Digital Skills and Older Workers

Supporting Success in Training and Employment in a Digital World

Ian Hecker, Shayne Spaulding, and Daniel Kuehn

September 2021

The COVID-19 pandemic, which has driven millions of workers and students into remote work and education, has clarified the importance of having access to and the digital skills to operate technology (Hecker and Briggs 2021; Hecker and Loprest 2019; Muro et al. 2017). Digital skills and access have become even more essential in navigating almost every aspect of life, from going to the doctor to buying groceries to attending school. In postsecondary education, the pandemic has accelerated an expansion of online education and training and of employer demand for digital skills that was already underway. It has also elevated the importance of remote work. It has hit older workers especially hard because they face the greatest health risks in working in jobs that cannot be done remotely. Some estimates suggest that the pandemic's negative employment impacts have been concentrated in occupations where remote work is not feasible.[1] Some fields have remained stable or even grown during the pandemic, and the pandemic has likely accelerated the expansion of remote work moving forward.[2] This suggests that the postpandemic recovery may be less accessible to people who do not have the skills or ability to work remotely.

The acceleration of the shift to online and remote learning and working brings new opportunities, but it also brings the potential for further inequities in the labor market. Older workers, a group disproportionately at risk from COVID-19 that also experienced higher increases in long-term unemployment than other workers during the pandemic (Bennett 2021), stand to benefit greatly from the expanded access that online and remote learning and working provides.[3] This is especially true given increasing demand for digital skills in the labor market (Hecker and Briggs 2021; Hecker and Loprest 2019; Muro et. al. 2017). Even before the pandemic, the increasing digitization of work put a premium on digital skills, which were often necessary to participate in training and education; to search and apply for jobs and to succeed in those jobs; and to connect with other supports, social networks, news and information, and public benefits (Hecker and Loprest 2019; Muro et. al. 2017; Robinson et al. 2015).

Many Americans, regardless of age, lack digital skills, and these skill gaps are disproportionately large for individuals facing other barriers such as limited English proficiency, poverty, and limited education (Hecker and Loprest 2019). Any policies and strategies put forth must account for these disparities in addressing digital skills gaps. This study documents some of the barriers and opportunities that exist for older workers accessing online programs, with a focus on their digital skill levels. We define older adults as those who are age 50 or older, and throughout this brief we compare these adults with those younger than 50. We analyze the 2017 Programme for the International Assessment of Adult Competencies (PIAAC) survey to explore the digital skill levels of older workers, and how older workers' race, ethnicity, income, occupation, and other characteristics are associated with digital skill levels. We also analyze American Community Survey (ACS) data to understand how older workers' poverty status and access to broadband, internet, and computers and other devices is associated with digital skill levels. The analysis is complemented by information collected during interviews with leaders of programs to support digital skill training for older adults. We find the following:

- Older Americans have lower levels of digital skills (digital skills score of 257, on average), than younger Americans (digital skills score of 280, on average), and variation by subgroup is substantial. As a reference point, this gap of 23 points is equivalent to about half the gap between an individual who can complete a task by navigating across web pages or applications and someone who cannot.
- Older Americans from historically oppressed groups (i.e., people of color and women) have lower levels of digital skills than older white workers. Among those over 50, white Americans are most likely (18 percent) and Black Americans are least likely (3 percent) to be digitally literate.
- Older Americans who have basic digital skills or who are digitally literate have, on average, higher numeracy and literacy skills than younger Americans, underscoring just some of older workers' assets.
- Older Americans with better computer and internet access have higher levels of digital skills than older Americans who do not, but their digital skills are still lower than younger Americans even when they have access.
- Older workers with more digital skills have significantly higher earnings than those with less and are better positioned to compete for the jobs of the future.

Based on these findings, we offer the following insights:

- Digital skills may be the missing puzzle piece that would allow older Americans to apply the other skills and assets they have to their jobs and other aspects of their lives.
- Closing digital skills gap for older workers could have an especially large payoff for the skills and earnings of older workers from historically oppressed groups.
- Targeted funding and programs are needed to meet the needs of older workers

- Education and training programs serving older workers should consider ways to build confidence, leverage peer learning, assess digital fluency, and teach digital skills in context.
- Older Americans need digital skill training, and targeting efforts to occupations with large gaps of digital skills between older and younger workers and/or occupations with growing demand.

