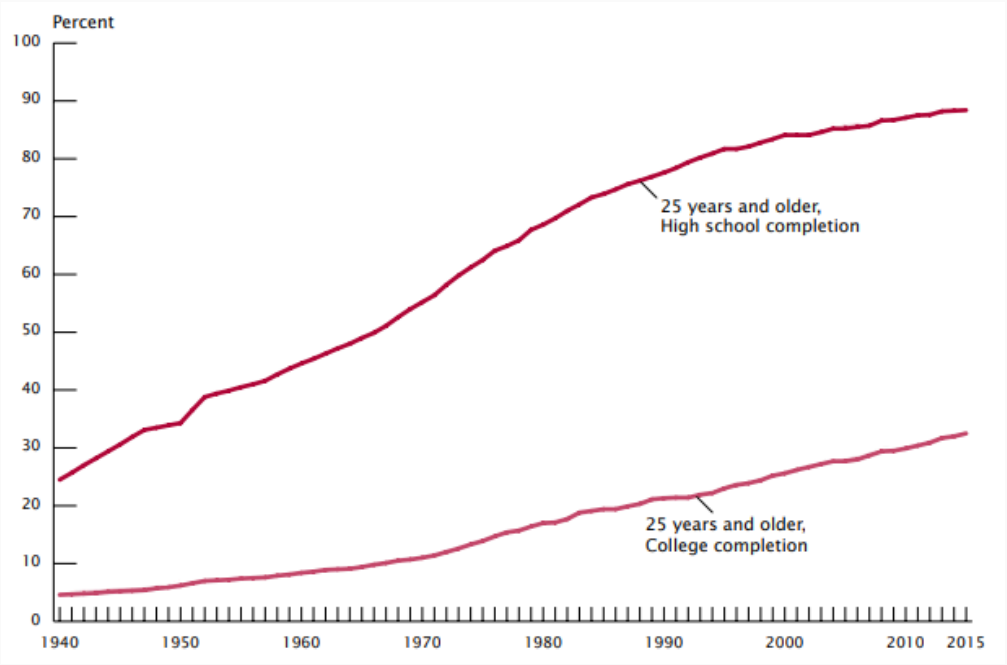
Our goal with this report is to present a case for why we must develop strategic interventions to buttress America's middle-skill workers not only with higher levels of education but also, critically, with the skills they need so they are better equipped for the jobs of today—and those that will most certainly exist in the future. To make this case, we explore the most pressing future skill demands of middle-skill jobs by examining occupational data and trends. We also look at what experts suggest are the skill expectations for emergent jobs and how these skills are distributed in what are now understood to be middle-skill jobs—that is, jobs requiring education beyond a high school degree but less than a 4-year bachelor's degree.[6] The National Academies of Sciences® also refers to these types of jobs as skilled technical jobs that have emerged "due to the increased complexity of job specific task expectations tied to technology and automation."[7] Part of the aim of this paper is to understand the demands of these types of jobs not simply in terms of educational attainment, but rather in terms of the skills likely needed to perform such work successfully. To provide a context for understanding what we see as a troubling skills challenge ahead for middle-skill workers, we explore data from international surveys of adult skills along with national data on student reading and math skills. These assessments reveal important deficits in the very skills that support success in the work of the future. We end our paper with a theory of action for policy makers, researchers, and funders that we believe will significantly improve the literacy, numeracy, and digital skills of adults and put them on a pathway for future educational and occupational growth. Our approach relies on the development of a learning and assessment system rooted in evidence centered design (ECD) principles and applicable in a variety of workplace and educational contexts.

Context

The business, education, and research communities have begun to focus more pointedly on how work—and the skills and tasks that workers are required to have and perform—has changed for many who once made up the bulk of the burgeoning middle class throughout much of the 20th century. In fact, the definition of what constitutes middle-skill work has shifted dramatically over the course of the last 70 years, as has our understanding of the type of education and skills needed for this work.

The growth in levels of education through the 20th century is clear in Figure 1, which shows that about a quarter of the population age 25 and older had earned at least a high school degree in 1940; 75 years later, in 2015, nearly 90 percent had completed high school.[8]

Figure 1: High School and College Completion Percentages for the U.S. Population 25 and Older (1940–2015)



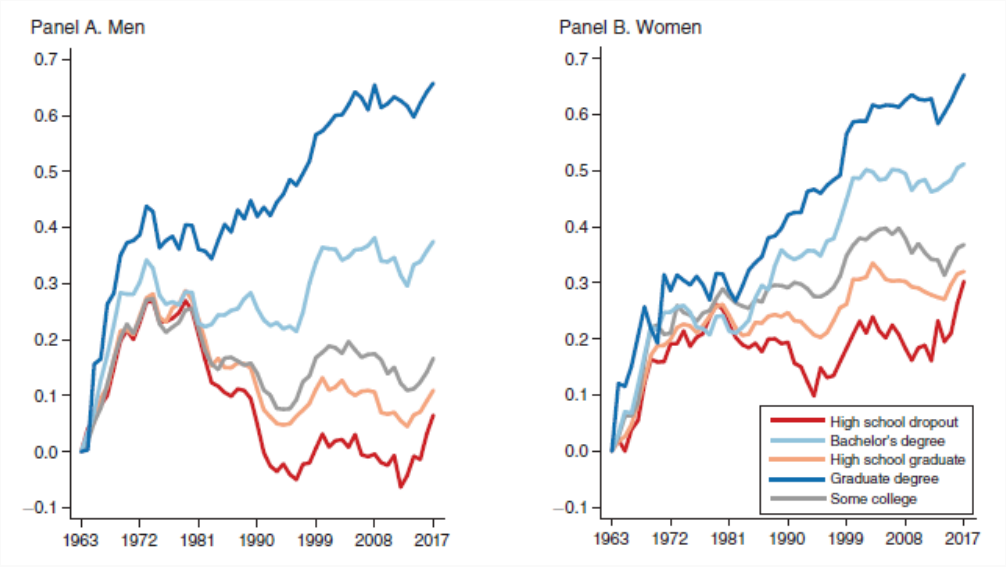
Note: "High school completion" includes equivalent.
Source: U.S. Census Bureau, 1947–2015, Current Population Survey and 1940 Decennial Census[9]

The steady rise of high school graduation rates in the mid-20th century (as well as increased years of schooling, even for those who did not earn a high school degree or equivalent) dovetailed with the growth of more complex manufacturing jobs that required the ability to read manuals, interpret blueprints, or maintain machinery. Semiskilled and skilled white-collar work (e.g., clerical, managerial) grew alongside what scholars refer to as the "high school movement" in the United States.[10] During this time, the economy witnessed a large increase in both productivity and prosperity (in terms of income compensation) with the two growing in lockstep from roughly 1947–1970.

Beginning in the 1970s, though, levels of productivity and wages began to diverge. Productivity benefited from a combination of technology growth (automation) and the globalization of supply chains, while the wages of workers became increasingly stratified by levels of educational attainment. Thus, as one labor economist sums up the period between 1980 and 2010, "Productivity growth did not translate into shared prosperity, but rather into employment polarization."[11] This polarization was characterized by the emergence (or growth) of well-remunerated jobs for highly skilled individuals as well as a growing service sector that did not require high levels of skills (and/or educational attainment) and commanded lower wages.

Figure 2 illustrates this polarization by showing the growth in weekly earnings of men and women ages 16–64 with different levels of educational attainment across roughly five decades. What is evident for both men and women is that the relative change in weekly earnings was about the same regardless of level of educational attainment until the late 1970s. After this point, there is a dramatic shift. While earnings for those with higher levels of education continued to grow—sharply in some cases—the growth in earnings for those with lower levels of educational attainment dropped off, especially for men. The reasons for this departure are numerous and complex;[12] however, shifts in return to education and skills played—and continue to play—an important role in this ongoing process.

Figure 2: Cumulative Change in Weekly Earnings of Working Age Adults 16–64, 1963–2017[13]



Source: David H. Autor, "Work of the Past, Work of the Future," *AEA Papers and Proceedings 109* (May 2019): 1–32, https://doi.org/10.1257/pandp.20191110, based on Current Population Survey (CPS) Annual Social and Economic Supplement. Copyright © 2019 American Economic Association; reproduced with permission of the *AEA Papers and Proceedings.*

The data presented in Figure 2 provides strong evidence for the fact that the nature of work, and the skills and education required to do work that is well remunerated, has undergone dramatic changes over the course of the last 40 years. Following World War II, wages for workers with high school–level skills grew at a similar rate to those with higher levels of education and skills; increasingly after 1970, this was no the longer the case.

Moreover, the technological and policy shifts that have engulfed our society over these past five decades have had disparate impacts, with America's working- and middle-class families bearing a heavy burden. This shift is perhaps most evident in work from two Princeton University economists, Anne Case and Angus Deaton, who detailed a decline in American life expectancy and suggested that these "deaths of despair," which they defined as premature deaths in prime age from suicides, alcohol-related liver diseases, and drug overdose, can be in part attributed to a deterioration in the lives of Americans who entered adulthood after 1970 without a college degree—the skills measure used in their analysis.[14]

The concern for those with less than postsecondary education is not new, of course. President Barack Obama called for sharp increases in postsecondary education for young adults in order to help address the significant shifts in our economy and labor market.[15] Other efforts include the Lumina Foundation®, which challenged the nation to have at least 60 percent of all adults obtain some postsecondary training by 2025.[16] A growing body of research suggests that although postsecondary education leading to a certificate, degree, and/or credential is important to improving opportunities for the future, the actual skill levels that workers possess play an even more important role in explaining employment outcomes.[17] What's more, a troubling pattern is emerging where degrees are not as closely connected to skills as widely thought.[18] A powerful example of this finding comes from an examination of data from a large-scale assessment of adult skills, which indicates that over half (53 percent) of young adults ages 16–34 with a high school degree and some postsecondary education, typical of middle-skills workers, lack the skills that many experts believe are required to meet the challenges of today's technological workplace where middle-skill occupations are increasingly demanding higher levels of cognitive skills.[19]

The Future of Skills

Knowledge, Skill, and Ability Expectations

Given the realities we face, how do we best understand what constitutes middle-skills work at present and how do we best prepare workers to succeed in occupations that make up the bulk of work in middle-skills occupations? An important aspect of addressing these questions is to first have a better sense of the types of skills that are expected of workers in middle-skill jobs.

Middle-skill jobs or occupations (as noted, sometimes referred to as skilled technical jobs) are a category of jobs and occupations that are variously defined by wage levels, educational requirements, and/or types of tasks that workers perform.[20] Research indicates that the measure of skill involved in performing tasks required in middle-skill occupations is key to distinguishing the work within this broad occupational category.[21] In addition, labor economists generally agree that middle-skill work requires specialized education/training after high school.[22] Career and technical educationprograms within the community college system are typically the vehicle for training and advancement for many middle-skill occupations.

To understand better the characteristics of work in middle-skill occupations, we turn to data from the U.S. Department of Labor's Occupational Information Network (O*NET®). O*NET is a comprehensive, data-driven, occupational classification system. Using a combination of surveys, expert ratings, and employer data, the O*NET data document knowledge, skill, ability, and work-style requirements across jobs on five different levels of education, experience, and training expectations. These levels are referred to as zones and range from 1 (*little or no preparation needed*) to 5 (*extensive preparation needed*), with Zone 3 (*medium preparation needed*) generally requiring some postsecondary training and certification.[23]

Our focus is on the skill expectations of jobs in Zone 3. We also want to look at Zone 2 as "on-ramp" jobs and at Zone 4 as those jobs mostly require a bachelor's degree to investigate whether Zone 3 and Zone 4 job skill expectations are blurring. Examples of jobs in these zones include customer service representatives and security guards in Zone 2; electricians, court reporters, and medical assistants in Zone 3; and sales managers, graphic designers, and chemists in Zone 4. Jobs in Zones 1 and 5 are excluded from the discussion because our focus is on creating on-ramps for middle-skill work with the goal of understanding the level and type of skills that are increasingly expected of middle-skill workers today and into the future.

Golubovich, Su, and Robbins (2017) investigated the core competencies of middle-skill workers across multiple domains including abilities, skills, and work styles using data from O*NET to identify key core competencies of middle-skill jobs.[24] Our focus in this report is on abilities and skills. *Abilities* are defined as "relatively stable psychological characteristics that allow individuals to perform particular types of tasks."[25] These abilities typically fall across four categories: cognitive, physical, psychomotor, and sensory, with cognitive abilities considered to be the best predictor for job performance and training.[26] *Skills* are defined as "a set of strategies and processes that enable individuals to acquire and work with information within a specific performance domain." Skills are typically developed over time and considered "one of the direct determinants of job performance."[27] We do not focus on work styles, which comprise interpersonal and intrapersonal qualities frequently referred to

as noncognitive skills.[28] Tables 1 and 2 summarize the key abilities and skills by O*NET job zone identified by Golubovich et al. to be "integral to success across the majority of middle-skill jobs."[29]

Table 1 presents the percentage of jobs by zone where workers' abilities "that influence the acquisition and application of verbal information in problem solving"[30] are deemed *important* or *very important* for success.[31] What is immediately clear is that for Zone 4 jobs—a majority of which require a bachelor's degree—written comprehension (100 percent), written expression (97.7 percent) inductive reasoning (97.7 percent), and category flexibility (97.7 percent) are deemed to be *important* or *very important* worker abilities. Fluency of ideas (79.5 percent) and bringing originality to work to solve problems (75 percent) are also regarded as *important* or *very important* for workers in a majority of Zone 4 jobs. Not surprisingly, from this analysis, cognitive skills in the service of problem-solving would be essential for success in Zone 4 jobs.

According to O*NET classifications, Zone 3 jobs typically require a medium level of preparation and 1 to 2 years of job experience, with most occupations in this zone requiring vocational school training, on-the-job training, or an associate's degree or more.[32] An analysis of Zone 3 jobs shows a similar pattern as that of Zone 4 jobs for abilities in written comprehension (90.2 percent), inductive reasoning (88.4 percent), flexibility in thinking (84.8 percent), and the ability to communicate effectively in writing (written expression, 75.9 percent). In other words, as with Zone 4 jobs, an array of cognitive abilities is integral for a majority of jobs in this largely middle-skill job zone.[33] Where Zone 3 and Zone 4 differ is with respect to the fluency of ideas and originality. This finding may reflect the way expectations increase to solve problems with a level of creativity and innovation commensurate with increased job complexity.

Zone 2 jobs require some preparation and are available to those with limited work experience; the typical level of education for Zone 2 jobs is a high school degree, though some of the jobs in this zone do require vocational training or more. As can be seen in Table 1, Zone 2 jobs do not rise to the level of cognitive demand seen in Zone 3 and Zone 4 jobs. Nevertheless, written comprehension and inductive reasoning are considered integral for half of the jobs in this zone.

Table 1: Select Cognitive Abilities Rated as Important or Very Important by Experts[34]

O*NET, COGNITIVE ABILITIES	DEFINITION	JOB ZONE 2	JOB ZONE 3	JOB ZONE 4	DIFF. ZONE 2 - 3	DIFF. ZONE 2 - 4	DIFF. ZONE 3 - 4
Written Comprehension	The ability to read and understand information and ideas presented in writing.	50.7	90.2	100	**39.5**	**49.3**	**9.8**
Written Expression	The ability to communicate information and ideas in writing so others will understand.	23.2	75.9	97.7	**52.7**	**74.5**	**21.8**
Fluency of Ideas	The ability to come up with a number of ideas about a topic (the number of ideas is important, not their quality, correctness, or creativity).	5.1	33	79.5	**27.9**	**74.4**	**46.5**
Originality	The ability to come up with unusual or clever ideas about a given topic or situation, or to develop creative ways to solve a problem.	6.5	25.9	75	**19.4**	**68.5**	**49.1**
Inductive Reasoning	The ability to combine pieces of information to form general rules or conclusions (includes finding a relationship among seemingly unrelated events)	53.6	88.4	97.7	**34.8**	**44.1**	**9.3**
Category Flexibility	The ability to generate or use different sets of rules for combining or grouping things in different ways.	34.1	84.8	97.7	**50.7**	**63.6**	**12.9**

Note. Percent of occupations within zone that have important or very important attribute ratings.[35]
Data from O*NET OnLine by the U.S. Department of Labor, Employment and Training Administration (USDOL/ETA). Used under the CC BY 4.0 license. O*NET® is a trademark of USDOL/ETA.

Table 2 examines jobs in Zones 2, 3, and 4 based on the importance of core skills necessary to "facilitate learning or the more rapid acquisition of knowledge."[36] This table shows that for most jobs in Zone 4, skills such as active learning (95.5 percent), coordination (97.7 percent), complex problem-solving (93.2 percent), judgment and decision-making (98.9 percent), and time management (95.5 percent) are judged to be *important* or *very important* skills. Reading comprehension skills are uniformly considered integral (100 percent) across Zone 4 jobs, which given the strong connection between reading comprehension and knowledge building is largely expected.[37]

Zone 3 jobs follow a similar pattern to Zone 4 jobs on skill attributes, especially regarding reading comprehension (88.4 percent), complex problem-solving (84.8 percent), and judgment and decision-making (83 percent) skills. Zone 2 jobs largely depart from the pattern evident in Zones 3 and 4; however, reading comprehension remains an important skill attribute for nearly half of the jobs in this zone (47.1 percent).

Table 2: Select Skills Rated as Important or Very Important by Experts[38]

O*NET SKILLS	DEFINITION	JOB ZONE 2	JOB ZONE 3	JOB ZONE 4	DIFF. ZONE 2 - 3	DIFF. ZONE 2 - 4	DIFF. ZONE 3 - 4
Reading Comprehension	Understanding written sentences and paragraphs in work related documents.	47.1	88.4	100	**41.3**	**52.9**	**11.6**
Writing	Communicating effectively in writing as appropriate for the needs of the audience.	18.1	65.2	54.7	**47.1**	**36.6**	**-10.5**
Active Learning	Understanding the implications of new information for both current and future problem-solving and decision-making.	8.7	62.5	95.5	**53.8**	**86.8**	**33**
Social Perceptiveness	Being aware of others' reactions and understanding why they react as they do.	34.1	67	86.4	**32.9**	**52.3**	**19.4**
Coordination	Adjusting actions in relation to others' actions.	45.7	76.8	97.7	**31.1**	**52**	**20.9**
Complex Problem-Solving	Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions.	34.1	84.8	93.2	**50.7**	**59.1**	**8.4**
Judgment and Decision Making	Considering the relative costs and benefits of potential actions to choose the most appropriate one.	37.7	83	98.9	**45.3**	**61.2**	**15.9**
Time Management	Managing one's own time and the time of others.	32.6	75.9	95.5	**43.3**	**62.9**	**19.6**

Note. Percent of occupations within zone that have important or very important attribute ratings.[39]
Data from O*NET OnLine by the U.S. Department of Labor, Employment and Training Administration (USDOL/ETA). Used under the CC BY 4.0 license. O*NET® is a trademark of USDOL/ETA.

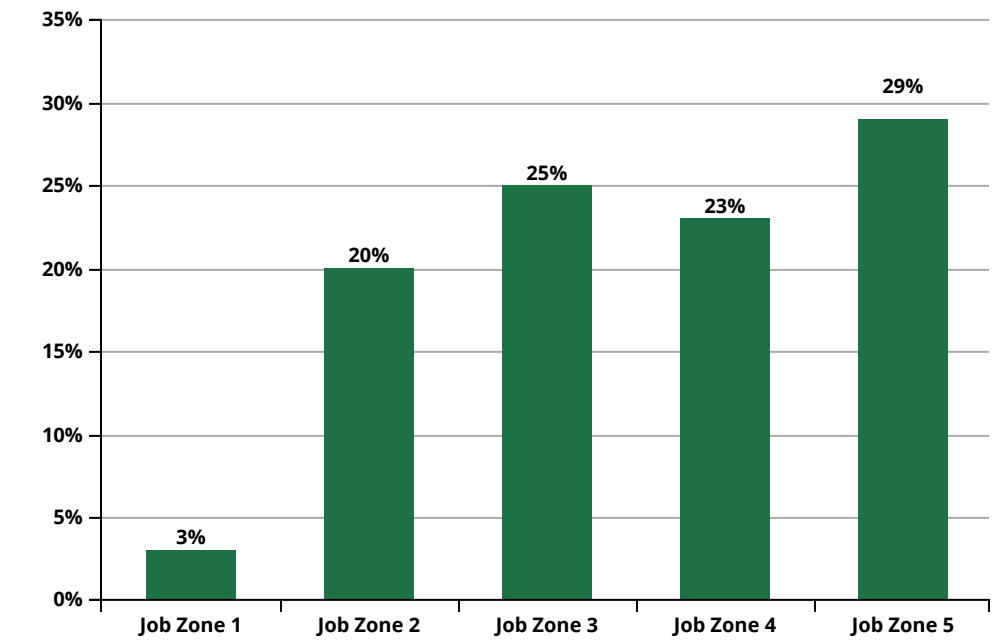
A key takeaway from the analysis of attributes and skills by job zone classification is the substantial degree of similarity in the cognitive abilities and skills deemed integral for jobs in Zone 3 and Zone 4, despite the differences in training typically associated with these zones. This finding suggests that the abilities and skills needed for middle-skill jobs, which are traditionally associated with postsecondary education below a 4-year bachelor's degree and

most prevalent in Zone 3, are similar to those in demand for Zone 4 jobs, which typically require a bachelor's degree. Also noteworthy is the fact that Zone 3 jobs are well differentiated from those in Zone 2. These findings have important implications for middle-skill workers regarding their training/retraining and educational pathways.

Knowledge, Skill, and Ability Expectations for Emergent Jobs

In order to explore the types of skills needed for the future labor market, we examined a number of different projections, including our own estimate based on O*NET's Bright Outlook occupations.[40] Bright Outlook occupations are those that are expected to grow faster than average (employment increase of 7 percent or more) from 2018–2028 and/or are projected to have 100,000 or more job openings in that same period. To understand the skill needs of jobs in these occupations, each Bright Outlook occupation was recoded to an O*NET job zone using the O*NET Online Crosswalk search.[41] As shown in Figure 3, nearly half of the Bright Outlook occupations will fall into Zones 3 and 4 by 2028, with less than a quarter falling below Zone 3 and 29 percent falling in the highest zone. The takeaway here is that a majority of the growth occupations, according to O*NET, will be in job zones that require increasingly higher levels of skills.