This study fills an important gap in our knowledge of digital skills. It informs the work of policymakers, practitioners, employers, and funders by providing an understanding of older workers' digital skills, the barriers and opportunities this population faces to accessing online programs, and potential strategies that may be used to support success for older workers in education and training programs and in employment.

Data Sources and Methods

This study relies on data from the PIAAC survey and the ACS. Findings from these primary analyses are supplemented with insights from a small number of interviews with program leaders and staff.

We analyzed the PIAAC survey data to understand the level and variation of digital skills for older Americans. The PIAAC measures digital skills through an online assessment of "problem solving in technology-rich environments (PSTRE)," which "measures skills and abilities that are required for solving problems while operating in a technology-rich environment … [by] present[ing] tasks of varying difficulty to be performed in simulated software applications using command and functions commonly found in the technology environments of email, web pages, and spreadsheets."[4]

Survey respondents are assigned a PSTRE score based on their performance on the online assessment. Individual scores are difficult to map on exact skill levels, but PIAAC skill level categories help provide an indication of how significant changes in PSTRE scores are. An individual at PIAAC digital skill Level 1 can use "widely available and familiar technology applications, such as e-mail software or a web browser" but is unable to easily navigate across different pages or applications or accomplish tasks that require multiple steps. A score 50 points higher would move anyone from Level 1 to Level 2. Individuals in Level 2 are able to use both familiar and more novel technology and can navigate across multiple pages or applications. However, they still require explicit direction to solve a problem. Another 50 points would move anyone from Level 2 to Level 3. Individuals at Level 3 can complete tasks without explicit direction and are able to rely on integration and inferential reasoning skills in the technological context. Thus, while the meanings of individual level skill differences are not always well defined in the PIAAC, score differences of about 50 points represent significant and observable steps up in digital skills.

The PIAAC also includes a group of individuals who did not take the PSTRE assessment because they indicated they had no computer experience, failed a basic digital skill screening test, refused to take the PSTRE,[5] or did not participate in the PSTRE for either a literacy-related reason (being unable to speak or read the test language, having difficulty reading or writing, or having a learning or mental disability) or an unknown reason.[6] Those in the latter group were dropped because of small sample size.

Table 1 shows the categories used in this brief when discussing findings from the PIAAC, except when discussing occupation-level findings.[7] We assume that those who do not take the PISTRE for reasons other than literacy related reason have no digital skills. Those with Level 1 or lower are categorized as having only basic digital skills. For our analysis, those with digital skills of Levels 2 and 3 are combined and considered digitally literate.

TABLE 1

Categories of Digital Skills Use in the Brief

Category	Definition	Example
No digital skills	Those who did not take the PSTRE because they had no computer experience, failed the basic digital skill screening test, or refused to take the PSTRE.[a]	
Basic digital skills	Those with average score values of 0 to 290, combining PIAAC Level 1 (score values 241 to 290) and below PIAAC Level 1 (score values 0 to 240)	Can use "widely available and familiar technology applications, such as email software or a web browser" that does not require navigation across multiple pages of a web browser or using an application such as email in tandem.
Digitally literate	Those with average score values of 291 to 500, combining PIAAC Level 2 (score values 291 to 340) and PIAAC Level 3 (score values 341 to 500)	At Level 2, being able to navigate across multiple pages of a web browser and use an application such as email in tandem. At Level 3, being able to use a sort function to solve a problem in a spreadsheet, or schedule a meeting using a new-to-the-user web application with multiple constraints, including booked rooms and conflicting schedules.

Source: Authors' framework.
Note:
[a] Just under half, or 45.1 percent, of those in the "no digital skills" category refused to take the PSTRE assessment via computer. It is possible that some of these individuals may have had digital skills. However, as is described by Mamedova et. al. (2018), it is not possible to distinguish other reasons for not taking the computer-based assessment from digital literacy reasons, and so all respondents who refused to take the assessment on a computer are classified as having no digital skills.