Figure 3: Percentage of O*NET Bright Outlook Occupations by Job Zone, 2018–2028

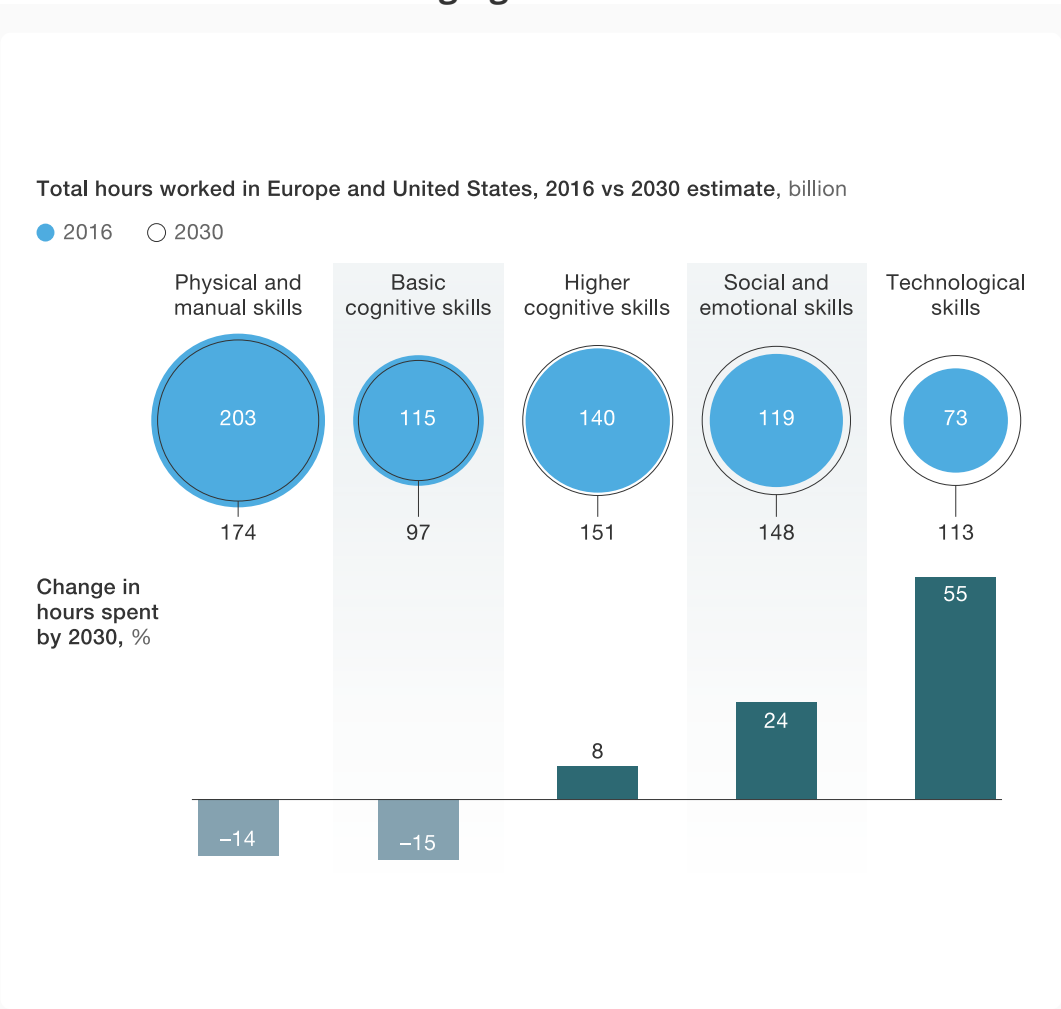


Source: O*NET Bright Outlook occupations crosswalked to O*NET job zones by authors using O*NET crosswalk information. See Appendix A for crosswalk results.

Data from the McKinsey Global Institute (MGI) offer a slightly different take on future skill demands by analyzing hours worked across all labor sectors using a five-cluster, 25-skill taxonomy, again, informed by O*NET.[42] Specifically, MGI examined the distribution of labor

hours in 2016 and as estimated for 2030 based on automation and macroeconomic trends and projections. By their calculations, physical and basic cognitive skill hours will decline by 14 percent and 15 percent respectively, while higher cognitive, social and emotional, and technological skills will increase by 8, 24, and 55 percent respectively (Figure 4). The increases in the latter three classifications of skills were slightly higher, 9, 26, and 60 percent respectively, when just considering the United States. With regard to cognitive skills, these findings may be misleading in the sense that whereas jobs requiring *only* basic cognitive skill hours are diminishing, this does not mean that basic or essential skill expectations are not still required; rather, having this level of skills is subsumed in the higher-order cognitive skills growth. The notion that one needs these essential cognitive skills in order to build higher-order cognitive skills is an assumption that we explore in the next section of this paper.

Figure 4: Skills Needed in a Changing Workforce



Source: Figure from Jacques Bughin, Eric Hazan, Susan Lund, Peter Dahlström, Anna Wiesinger, and Amresh Subramaniam, *Skill Shift: Automation and the Future of the Workforce (Washington, DC: McKinsey Global Institute, 2018),* https://www.mckinsey.com/featured-insights/future-of-work/skill-shift-automation-and-the-future-of-the-workforce. Copyright © 2020 McKinsey & Company. All rights reserved. Reprinted by permission

Other research similarly supports the contention that more and higher levels of skills have redefined the baseline needed for today's workplace. Pearson and Nesta (formerly NESTA, National Endowment for Science, Technology and the Arts) gathered expert panels and applied trend analyses and machine learning to O*NET data to organize occupations into high-growth clusters, including advanced manufacturing, skilled trades, health care, computer and mathematical operations, personal care and service, and engineering and technology.[43] They then examined critical skills required in these emergent jobs, which allowed them to extrapolate future skill demands. Top-ranked skills included the following:[44]

- Interpersonal skills
- Higher-order cognitive skills (e.g., critical thinking and decision-making)
- Fluency of ideas skills (e.g., oral and written communication)
- Digital technology skills
- Intercultural fluency skills

Given findings discussed in this section, workers in middle-skill occupations will need higher levels of skills including, for example, the ability to problem solve and think critically in order to work effectively alongside new technology and automated processes.In the next section, we explore one critical question: are middle-skill workers prepared?

The Paradox of Increasing Skill Expectations

Many readily acknowledge that skills such as problem-solving and critical thinking are increasingly important, but perhaps what is not fully appreciated is the extent to which these skills rely upon a strong foundation of literacy and numeracy skills that are increasingly associated with digital environments. It is difficult—if not impossible—to critically evaluate, interpret or make meaningful inferences, or problem solve in any area of knowledge without the ability to decipher various kinds of texts and to meaningfully understand and apply numeric information in both work and everyday contexts. Research also shows that across a range of issues including wages, health, and indicators of civic engagement and trust, adults with higher levels of literacy and numeracy skills fare better than their counterparts with lower skill levels.[45]

As we argued previously, the literacy and numeracy skills gained in a typical U.S. high school education may have been sufficient to acquire and maintain a job paying middle-class wages during much of the last century. Increasingly since the mid-1970s, however, these skills have become "just the starting point"[46] toward mastering the kinds of competencies needed for emerging middle-skills jobs.

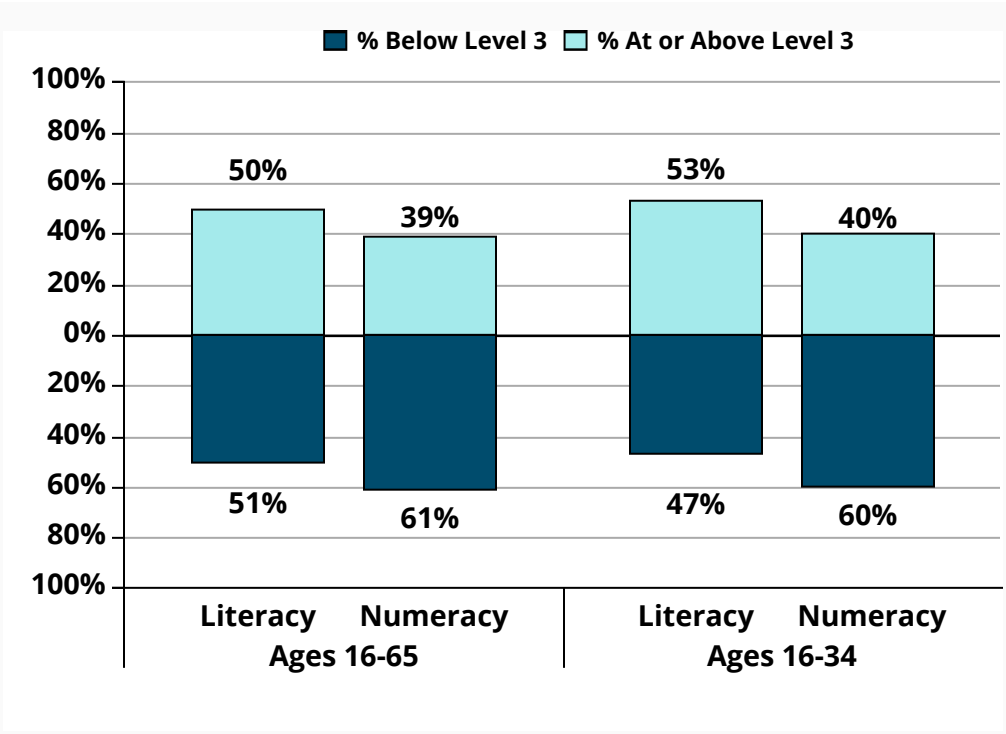
Extensive research on adult literacy conveys a similar message. As Kirsch et al. noted at the turn of this century, "[L]iteracy can be thought of as a currency in this society. Just as adults with little money have difficulty meeting their basic needs, those with limited literacy skills are likely to find it more challenging to pursue their goals—whether these involve job advancement, consumer decision making, citizenship, or other aspects of their lives." If this was an apt statement two decades ago, it is even more so today. In fact, the authors prophetically warned at the time that "even if adults who performed in the lowest literacy levels are not experiencing difficulties at present, they may be at risk as the nation's economy and social fabric continue to change."[47]

Large-scale assessments of adult proficiencies can help us evaluate the extent to which key segments of our population are prepared for the challenges they are currently confronting and those that will almost certainly lie ahead. First administered in 2012, the PIAAC, overseen by the OECD, seeks to measure the key cognitive and workplace skills individuals need to succeed in the marketplace and to fully participate in society. This household survey of adults ages 16–65 years of age is designed to assess essential 21st century literacy and numeracy skills. Real-world assessment tasks probe respondents' ability to distinguish between relevant and irrelevant information; correctly fill out online forms; integrate, synthesize, and interpret arguments offered in various forms of media; understand employment requirements; and calculate the costs and benefits of retirement plans, to name a few.

Results from PIAAC, shown in Figure 5, reveal that large segments of the U.S. population (ages 16–65) currently do not possess some of the essential skills upon which they will need to build their future. In fact, half perform below what many experts identify as a minimum standard (Level 3) for literacy, and 61.2 percent perform below the minimum standard for numeracy.[48] Moreover, the PIAAC results expose a striking paradox: although a larger proportion of our young adults (ages 16–34) than ever before are graduating high school or obtaining certificates and completing some form of postsecondary education, many lack the essential skills they will likely need to prosper.[49] For example, approximately 36 million, or nearly half of this young age cohort, performs below the minimum standard for literacy, and nearly 46 million (60 percent of the cohort) performs below the minimum standard for

numeracy, despite the large share of this cohort graduating from high school and pursuing postsecondary education and the fact that they are the most recent products of the educational system.[50]

Figure 5: Percent of Population by Age Group at Select Performance Levels, PIAAC Literacy and Numeracy Skills, 2012/2014



Source: Graphic prepared by authors using data from the Organisation for Economic Co-operation and Development (OECD), Programme for the International Assessment of Adult Competencies (PIAAC), 2012/2014

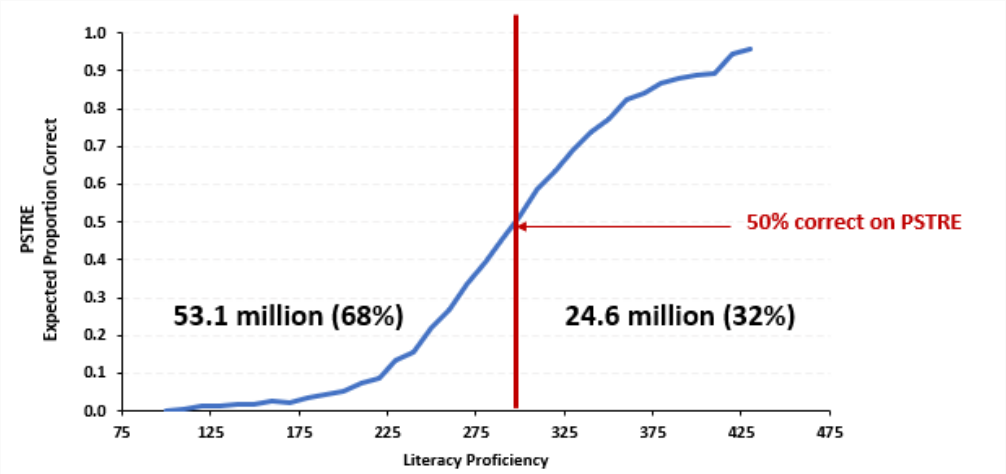
In general, a key difference between the kinds of tasks that those who perform at or above Level 3 can do compared to those below this standard hinges on the complexity of what an individual is being asked to do with a text or display of information. For example, in numeracy, those who perform at Level 2 can likely interpret simple representations of data, but they struggle to recognize and work with more complex mathematical patterns and relationships and to interpret and act upon numerical information embedded in a broader range of common contexts. In literacy, those who perform at Level 2 can likely paraphrase main ideas contained in relatively short texts or make low-level inferences, yet they struggle to compare, contrast, evaluate, interpret, and synthesize one or more pieces of information that require varying levels of inference as well as to construct meaning across a variety of texts.

In addition to assessing literacy and numeracy skills, the PIAAC assessment includes a domain called problem-solving in technology-rich environments (PS-TRE). PS-TRE is defined by the OECD as "using digital technology, communication tools, and networks to acquire and evaluate information, communicate with others, and perform practical tasks."[51] Tasks in this

domain measure a range of problem-solving skills and abilities including goal setting, planning, selecting, evaluating, organizing, and communicating results in digital environments such as interactive web pages, spreadsheets, and email.

Figure 6 demonstrates the important relationship between literacy and higher-order skills by showing the association between performance on the PIAAC literacy assessment and the ability of adults to perform well on the PS-TRE tasks. In order to answer just half of the items correctly on the PS-TRE assessment in PIAAC, one would need to perform in the middle of Level 3 on the assessment (276–325 on a 0–500 scale). According to the PIAAC results, approximately 68 percent of young adults in the United States, or slightly over two-thirds of individuals ages 16–34, performed below the literacy level needed to obtain a score of 50 percent correct on the PS-TRE tasks. Findings were similar for those who pursued postsecondary education including for over two-thirds of those who either earned a certificate, attended a trade school, or obtained an associate's degree. Results were worse—that is, percentages were higher across the board—when looking at the relationship between numeracy skills and performance on the PS-TRE assessment.

Figure 6: Association of PIAAC Literacy Proficiency with Expected Scores in PIAAC Problem-Solving in Technology Rich Environments (PS-TRE), Population 16–34, 2012/14



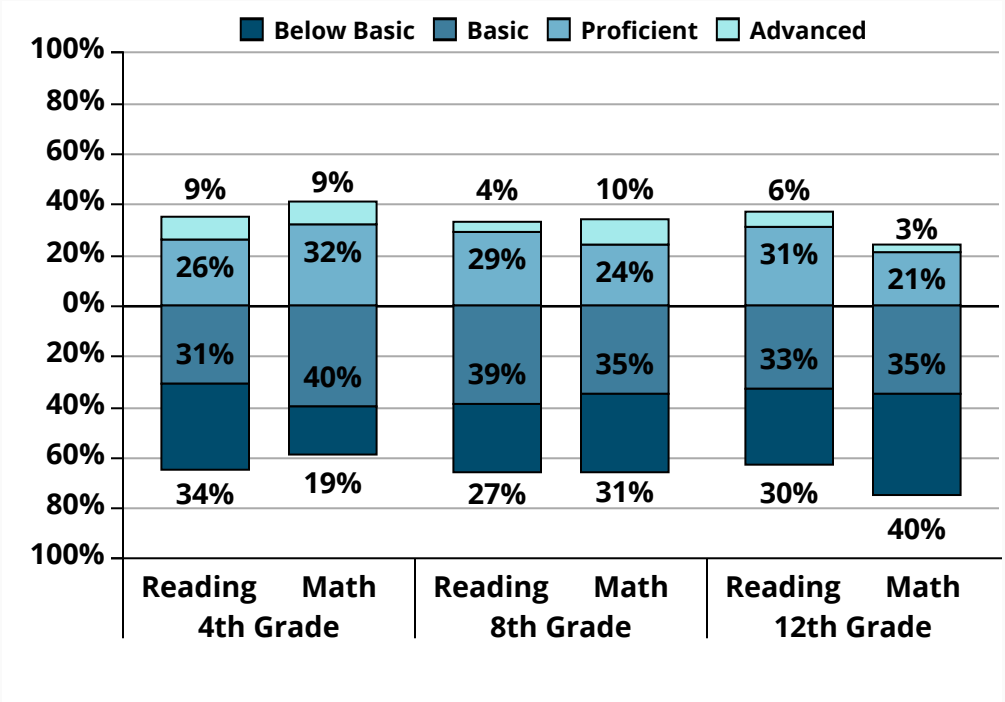
Source: Graphic prepared by authors using data from the Organisation for Economic Co-operation and Development (OECD), Programme for the International Assessment of Adult Competencies (PIAAC), 2012/2014.

The skills challenge is likewise prevalent among the U.S. incarcerated population, many of whom will be released into society and in search of sustainable employment opportunities.[52] Research shows that large percentages of those who reenter do so, according to the *U.S. PIAAC Survey of Incarcerated Adults,* without adequate levels of literacy and numeracy skills.[53] We also acknowledge that noncognitive skills associated with risk-taking, lack of emotional regulation, and social skills are important determinants of workplace success.[54]

The results from adult skill assessments are matched by equally troubling overall performance outcomes in reading as well as in mathematics from the National Assessment of Educational Progress (NAEP) at Grades 4, 8, and 12 (Figure 7). Here again, it is the more complex knowledge and skills that many of our students are lacking. In reading at Grade 12,

for example, students below NAEP *proficient* struggle to locate and integrate information using sophisticated analyses of the meaning and forms of the text and to provide specific text support for inferences, interpretative statements, and comparisons. Similarly, 12th graders who perform below NAEP *proficient* in mathematics have difficulty not only recognizing when mathematical concepts, procedures, and strategies are appropriate, but also selecting, integrating, and applying them to solve mathematical problems.[55]

Figure 7: NAEP Achievement Levels by Select Subject Area and Grade, 2019



Source: Graphic prepared by authors using data from the U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2019.

Skills deficits evident in this large-scale data are part of a deep and complex problem that we are currently facing:[56] too many adults do not have the essential literacy and numeracy skills required to support the changing demands of life in our fast-paced, technological world. And, as the NAEP data reveal, we do not seem to be growing our way out of the problem by preparing younger students with the skills they will need in the future. This skills issue is an especially difficult challenge for underskilled workers who will need increasing levels of literacy and numeracy to adapt to and work alongside technological advances happening across many middle-skill occupations. A key challenge before us, then, is to develop policies and interventions that can be put in place to meaningfully improve the literacy and numeracy proficiencies of those with low skills in order to help pave the way for their success given the increasing demands of middle-skill work.

Action Agenda

Increasingly, various stakeholders in the business community, policy makers, and researchers are calling for significant investments in reskilling and upskilling America's workers, especially in response to the economic and labor market crises related to COVID-19.[57] However, for reskilling and upskilling efforts to be successful for middle-skill workers, we must be clear about the kinds of skills these workers will need, the skills many currently have, and how best to bridge any divide.

To do this, we believe, requires high-quality, targeted interventions grounded in the assumption that adults with insufficient levels of literacy, numeracy, and increasingly important digital skills—no matter what level of education or career—can significantly improve their skill levels when provided with learning and assessment systems that focus on key underlying constructs that reflect the types of knowledge and skills required for work, education, and everyday life. To accomplish this, we believe that interventions need to be developed using coherent, evidence-centered frameworks that clearly define and then systematically operationalize the acquisition of skills and knowledge that underlie key cognitive constructs. Moreover, we think this content should be delivered efficiently to learners through an integrated learning and assessment system that relies on innovative and flexible approaches that meet the current and future needs of adult learners.

A Theory of Action for Developing Targeted Interventions to Improve Adult Skills

The theory of action (TOA) presented here is intended to highlight thinking on how to best develop these targeted solutions. Creating a conceptual framework and highlighting assumed linkages among actions, the mechanisms of change, and outcomes are common practices that have a long history in program evaluation research literature.[58] Two examples of researchers using TOA include Randy Bennett in 2010, who used a TOA to describe a comprehensive formative and summative assessment model for K–12 learners, and Maurice Cogan Hauck et al., in 2016, who used a TOA to propose a model for English learner language proficiency assessments within the United States.[59] Both presented an explicit rationale for each component supported by research and theory.

As shown in Figure 8, our approach relies on ECD and includes an innovative delivery platform that is designed to stimulate and motivate learners and instructors/trainers throughout the learning experience. After describing our approach, we offer a model that describes the key components of a learning and assessment system for adults that are intended to work together to bring about a set of desired or intended outcomes. We also suggest a set of mechanisms that are likely to bring about the intended outcomes.