We also drew on the ACS, a nationally representative household survey conducted annually by the US Census Bureau, to leverage its' data on poverty and on access to the internet and access to technology devices, including laptops, desktops, smart phones, tablets, or other wireless computers. For these analyses, we used information from the PIAAC to predict average digital skill scores for groups of respondents in the ACS. These analyses are reported in terms of scores, rather than the levels above, because of data limitations.[8] Finally, we conducted **six interviews** with leaders of programs that support digital learning for older adults. These interviews explore challenges organizations are facing in supporting this population, promising strategies, and lessons to improve programming moving forward. Interviewees were selected with input from the AARP Foundation and were chosen to reflect diverse settings, service populations, and geographies. The interviews were semistructured and conducted virtually in spring 2021.

Context

As a result of increases in life expectancy, improvements in physical health, decreases in the number of physically demanding jobs, and increases in the Social Security retirement age, Americans are working longer, and older workers have become a significantly larger percentage of total jobseekers (Butrica and Mudrazija 2021; Wandner, Balducchi, and O'Leary 2015, 2018). Older workers who change jobs do so for a variety of reasons (Wandner, Balducchi, and O'Leary 2018). They may slowly transition to retirement by decreasing hours worked, they may leave manual labor jobs because of aging, they may retire and then reenter the labor force, or they may seek better compensation or benefits or more flexible hours (Johnson, Kawachi, and Lewis 2009; Nanda, Gasperini, and Patterson 2016). When they seek new jobs (whether voluntarily or involuntarily), older workers' earnings losses are greater, and the duration of time it takes them to find a new job is longer than for prime-age workers (Wandner, Balducchi, and O'Leary 2018). Understanding this context is important for supporting older workers, but there are additional challenges and opportunities related to supporting older workers in education and training and the labor market.

The Unique Assets that Older Workers Bring

Older workers bring many assets to the workplace (including specialized knowledge and skills developed through experience), so they are often well positioned to serve as leaders for other staff. Older workers' skills include both technical and occupational skills as well as interpersonal and "employability" skills that help them succeed in the workforce. Further, older workers who return to the labor force after an involuntary job separation have higher retention rates and longer tenures than younger workers (Wandner, Balducchi, and O'Leary 2018), which should be appealing for employers. Digital skill gaps may serve as a barrier to older Americans fully applying these existing skill sets in the context of work (Kakulla 2021), although the majority of older workers report that they are eager to learn new digital skills.[9]

Challenges with Access to Technology

Existing research finds that the lower rates of broadband service adoption, technology access, and digital skills are concentrated among people who are older, historically oppressed (e.g., Black, Latinx, or Indigenous), less educated, and less affluent, as well as those residing in rural areas (Council of Economic Advisers 2015). It is critical to acknowledge that structural barriers exist that prevent these groups from gaining access and digital skills, including the price of broadband and physical network gaps in broadband infrastructure (Tomer and Fishbane 2020), two barriers that disproportionately affect rural communities (although many low- income households also lack access to technology). These discrepancies in the access and use of technology at school and home create inequities that start early in life.[10]

Challenges with Digital Skills

As this brief explores, access to online programs and remote work is also dependent on digital skills. Because many older workers simply did not grow up using and adapting to newer technologies, a lack of confidence in technology is an often-cited reason why older workers tend to have lower digital skills (Hunsaker et al. 2019; Quan-Haase et al. 2018). Fear of digital crime or having sensitive information compromised is another related reason older people may choose not to use computers or smart phones as frequently as younger people (Moroney and Jarvis 2020). The COVID-19 pandemic has forced many older people to use technology to interact with family and engage in other social events, closing the gap on some of these hesitancies and fears.

Ageism in the Labor Market

Despite the Age Discrimination in Employment Act, which was passed in 1967 and prohibits employment discrimination against people 40 years of age or older, older Americans continue to face discrimination in the labor market (Employment and Training Administration 2008; Lipnic 2018). Even with research that finds age does not predict productivity, ageist stereotypes persist. In a 2020 AARP survey of adults over 45 years old, 78 percent of respondents indicated that they have observed or experienced age discrimination in the workplace, a significant increase from the 61 percent who reported observing or experience discrimination in 2017. Of those who reported discrimination, 38 percent report that it is very common.[11]

The stereotype that all older workers are not as fluent or comfortable with technology as young people is a significant barrier to employment. Employers often act on this bias by assuming that older workers lack digital skills or by making other discriminatory decisions (research suggests that employers overestimate the costs associated with hiring older workers and underestimate the benefits; see Employment and Training Administration 2008). This leads to employers hesitating to hire or promote older workers, and this can lead older workers to internalize the notion that they cannot acquire digital skills (Losh 2013).