Figure 8: Theory of Action to Promote Adult Skills Acquisition

EVIDENCE CENTERED DESIGN (ECD) LEARNING AND ASSESSMENT SYSTEM TO IMPROVE SKILLS

Innovative, technology-based delivery platform

COMPONENTS	MECHANISMS	INITIAL OUTCOMES	LONG-TERM OUTCOMES
• Professional materials that guide the understanding and use of the system • Instructional materials developed to reflect desired constructs; content can be general or job specific • Assessments ◦ Formative assessments containing item sets representing specific competencies, practice exercises and interpretative information (feedback) ◦ Baseline and summative assessments representing targeted learning progressions and proficiency benchmarks	• Promote efficient and effective use of the learning system for trainers • Asynchonous and synchronous instruction supporting varied learning options • Motivational strategies that support learners • Immediate feedback to support learning • Actionable data to evaluate program effectiveness	• Learners acquire desired competencies at sufficient levels • Trainers and instructors understand the learning and assessment system in order to effectively support learners • Increase use of formative assessments to support and guide learning	• Learners can successfully continue career or educational opportunities • Data is collected to inform continuous improvement • Business leaders, educators and policy makers value skill gains among key populations

The Approach

Recent advances in measurement science provide a model for the design and development of assessments that focus on the collection of validity evidence to support the development and appropriate use of the instruments. Linking learning materials with these assessments requires the same rigor and understanding needed to develop assessments. The approach used to develop this type of learning and assessment system is referred to as evidence centered design, or ECD, and offers a critical roadmap for the development of coherent and quality interventions.[60]

In brief, an ECD approach requires a conceptual framework in which there is agreement on an operational definition of target constructs, including the knowledge and skills that should be assessed and an understanding of how the assessment data will be used. The operational definition for each construct is developed in collaboration with one or more groups of domain experts in order to ensure that it reflects current research and thinking in the field. The conceptual framework then expands upon that definition to further identify the knowledge and skills of interest. This framework forms a blueprint for the development of an assessment designed to collect the types of evidence needed to locate individuals along a continuum or scale of key competencies in the domain of interest (e.g., literacy, numeracy, or digital skills). With this information, assessment developers can create short descriptions of the tasks that fall along the scale representing the underlying construct using the features that were used to build the tasks. Once the assessment items are developed and

administered, statistical analyses are used to place items along the domain scale, ranging from easiest to hardest. Then developers create short descriptions of those items, focusing on the key task features that were defined in the framework and used to build the tasks. Such descriptions make it possible to go beyond simply identifying that one item was more difficult than another and, instead, define levels of performance by articulating how the skills and knowledge required to successfully complete the items progressively change and increase along the scale. Using such a model provides an opportunity to design and build standardized assessments that allow for benchmarking proficiency and diagnostic information that is tied to desired learning progressions. In addition, this model also allows users to gauge progress and evaluate the need for continued learning.

An effective intervention system should be developed around an innovative, technology-based delivery platform that will deliver learning and assessment materials in an efficient and effective manner while also offering maximum flexibility for instructors and learners through the use of flexible learning options and embedded motivational strategies.

Further, the design features—innovative, technology-based design and delivery—of this learning and assessment system are expected to support both instructors and learners with nimble and flexible content delivery options including synchronous, asynchronous, and blended approaches that can be used across a variety of settings.

Synchronous instruction supports learning by allowing instructors to use their knowledge of the framework to communicate and elaborate on the learning materials provided. This approach also allows for, and promotes, interactions among the learners. The system should be designed to also provide "on demand," or asynchronous learning, that enables learners to engage in learning and practice at their convenience. The flexibility of the system would fully support blending these approaches where doing so makes the most sense for learners.

The most important pedagogical features provided by enhanced digital technologies across learning environments are that the instructional content is presented in small "chunks" or "micro lessons" that allow for rapid absorption and rehearsal and that practice items are followed by immediate feedback. Ultimately, the instructional content should be relevant, allow for learner and instructor control of the learning process, be provided over a relatively brief period of time, and demonstrate explicit and manageable activities in a proposed task-interaction learning analytics model.[61]

Such an approach to learning and instruction supports successive or incremental "wins" for learners. If learners are expected to sustain their commitment to learning, they need to see that they are progressing and that they are acquiring the knowledge and skills expected, even if progress is sometimes slower than learners may wish. This approach is a fundamental principle of motivation (i.e., building learner self-efficacy).[62] If learners do not see even small, continuous progress, they are less likely to remain committed to their own growth and development.

Components of an ECD Learning and Assessment System

As Figure 8 illustrates, the underlying premise in our TOA is that targeted interventions that successfully build on ECD principles tend to share a set of core, integrated components: support materials that guide understanding and use of the system; instructional materials grounded in ECD design principles that can be general or job specific; and, assessments, including formative assessments that guide learning through practice and feedback on

specific competencies, as well as standardized assessments representing targeted learning progressions and proficiency benchmarks that can be used to collect baseline and summative data from students.[63]

SUPPORT MATERIALS

Support materials are intended to help instructors develop a deeper understanding of the knowledge and skills that are the focus of the intervention in order to provide a more effective and engaging learning experience. These materials include training modules, teacher manuals, explanations of key aspects from the domain frameworks, and suggestions for best practices associated with interpreting assessment results and preparing and delivering instruction. Acquiring a deeper understanding of the construct and associated competencies will also enable instructors to adapt materials to a specific occupational sector or employment context. The support materials also provide instructors with information that will assist them with the interpretation and use of the assessment data in order to identify individuals who can benefit most from these interventions and monitor their progress. In addition, the interim or formative measures embedded within the instruction provide both the learner and the instructor with important feedback that can support ongoing learning and improve outcomes.

INSTRUCTIONAL MATERIALS

Instructional materials will be based on the domain frameworks developed by content and measurement experts who will begin by reaching consensus around a definition of the construct that includes the identification of what is important for individuals to know and be able to do. For example, in the PIAAC assessment of literacy, the development process included efforts by a panel of international reading experts to specify both the different purposes for reading and the types of texts to be included—two key features associated with the definition of literacy. A set of context/content areas also was identified to help assure adequate variation in language structures, vocabulary, and background knowledge. In developing instructional materials, the focus would be similar; that is, instruction would focus on the structure of various text types including informational texts and documents such as tables, charts, graphs, and diagrams, along with lessons that focus on recognizing the various purposes for engaging with these texts and the strategies associated with each purpose.[64] In this way, both instructors and learners become familiar with the various text types, their rhetorical structure, and how various purposes interact to impact goals and strategies. The knowledge and skills associated with developing these competencies should be the focus of the instructional materials.

Contextualization of instructional materials is another key feature of successful interventions we have in mind. Because the assessment and learning materials will rely on ECD, a learning and assessment system can be developed around the range of printed and digital information found in everyday life and of interest to adult learners. This approach was used to develop the literacy, numeracy, and problem-solving instruments found in recent international assessments of adult skills such as PIAAC.[65] Beyond the development of instructional materials that are based on everyday tasks, the opportunity exists to adapt these instructional and assessment materials to specific occupational and job contexts. Because the proposed intervention is based on a model in which key features of each domain are identified and defined, well-trained instructors and/or trainers can incorporate

job-specific content and materials tied to career-centered knowledge and skill progressions so that learners are able to both improve their essential literacy, numeracy, or digital skills and acquire job- or context-specific knowledge.

Incorporating contextualized interim or formative assessment exercises along with practice materials enables learners to improve their core skills while also acquiring specific job skills and knowledge that will benefit both the employer and the current or future employee. This approach is recommended by Columbia University's Community College Research Center on cocurricular activities and remediation while taking credit-bearing courses.[66] Furthermore, the skills and knowledge learners develop will not only be immediately useful to them but also provide a "stackable" and transferable set of skills that will provide them a foundation on which they can obtain additional education or training, either on their own, or as part of a formal program, as society and the workplace continue to evolve and career progression opportunities arise.

ASSESSMENTS

In contrast to baseline and summative assessments, which are highly structured and standardized, *formative assessments* are linked to specific knowledge and skills associated with the instructional materials. Exercises associated with specific instructional materials should be provided as part of the system, but instructors would be encouraged to adapt or contextualize these interim assessments and practice materials as well as create their own. This approach will enable learners to see and understand the connections with their own lives and may motivate them to spend more time with the materials. Overall, these materials are intended to both support and enhance learning.

Baseline and summative assessments are standardized assessments that can be linked to current national and/or international assessments focused on constructs of interest such as literacy and numeracy. It is expected that these assessments will be delivered on technology-based devices and will be able to provide important information about individuals in terms of the current level of knowledge and skills they are able to demonstrate. This type of information is important to determine where each individual is with respect to a particular construct and whether they are likely to benefit from the targeted intervention. After the intervention has been completed, the summative assessment will be able to measure the amount of learning that has taken place at the individual level and can be used more broadly to evaluate for whom and under what conditions the intervention was effective. The summative measure can also be used to develop predictive information about future educational or workplace success.

Mechanisms of an ECD Learning and Assessment System

Several action mechanisms connect the various system components to the desired outcomes:

- Support materials will promote efficient and effective use of the learning and assessment system.
- The delivery platform will support synchronous, asynchronous, and blended options that can be used across a variety of settings.
- Instructional materials will be presented in relatively small "chunks" or "micro lessons" that allow for discussion or rehearsal through practice exercises providing

immediate feedback.

- The conceptual framework will provide actionable information about individual learners and the overall effectiveness of the program.

First, the use of the support materials by instructors is expected to promote efficient and effective use of the learning and system. How is this likely to occur? The support materials are intended to provide instructors with information pertaining to the conceptual framework that underlies each construct. Our expectation is that the framework provides not only the guidelines for how the instructional system is organized and delivered, but also an understanding of how instructors can best communicate this information to learners as they move through the materials. Also, a deep understanding of the overall framework will enable instructors to adapt and/or develop supplementary materials for specific work contexts.

A second mechanism that is expected to have an impact on outcomes is the fact that the delivery platform will support synchronous, asynchronous, and blended options that can be used across a variety of settings. Adult learners often have multiple responsibilities, including working and taking care of family members, that present constraints on their time. It is important, therefore, that interventions recognize the need for adults to have some control of their learning experience in terms of where and when they can engage with the instructional materials.

Third, it is also expected that the instructional materials will be presented in relatively small "chunks" or "micro lessons" that allow for discussion or rehearsal through practice exercises providing immediate feedback. This approach is intended to motivate learners by providing them with the opportunity to demonstrate that they are acquiring new knowledge and skills, which will reinforce the fact that the time and effort they are investing in their learning is worthwhile. This mindset is important in helping them to stay committed to their own growth and skill development.

Finally, because the conceptual framework also informs the formative and summative assessments, actionable information will be available about individual learners as well as the overall effectiveness of the program. For example, information provided by the baseline and summative assessments will be used to identify learners who are best able to benefit from the instruction and as well as demonstrate the overall effectiveness of the system in terms of individual growth. In addition, the availability of practice materials with immediate feedback will provide learners and instructors with opportunities for additional engagement with exercises that can both reinforce the instruction and correct any misunderstandings on the part of learners.

Initial Outcomes

To be successful, the learning and assessment system will first need to provide direct evidence that, with appropriate effort and engagement with the system, individuals are able to demonstrate that they have increased their literacy, numeracy, and digital skills to a point where they can benefit from additional education and/or job-specific training programs. This will require the collection and use of the data from the baseline and summative assessments, which allow programs to evaluate the level of skill that learners demonstrate when they begin and the amount of learning that has taken place. The assessment components of the integrated system described here will be able to administer, score, and display this type of information.

The second initial outcome that we expect from engagement with the type of learning and assessment system we are proposing is the recognition that the cognitive skills required to understand, use, and interpret written and mathematical information in digital contexts is the bridge to the types of higher-order skills increasingly required to obtain stable, sustainable employment. A key part of this is that instructors and learners gain knowledge and understanding of the underlying conceptual framework, including the characteristics associated with how it has been operationalized and applied to both the learning and assessment parts of the system. This awareness relies on the fact that the support materials, instructional system, and assessment instruments are based on the same conceptual framework and, therefore, are linked to create an efficient and effective learning and assessment system. By shoring up literacy, numeracy, and digital skills, teachers and instructors understand that they have access to a new model that can help improve the talent base that will allow adult learners to be better equipped for the jobs of today and better able to engage in ongoing learning that will prepare them for the jobs/employment opportunities of the future.

A third initial outcome we anticipate from adoption and use of an ECD learning and assessment system is that there is an increased use of formative assessments to support and guide learning. Interim assessments are designed to provide specific information about whether individuals understand the instruction they are receiving. This is best accomplished using practice exercises or specially designed tasks aimed at specific competencies associated with the instruction. As these materials are designed to provide immediate feedback and support for learning, it is important to have evidence that these materials are routinely used by the learners through workbook-like materials and by instructors during direct instruction.

Long-Term Outcomes

A key long-term outcome for this system is that learners recognize that they have improved their literacy, numeracy, and digital skills. With these improved and stackable or transferable skills, individuals will recognize that they are better able to benefit from job-specific training and, longer term, are better equipped to learn on their own in a time of rapidly evolving technologies and workplace demands.

To ensure that the system is effectively meeting this goal requires continuous improvement of the components and mechanisms that comprise the model. This will mandate the development of a set of indicators that can guide data collection strategies, monitor progress, and point to needed enhancements and improvements to the system. To be most effective, these indicators should be based on ongoing research and findings from various interventions implemented across a range of contexts and populations. Ultimately, the question we should be asking is not whether a specific intervention is effective; but for whom it is effective and under what conditions.

With this proposed approach, we have the opportunity to reimagine how successful interventions are designed, delivered, and promoted and to help millions of our struggling middle-skill workers develop the literacy, numeracy, and digital skills needed to advance their career and life opportunities. A critical outcome for the learning and assessment system is that its successes garner the interest and support of business leaders, educators, and key stakeholders. This support would facilitate implementation of the model in high schools, community colleges, and other organizations including those serving incarcerated populations and those offering after-school/work options.

Ultimately, this effort for linking essential skill development with additional education or actual career opportunities aims to:

- Attract more—and more diverse—students who need access to improved learning and assessment opportunities that will help propel them through to successful completion of educational and career and technical programs
- Improve the design of essential skills programs to more intentionally align with actual job and career opportunities for which preparation requires certain literacy, numeracy, and digital literacy as well as other work-readiness skills
- Demonstrate that more adults will have access to and succeed in educational and job-specific training opportunities
- Provide learners with stackable and portable skills that they can continue to build on in the future

Some Final Thoughts

As our society continues to undergo change that requires larger percentages of our population to acquire higher-order skills such as complex problem-solving and critical thinking, strategic and systematic policies and interventions are needed to change the circumstances of those with insufficient levels of literacy, numeracy, and digital skills so that they are better positioned to succeed in the economy and society of today and tomorrow.

Through targeted learning and assessment systems, adults with insufficient skill levels can develop the competencies that they need today. Successful interventions will also help prepare them for a future in which they must be able to benefit from ongoing educational and training programs in rapidly changing workplace and societal environments and be able to continuously and independently acquire new knowledge and higher-order skills .

As the number of voices calling for investments in upskilling and reskilling America's workers mount, we must be mindful that interventions take into account learners' existing literacy, numeracy, and digital skill levels. As we come to recognize the importance of these essential skills, we should also consider the current narrative around degrees, certificates and certification. For too long, we have relied on increasing the quantity of education, assuming this would provide better skills and set individuals on the right course toward entering and sustaining an economically stable life. Yet, as discussed above, a surprisingly large number of young adults are leaving upper secondary and postsecondary education lacking the essential skills they need for future success in education or the labor market. Policy makers and others must focus on providing opportunities for adults—even those with certificates and degrees—to improve their literacy, numeracy, and digital skills to support future learning, including job-specific training and retraining.

Appendix A: Bright Outlook Occupations, O*NET Crosswalk

Appendix Table A: Bright Outlook Occupations, O*NET Crosswalk

CODE	OCCUPATION	JOB ZONE RECODE
15-2011.00	**Actuaries**	**4**
29-1199.01	**Acupuncturists**	**5**
29-1141.01	**Acute Care Nurses**	**3**
25-2059.01	**Adapted Physical Education Specialists**	**4**
11-3011.00	**Administrative Services Managers**	**3**
29-1141.02	**Advanced Practice Psychiatric Nurses**	**5**
13-1011.00	**Agents and Business Managers of Artists, Performers, and Athletes**	**4**
45-2091.00	**Agricultural Equipment Operators**	**1**
53-2022.00	**Airfield Operations Specialists**	**3**
29-1069.01	**Allergists and Immunologists**	**5**
53-3011.00	**Ambulance Drivers and Attendants, Except Emergency Medical Technicians**	**2**
39-3091.00	**Amusement and Recreation Attendants**	**1**
29-1071.01	**Anesthesiologist Assistants**	**5**
19-1011.00	**Animal Scientists**	**5**
39-2011.00	**Animal Trainers**	**2**
19-3091.01	**Anthropologists**	**5**
19-3091.00	**Anthropologists and Archeologists**	**5**
25-1061.00	**Anthropology and Archeology Teachers, Postsecondary**	**5**
13-2021.00	**Appraisers and Assessors of Real Estate**	**4**
13-2021.02	**Appraisers, Real Estate**	**4**
23-1022.00	**Arbitrators, Mediators, and Conciliators**	**5**
19-3091.02	**Archeologists**	**5**
17-1011.00	**Architects, Except Landscape and Naval**	**4**
25-1031.00	**Architecture Teachers, Postsecondary**	**5**
25-4011.00	**Archivists**	**5**
25-1062.00	**Area, Ethnic, and Cultural Studies Teachers, Postsecondary**	**5**
29-1125.01	**Art Therapists**	**5**
25-1121.00	**Art, Drama, and Music Teachers, Postsecondary**	**5**
13-2021.01	**Assessors**	**3**
29-9091.00	**Athletic Trainers**	**5**
19-2021.00	**Atmospheric and Space Scientists**	**4**
27-4011.00	**Audio and Video Equipment Technicians**	**3**
29-1181.00	**Audiologists**	**5**
39-5011.00	**Barbers**	**3**
35-3011.00	**Bartenders**	**2**
49-3091.00	**Bicycle Repairers**	**2**
43-3021.00	**Billing and Posting Clerks**	**2**
43-3021.02	**Billing, Cost, and Rate Clerks**	**2**
43-9111.01	**Bioinformatics Technicians**	**4**
25-1042.00	**Biological Science Teachers, Postsecondary**	**5**

Note. *Unable to determine Job Zone Category
Source: Data for Crosswalk from O*NET OnLine by the U.S. Department of Labor, Employment and Training Administration (USDOL/ETA). Used under the CC BY 4.0 license. O*NET® is a trademark of USDOL/ETA.
*O*NET Bright Outlook Occupations*, accessed November 2019. https://www.onetonline.org/help/bright/
O*NET Online Crosswalk Search, accessed November 2019. https://www.onetonline.org/crosswalk/.

Appendix Table A: Bright Outlook Occupations, O*NET Crosswalk (Cont.)

CODE	OCCUPATION	JOB ZONE RECODE
19-4021.00	**Biological Technicians**	**4**
15-2041.01	**Biostatisticians**	**5**
47-2021.00	**Brickmasons and Blockmasons**	**2**
37-2019.00	**Building Cleaning Workers, All Other**	*****
15-1199.08	**Business Intelligence Analysts**	**4**
25-1011.00	**Business Teachers, Postsecondary**	**5**
27-4031.00	**Camera Operators, Television, Video, and Motion Picture**	**3**
29-2031.00	**Cardiovascular Technologists and Technicians**	**3**
43-5011.00	**Cargo and Freight Agents**	**2**
47-2031.00	**Carpenters**	**2**
17-1021.00	**Cartographers and Photogrammetrists**	**4**
47-2051.00	**Cement Masons and Concrete Finishers**	**1**
35-1011.00	**Chefs and Head Cooks**	**3**
21-1021.00	**Child, Family, and School Social Workers**	**4**
29-1011.00	**Chiropractors**	**5**
19-4061.01	**City and Regional Planning Aides**	**4**
19-2041.01	**Climate Change Analysts**	**5**
15-2041.02	**Clinical Data Managers**	**4**
29-1141.04	**Clinical Nurse Specialists**	**5**
19-3031.02	**Clinical Psychologists**	**5**
19-3031.00	**Clinical, Counseling, and School Psychologists**	**5**
27-2022.00	**Coaches and Scouts**	**4**
35-3021.00	**Combined Food Preparation and Serving Workers, Including Fast Food**	**1**
49-9092.00	**Commercial Divers**	**3**
53-2012.00	**Commercial Pilots**	**3**
43-2099.00	**Communications Equipment Operators, All Other**	*****
21-1099.00	**Community and Social Service Specialists, All Other**	*****
21-1094.00	**Community Health Workers**	**4**
15-1111.00	**Computer and Information Research Scientists**	**5**
11-3021.00	**Computer and Information Systems Managers**	**4**
51-4012.00	**Computer Numerically Controlled Machine Tool Programmers, Metal and Plastic**	**3**
15-1199.00	**Computer Occupations, All Other**	*****
15-1121.00	**Computer Systems Analysts**	**4**
15-1199.02	**Computer Systems Engineers/Architects**	**4**
15-1151.00	**Computer User Support Specialists**	**3**
47-4011.00	**Construction and Building Inspectors**	**3**
47-4099.00	**Construction and Related Workers, All Other**	*****
47-2031.01	**Construction Carpenters**	**2**
47-2061.00	**Construction Laborers**	**2**
11-9021.00	**Construction Managers**	**4**
35-2014.00	**Cooks, Restaurant**	**2**
13-1051.00	**Cost Estimators**	**4**
19-3031.03	**Counseling Psychologists**	**5**
21-1019.00	**Counselors, All Other**	*****
23-2091.00	**Court Reporters**	**3**
13-2071.00	**Credit Counselors**	**4**
25-1111.00	**Criminal Justice and Law Enforcement Teachers, Postsecondary**	**5**
29-1141.03	**Critical Care Nurses**	**3**
25-4012.00	**Curators**	**5**
29-2011.01	**Cytogenetic Technologists**	**4**
29-2011.02	**Cytotechnologists**	**5**

Note. *Unable to determine Job Zone Category
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*O*NET Bright Outlook Occupations*, accessed November 2019. https://www.onetonline.org/help/bright/
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Appendix Table A: Bright Outlook Occupations, O*NET Crosswalk (Cont.)