Meeting the Training and Employment Needs of Older Workers

Because workers are remaining in the labor market longer than in the past, older workers are an important population to consider in the design of workforce programs and services. Yet there is limited focus on older workers in the public workforce system. The Senior Community Service Employment Program is the only public workforce program serving older workers exclusively.[12] Furthermore, a 2008 study task force on aging report convened by the US Department of Labor finds that older workers are less likely to receive job training than younger workers (Employment and Training Administration 2008). There are opportunities to improve and expand services to older workers in the public workforce system, especially when it comes to digital skills and access.

Findings

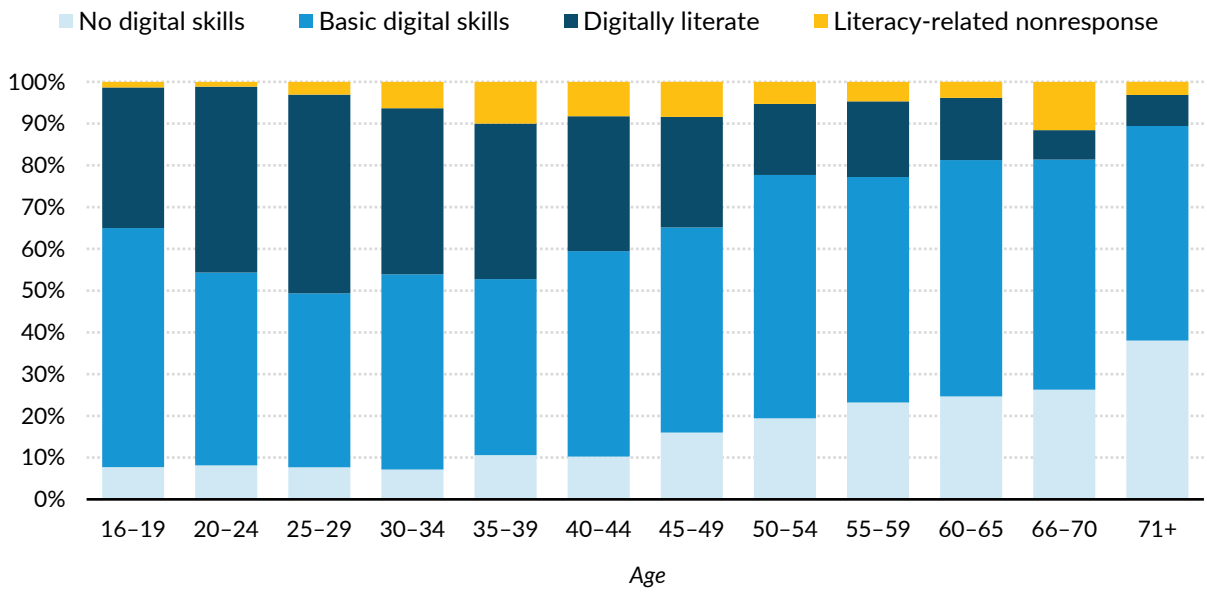
In this section we describe findings from the data analysis. Although this analysis finds that Americans age 50 or over have lower levels of digital skills, in general, than Americans under age 50, we find that there is substantial variation within subgroups of Americans (namely, historically oppressed or disadvantaged groups tend to have lower levels of digital skills). We also find that higher digital skill levels are associated with higher earnings, especially for older Americans, and that older Americans, who as a whole score lower on the PIAAC in numeracy and literacy skills than younger Americans, actually score higher than younger Americans when the sample is limited to those with higher digital skill levels.