CODE	OCCUPATION	JOB ZONE RECODE
15-1199.07	**Data Warehousing Specialists**	**4**
15-1141.00	**Database Administrators**	**4**
15-1199.06	**Database Architects**	**4**
31-9091.00	**Dental Assistants**	**3**
29-2021.00	**Dental Hygienists**	**3**
51-9081.00	**Dental Laboratory Technicians**	**2**
29-1021.00	**Dentists, General**	**5**
29-1069.02	**Dermatologists**	**5**
47-5011.00	**Derrick Operators, Oil and Gas**	**1**
29-2032.00	**Diagnostic Medical Sonographers**	**3**
29-1031.00	**Dietitians and Nutritionists**	**5**
35-9011.00	**Dining Room and Cafeteria Attendants and Bartender Helpers**	**1**
11-9039.01	**Distance Learning Coordinators**	**5**
15-1199.12	**Document Management Specialists**	**4**
47-5021.00	**Earth Drillers, Except Oil and Gas**	**2**
25-1063.00	**Economics Teachers, Postsecondary**	**5**
19-3011.00	**Economists**	**5**
11-9039.00	**Education Administrators, All Other**	*****
11-9033.00	**Education Administrators, Postsecondary**	**5**
11-9031.00	**Education Administrators, Preschool and Childcare Center/Program**	**4**
25-1081.00	**Education Teachers, Postsecondary**	**5**
21-1012.00	**Educational, Guidance, School, and Vocational Counselors**	**5**
49-9051.00	**Electrical Power-Line Installers and Repairers**	**3**
47-2111.00	**Electricians**	**3**
47-4021.00	**Elevator Installers and Repairers**	**3**
29-2041.00	**Emergency Medical Technicians and Paramedics**	**3**
31-9099.02	**Endoscopy Technicians**	**3**
41-3099.01	**Energy Brokers**	**4**
25-1032.00	**Engineering Teachers, Postsecondary**	**5**
19-3011.01	**Environmental Economists**	**5**
17-3025.00	**Environmental Engineering Technicians**	**4**
19-2041.02	**Environmental Restoration Planners**	**5**
19-4091.00	**Environmental Science and Protection Technicians, Including Health**	**4**
19-2041.00	**Environmental Scientists and Specialists, Including Health**	**4**
53-7032.00	**Excavating and Loading Machine and Dragline Operators**	**2**
29-1128.00	**Exercise Physiologists**	**5**
47-5099.00	**Extraction Workers, All Other**	*****
29-1062.00	**Family and General Practitioners**	**5**
13-1074.00	**Farm Labor Contractors**	**2**
47-4031.00	**Fence Erectors**	**2**
27-4032.00	**Film and Video Editors**	**3**
43-3099.00	**Financial Clerks, All Other**	*****
13-2061.00	**Financial Examiners**	**4**
11-3031.00	**Financial Managers**	*****
11-3031.02	**Financial Managers, Branch or Department**	**4**
47-1011.00	**First-Line Supervisors of Construction Trades and Extraction Workers**	**3**
35-1012.00	**First-Line Supervisors of Food Preparation and Serving Workers**	**2**
37-1011.00	**First-Line Supervisors of Housekeeping and Janitorial Workers**	**2**
37-1012.00	**First-Line Supervisors of Landscaping, Lawn Service, and Groundskeeping Workers**	**3**
39-1021.00	**First-Line Supervisors of Personal Service Workers**	**3**
11-9039.02	**Fitness and Wellness Coordinators**	**4**

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Appendix Table A: Bright Outlook Occupations, O*NET Crosswalk (Cont.)

CODE	OCCUPATION	JOB ZONE RECODE
39-9031.00	**Fitness Trainers and Aerobics Instructors**	**3**
53-2031.00	**Flight Attendants**	**3**
47-2042.00	**Floor Layers, Except Carpet, Wood, and Hard Tiles**	**2**
47-2043.00	**Floor Sanders and Finishers**	**2**
35-9099.00	**Food Preparation and Serving Related Workers, All Other**	*****
35-2021.00	**Food Preparation Workers**	**1**
35-3041.00	**Food Servers, Nonrestaurant**	**1**
11-9051.00	**Food Service Managers**	**2**
25-1124.00	**Foreign Language and Literature Teachers, Postsecondary**	**5**
19-4092.00	**Forensic Science Technicians**	**4**
33-2022.00	**Forest Fire Inspectors and Prevention Specialists**	**3**
43-5011.01	**Freight Forwarders**	**2**
13-1131.00	**Fundraisers**	**4**
11-9071.00	**Gaming Managers**	**3**
39-1011.00	**Gaming Supervisors**	**2**
11-1021.00	**General and Operations Managers**	**4**
29-9092.00	**Genetic Counselors**	**5**
15-1199.05	**Geographic Information Systems Technicians**	**4**
19-4041.00	**Geological and Petroleum Technicians**	**4**
19-4041.02	**Geological Sample Test Technicians**	**4**
19-4041.01	**Geophysical Data Technicians**	**4**
15-1199.04	**Geospatial Information Scientists and Technologists**	**4**
47-2121.00	**Glaziers**	**2**
39-5012.00	**Hairdressers, Hairstylists, and Cosmetologists**	**3**
47-4041.00	**Hazardous Materials Removal Workers**	**3**
29-1199.00	**Health Diagnosing and Treating Practitioners, All Other**	**5**
21-1091.00	**Health Educators**	**4**
25-1071.00	**Health Specialties Teachers, Postsecondary**	**5**
29-2099.00	**Health Technologists and Technicians, All Other**	**3**
29-9099.00	**Healthcare Practitioners and Technical Workers, All Other**	*****
21-1022.00	**Healthcare Social Workers**	**5**
31-9099.00	**Healthcare Support Workers, All Other**	**3**
29-2092.00	**Hearing Aid Specialists**	**3**
49-9021.01	**Heating and Air Conditioning Mechanics and Installers**	**3**
49-9021.00	**Heating, Air Conditioning, and Refrigeration Mechanics and Installers**	**3**
47-3019.00	**Helpers, Construction Trades, All Other**	*****
47-3011.00	**Helpers--Brickmasons, Blockmasons, Stonemasons, and Tile and Marble Setters**	**2**
47-3012.00	**Helpers--Carpenters**	**2**
47-3013.00	**Helpers--Electricians**	**2**
47-5081.00	**Helpers--Extraction Workers**	**2**
49-9098.00	**Helpers--Installation, Maintenance, and Repair Workers**	**2**
47-3015.00	**Helpers--Pipelayers, Plumbers, Pipefitters, and Steamfitters**	**2**
51-9198.00	**Helpers--Production Workers**	**2**
47-3016.00	**Helpers--Roofers**	**2**
29-2011.03	**Histotechnologists and Histologic Technicians**	**3**
31-1011.00	**Home Health Aides**	**2**
29-1069.03	**Hospitalists**	**5**
35-9031.00	**Hosts and Hostesses, Restaurant, Lounge, and Coffee Shop**	**2**
17-2112.01	**Human Factors Engineers and Ergonomists**	**5**
11-3121.00	**Human Resources Managers**	**4**
19-2043.00	**Hydrologists**	**5**

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Appendix Table A: Bright Outlook Occupations, O*NET Crosswalk (Cont.)

CODE	OCCUPATION	JOB ZONE RECODE
19-2041.03	**Industrial Ecologists**	**5**
17-2112.00	**Industrial Engineers**	**4**
19-3032.00	**Industrial-Organizational Psychologists**	**5**
15-1121.01	**Informatics Nurse Specialists**	**4**
15-1122.00	**Information Security Analysts**	**4**
15-1199.09	**Information Technology Project Managers**	**4**
47-2132.00	**Insulation Workers, Mechanical**	**2**
41-3021.00	**Insurance Sales Agents**	**4**
27-3091.00	**Interpreters and Translators**	**4**
37-2011.00	**Janitors and Cleaners, Except Maids and Housekeeping Cleaners**	**2**
37-3011.00	**Landscaping and Groundskeeping Workers**	**1**
25-1112.00	**Law Teachers, Postsecondary**	**5**
29-2061.00	**Licensed Practical and Licensed Vocational Nurses**	**3**
19-4099.00	**Life, Physical, and Social Science Technicians, All Other**	*****
33-9092.00	**Lifeguards, Ski Patrol, and Other Recreational Protective Service Workers**	**2**
13-2071.01	**Loan Counselors**	**4**
43-4131.00	**Loan Interviewers and Clerks**	**3**
13-2072.00	**Loan Officers**	**3**
39-3093.00	**Locker Room, Coatroom, and Dressing Room Attendants**	**2**
29-1122.01	**Low Vision Therapists, Orientation and Mobility Specialists, and Vision Rehabilitation Therapists**	**5**
29-2035.00	**Magnetic Resonance Imaging Technologists**	**3**
39-5091.00	**Makeup Artists, Theatrical and Performance**	**3**
13-1111.00	**Management Analysts**	**5**
39-5092.00	**Manicurists and Pedicurists**	**2**
17-2121.02	**Marine Architects**	**4**
17-2121.01	**Marine Engineers**	**4**
17-2121.00	**Marine Engineers and Naval Architects**	**4**
13-1161.00	**Market Research Analysts and Marketing Specialists**	**4**
11-2021.00	**Marketing Managers**	**4**
21-1013.00	**Marriage and Family Therapists**	**5**
31-9011.00	**Massage Therapists**	**3**
15-2021.00	**Mathematicians**	**5**
49-9011.00	**Mechanical Door Repairers**	**2**
27-3099.00	**Media and Communication Workers, All Other**	*****
29-2012.00	**Medical and Clinical Laboratory Technicians**	**3**
29-2011.00	**Medical and Clinical Laboratory Technologists**	**4**
11-9111.00	**Medical and Health Services Managers**	**5**
51-9082.00	**Medical Appliance Technicians**	**3**
31-9092.00	**Medical Assistants**	**3**
31-9093.00	**Medical Equipment Preparers**	**2**
29-2071.00	**Medical Records and Health Information Technicians**	**3**
19-1042.00	**Medical Scientists, Except Epidemiologists**	**5**
43-6013.00	**Medical Secretaries**	**3**
13-1121.00	**Meeting, Convention, and Event Planners**	**4**
21-1023.00	**Mental Health and Substance Abuse Social Workers**	**5**
21-1014.00	**Mental Health Counselors**	**5**
29-9099.01	**Midwives**	**4**
49-9044.00	**Millwrights**	**2**
53-3099.00	**Motor Vehicle Operators, All Other**	*****
49-3052.00	**Motorcycle Mechanics**	**3**

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Appendix Table A: Bright Outlook Occupations, O*NET Crosswalk (Cont.)