Over Half of Older Americans Have Basic Digital Skills, but Older Americans Have Lower Levels of Digital Skills, On Average, Than Younger Americans

Older Americans have lower digital skills than younger workers (digital skills scores of 257 versus 280, on average, respectively). As a reference point, this gap of 23 points is equivalent to about half the gap between an individual who can complete a task by navigating across web pages or applications and someone who cannot. Looking across smaller age categories, the figure below shows that the share of digitally literate Americans increases by age group from 16 to 29 and then decreases starting at 30.[13] Therefore, contrary to stereotypes about young adults being more digitally fluent than older adults, the youngest cohort of Americans responding to the PIAAC are not the most digitally literate. Digital skills are acquired over time: the share of Americans with no digital skills[14] fluctuates between 7 and 8 percent from ages 16 to 34 and then begins to increase at age 35. The share of Americans with basic digital skills[15] decreases between age groups 16–19 and 25–29, then begins to steadily increase after age 40. Digital skills may be important for different reasons among older Americans. For instance, for those who are ages 50 to 65, digital skills may be important for moving up or to new occupations in the labor market, but for those who are older (age 65 and up), digital skills may be important for social connectivity, particularly during the pandemic, and for accessing key services. It should be noted, however, that many Americans work past the "traditional" age of retirement.

FIGURE 1

Digital Skills by Age



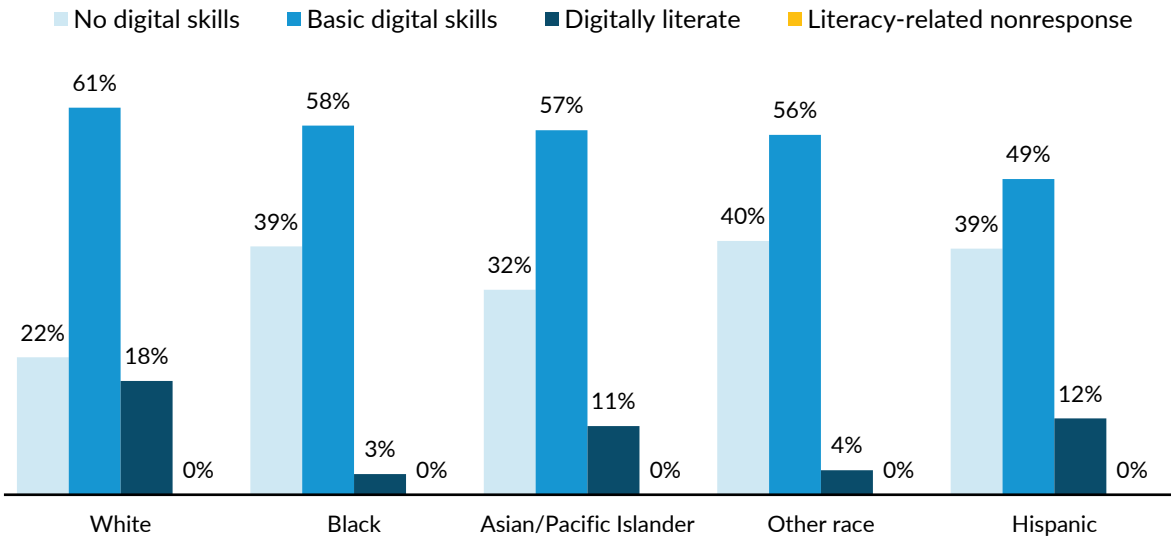
Source: Author calculations using data from the Programme for the International Assessment of Adult Competencies.

Historically Oppressed Groups Have Lower Levels of Digital Skills

Among those over age 50, white Americans are most likely (18 percent),[16] and Black Americans least likely (3 percent),[17] to be digitally literate. White Americans are least likely (22 percent)[18] to have no digital skills. Black Americans and Hispanic Americans are much more likely to have no digital skills (39 percent).[19] The digital skill gaps for Black Americans persist for those younger than age 50. Among those under age 50, Black Americans are least likely (17 percent)[20] to be digitally literate. It is important to note that within each of these subgroups there can be wide variation, with some individuals having high digital skill scores and others having very low scores.[21]