CODE	OCCUPATION	JOB ZONE RECODE
25-4013.00	**Museum Technicians and Conservators**	**4**
29-1125.02	**Music Therapists**	**4**
29-1199.04	**Naturopathic Physicians**	**5**
29-2099.01	**Neurodiagnostic Technologists**	**5**
29-1069.04	**Neurologists**	**5**
19-3039.01	**Neuropsychologists and Clinical Neuropsychologists**	**5**
39-2021.00	**Nonfarm Animal Caretakers**	**2**
29-1069.05	**Nuclear Medicine Physicians**	**5**
29-2033.00	**Nuclear Medicine Technologists**	**3**
29-1151.00	**Nurse Anesthetists**	**5**
29-1161.00	**Nurse Midwives**	**5**
29-1171.00	**Nurse Practitioners**	**5**
31-1014.00	**Nursing Assistants**	**2**
25-1072.00	**Nursing Instructors and Teachers, Postsecondary**	**5**
29-9012.00	**Occupational Health and Safety Technicians**	**3**
29-1122.00	**Occupational Therapists**	**5**
31-2012.00	**Occupational Therapy Aides**	**3**
31-2011.00	**Occupational Therapy Assistants**	**3**
47-2073.00	**Operating Engineers and Other Construction Equipment Operators**	**2**
15-2031.00	**Operations Research Analysts**	**5**
51-9083.00	**Ophthalmic Laboratory Technicians**	**2**
29-2057.00	**Ophthalmic Medical Technicians**	**3**
29-2099.05	**Ophthalmic Medical Technologists**	**3**
29-1069.06	**Ophthalmologists**	**5**
29-2081.00	**Opticians, Dispensing**	**3**
29-1041.00	**Optometrists**	**5**
29-1022.00	**Oral and Maxillofacial Surgeons**	**5**
29-1023.00	**Orthodontists**	**5**
29-1199.05	**Orthoptists**	**5**
29-2091.00	**Orthotists and Prosthetists**	**5**
23-2011.00	**Paralegals and Legal Assistants**	**3**
29-1069.07	**Pathologists**	**5**
47-2071.00	**Paving, Surfacing, and Tamping Equipment Operators**	**2**
39-9021.00	**Personal Care Aides**	**2**
39-9099.00	**Personal Care and Service Workers, All Other**	**
13-2052.00	**Personal Financial Advisors**	**4**
37-2021.00	**Pest Control Workers**	**2**
37-3012.00	**Pesticide Handlers, Sprayers, and Applicators, Vegetation**	**2**
29-2052.00	**Pharmacy Technicians**	**3**
25-1126.00	**Philosophy and Religion Teachers, Postsecondary**	**5**
31-9097.00	**Phlebotomists**	**3**
29-1069.08	**Physical Medicine and Rehabilitation Physicians**	**5**
31-2022.00	**Physical Therapist Aides**	**2**
31-2021.00	**Physical Therapist Assistants**	**3**
29-1123.00	**Physical Therapists**	**5**
29-1071.00	**Physician Assistants**	**5**
29-1069.00	**Physicians and Surgeons, All Other**	**5**
19-2012.00	**Physicists**	**5**
25-1054.00	**Physics Teachers, Postsecondary**	**5**
47-2072.00	**Pile-Driver Operators**	**2**
47-2152.01	**Pipe Fitters and Steamfitters**	**3**

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Appendix Table A: Bright Outlook Occupations, O*NET Crosswalk (Cont.)

CODE	OCCUPATION	JOB ZONE RECODE
47-2151.00	**Pipelayers**	**2**
47-2152.02	**Plumbers**	**3**
47-2152.01	**Plumbers, Pipefitters, and Steamfitters**	**3**
25-1065.00	**Political Science Teachers, Postsecondary**	**5**
19-4099.02	**Precision Agriculture Technicians**	**4**
25-2011.00	**Preschool Teachers, Except Special Education**	**3**
29-1069.09	**Preventive Medicine Physicians**	**5**
33-9021.00	**Private Detectives and Investigators**	**3**
11-9141.00	**Property, Real Estate, and Community Association Managers**	**4**
29-1024.00	**Prosthodontists**	**5**
31-1013.00	**Psychiatric Aides**	**2**
29-2053.00	**Psychiatric Technicians**	**3**
29-1066.00	**Psychiatrists**	**5**
19-3039.00	**Psychologists, All Other**	**5**
25-1066.00	**Psychology Teachers, Postsecondary**	**5**
11-2031.00	**Public Relations and Fundraising Managers**	**4**
53-7072.00	**Pump Operators, Except Wellhead Pumpers**	**2**
19-4099.01	**Quality Control Analysts**	**3**
29-1124.00	**Radiation Therapists**	**3**
29-2099.06	**Radiologic Technicians**	**3**
29-2034.00	**Radiologic Technologists**	**3**
29-1069.10	**Radiologists**	**5**
47-4061.00	**Rail-Track Laying and Maintenance Equipment Operators**	**2**
41-9021.00	**Real Estate Brokers**	**4**
41-9022.00	**Real Estate Sales Agents**	**3**
39-9032.00	**Recreation Workers**	**4**
29-1125.00	**Recreational Therapists**	**4**
49-3092.00	**Recreational Vehicle Service Technicians**	**2**
49-9021.02	**Refrigeration Mechanics and Installers**	**3**
53-7081.00	**Refuse and Recyclable Material Collectors**	**2**
29-1141.00	**Registered Nurses**	**3**
21-1015.00	**Rehabilitation Counselors**	**5**
47-2171.00	**Reinforcing Iron and Rebar Workers**	**2**
19-4099.03	**Remote Sensing Technicians**	**4**
39-9041.00	**Residential Advisors**	**3**
29-1126.00	**Respiratory Therapists**	**3**
47-2181.00	**Roofers**	**2**
47-5012.00	**Rotary Drill Operators, Oil and Gas**	**2**
47-2031.02	**Rough Carpenters**	**2**
47-5071.00	**Roustabouts, Oil and Gas**	**1**
41-3099.00	**Sales Representatives, Services, All Other**	**4**
19-3031.01	**School Psychologists**	**5**
15-1199.10	**Search Marketing Strategists**	**4**
49-2098.00	**Security and Fire Alarm Systems Installers**	**3**
47-4091.00	**Segmental Pavers**	**2**
25-3021.00	**Self-Enrichment Education Teachers**	**3**
47-4071.00	**Septic Tank Servicers and Sewer Pipe Cleaners**	**1**
47-5013.00	**Service Unit Operators, Oil, Gas, and Mining**	**2**
39-5093.00	**Shampooers**	**2**
47-2211.00	**Sheet Metal Workers**	**2**
39-5094.00	**Skincare Specialists**	**3**

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Appendix Table A: Bright Outlook Occupations, O*NET Crosswalk (Cont.)

CODE	OCCUPATION	JOB ZONE RECODE
39-1012.00	**Slot Supervisors**	**2**
11-9151.00	**Social and Community Service Managers**	**4**
21-1093.00	**Social and Human Service Assistants**	**4**
19-4061.00	**Social Science Research Assistants**	**4**
25-1113.00	**Social Work Teachers, Postsecondary**	**5**
19-3041.00	**Sociologists**	**5**
15-1132.00	**Software Developers, Applications**	**4**
15-1133.00	**Software Developers, Systems Software**	**4**
15-1199.01	**Software Quality Assurance Engineers and Testers**	**4**
19-1013.00	**Soil and Plant Scientists**	**5**
47-1011.03	**Solar Energy Installation Managers**	**3**
47-2231.00	**Solar Photovoltaic Installers**	**3**
47-4099.02	**Solar Thermal Installers and Technicians**	**3**
39-1021.01	**Spa Managers**	**3**
25-2059.00	**Special Education Teachers, All Other**	*****
25-2051.00	**Special Education Teachers, Preschool**	**5**
29-1127.00	**Speech-Language Pathologists**	**5**
31-9099.01	**Speech-Language Pathology Assistants**	**3**
29-1069.11	**Sports Medicine Physicians**	**5**
43-3021.01	**Statement Clerks**	**2**
43-9111.00	**Statistical Assistants**	**4**
15-2041.00	**Statisticians**	**5**
47-2022.00	**Stonemasons**	**3**
47-2221.00	**Structural Iron and Steel Workers**	**2**
21-1011.00	**Substance Abuse and Behavioral Disorder Counselors**	**5**
29-2099.07	**Surgical Assistants**	**3**
29-2055.00	**Surgical Technologists**	**3**
53-3041.00	**Taxi Drivers and Chauffeurs**	**2**
27-3042.00	**Technical Writers**	**4**
47-2053.00	**Terrazzo Workers and Finishers**	**2**
29-1129.00	**Therapists, All Other**	*****
47-2044.00	**Tile and Marble Setters**	**2**
39-7011.00	**Tour Guides and Escorts**	**3**
11-3131.00	**Training and Development Managers**	**4**
13-1151.00	**Training and Development Specialists**	**4**
53-6099.00	**Transportation Workers, All Other**	*****
39-7012.00	**Travel Guides**	**3**
11-3031.01	**Treasurers and Controllers**	**5**
37-3013.00	**Tree Trimmers and Pruners**	**2**
19-3051.00	**Urban and Regional Planners**	**5**
29-1069.12	**Urologists**	**5**
29-1131.00	**Veterinarians**	**5**
31-9096.00	**Veterinary Assistants and Laboratory Animal Caretakers**	**3**
29-2056.00	**Veterinary Technologists and Technicians**	**3**
15-1199.11	**Video Game Designers**	**4**
35-3031.00	**Waiters and Waitresses**	**2**
47-4099.03	**Weatherization Installers and Technicians**	**2**
15-1199.03	**Web Administrators**	**4**
15-1134.00	**Web Developers**	**3**
49-9081.00	**Wind Turbine Service Technicians**	**3**

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Appendix B: PIAAC Literacy Skills by Level of Educational Attainment, Population 16–34, 2012/2014

National Center for Education Statistics (NCES)
Institute of Education Sciences (IES®)
Program for the International Assessment of Adult Competencies (PIAAC)
This report was generated using the U.S. PIAAC International Data Explorer. https://nces.ed.gov/surveys/piaac/ideuspiaac

Appendix Table B: PIAAC Literacy Skills by Level of Educational Attainment, Population 16–34, 2012/2014 (Standard Errors in Parentheses)

EDUCATION - HIGHEST QUALIFICATION - LEVEL	BELOW LEVEL 1		LEVEL 1		LEVEL 2		LEVEL 3		LEVEL 4		LEVEL 5	
	%	SE	%	SE	%	SE	%	SE	%	SE	%	SE
Lower secondary or less (ISCED 1,2, 3C short or less)	6	(1.3)	24	(2.4)	42	(2.8)	24	(2.5)	4	(1.4)	‡	†
Upper secondary (ISCED 3A-B, C long)	3	(0.6)	12	(1.3)	38	(2.0)	37	(2.0)	10	(1.3)	1	(0.3)
Postsecondary, nontertiary (ISCED 4A-B-C)	‡	†	9	(2.6)	46	(4.9)	38	(4.4)	7	(2.3)	‡	†
Tertiary - professional degree (ISCED 5B)	‡	†	3	(1.3)	29	(4.2)	51	(4.9)	17	(3.6)	‡	†
Tertiary - bachelor's degree (ISCED 5A)	‡	†	2	(0.8)	16	(1.9)	50	(2.9)	30	(3.0)	2	(0.9)
Tertiary - master's/research degree (ISCED 5A/6)	‡	†	2	(1.3)	11	(3.2)	43	(5.1)	39	(4.5)	6	(2.7)

† Not applicable.

‡ Reporting standards not met.

Note. Detail may not sum to totals because of rounding. Some apparent differences between estimates may not be statistically significant.

Source: U.S. Department of Education, National Center for Education Statistics, Statistics Canada, and Organisation for Economic Co-operation and Development, Programme for the International Assessment of Adult Competencies (PIAAC), PIAAC 2012/2014 Literacy, Numeracy, and Problem Solving TRE Assessment.

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