FIGURE 2

Digital Skills by Race and Ethnicity among Adults Age 50 and Older

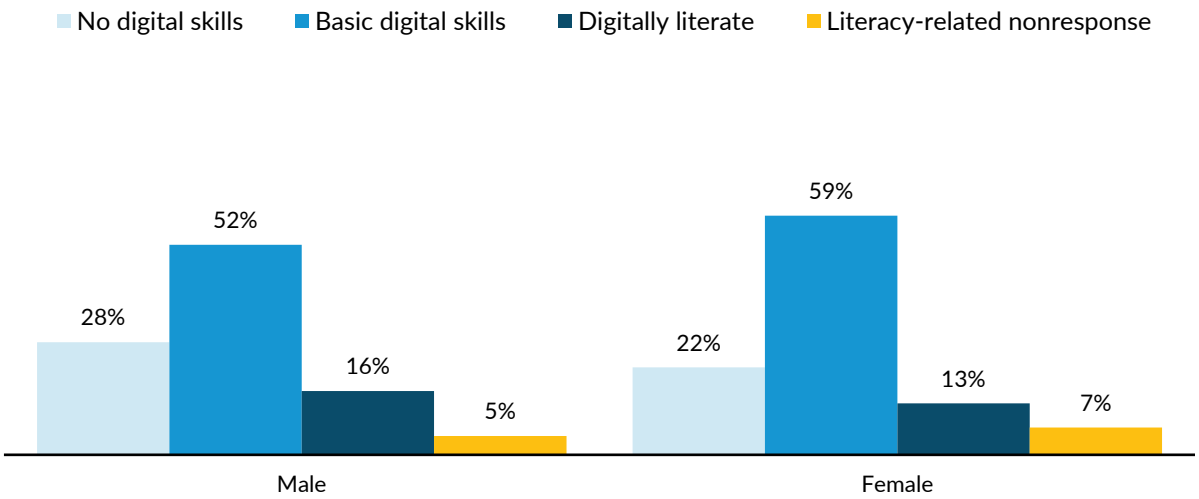


Source: Author calculations using data from the Programme for the International Assessment of Adult Competencies.
Notes: There is also a "missing race or ethnicity" category that is omitted from this graph. Ninety-three percent of those whose reported race/ethnicity was "missing" were also missing a digital level because of literacy-related nonresponse.

Older men are more likely (16 percent) than older women (13 percent) to be digitally literate,[22] but they are also more likely (28 percent) to have no digital skills than older women (22 percent).[23] This trend also exists for those under age 50 (not shown), where men are more likely (40 percent) to be digitally literate than women (35 percent),[24] but men are also more likely than women to have no digital skills (11 versus 9 percent, respectively).[25]

FIGURE 3

Digital Skills by Gender among Adults Age 50 and Older



Source: Author calculations using data from the Programme for the International Assessment of Adult Competencies.

As seen in table 2, older immigrants (42 percent) are far more likely to have no digital skills than older nonimmigrants (22 percent).[26] For those under age 50, the gap is smaller: 19 percent of immigrants have no digital skills compared with 8 percent of nonimmigrants. However, older immigrants are only slightly less likely to have basic digital skills (49 percent) than older nonimmigrants (56 percent), and for those under age 50, immigrants are actually more likely to have basic digital skills (53 percent) than nonimmigrants (46 percent).[27]

For both older and younger Americans, this analysis finds that, in general, the higher one's level of educational attainment, the more likely one is to be digitally literate and the less likely one is to have no digital skills (table 2). For older Americans, 80 percent who indicated their highest level of education as "primary or less" have no digital skills, while just 7 percent with more than a bachelor's degree had no digital skills, and nearly 40 percent at that level were digitally literate.[28]

TABLE 2

Digital Score and Immigration, Education, and MSA Status

Percentage

	Under Age 50			Age 50 or Older		
	No digital skills	Basic digital skills	Digitally literate	No digital skills	Basic digital skills	Digitally literate
Immigration status						
Is not an immigrant	8	46	39	22	56	15
Is an immigrant	19	53	28	42	49	9
Highest level of education						
Primary or less	48	52	0	80	20	0
Middle school	18	58	24	67	33	0
High school	12	58	31	36	59	5
Certificate program	7	69	24	15	76	9
Associate's degree	9	53	38	14	70	16
Bachelor's degree	6	29	65	9	62	29
More than a bachelor's degree	3	33	63	7	55	38
MSA status						
Non-MSA resident	11	57	29	33	56	10
MSA resident	9	47	38	22	53	14
MSA-suburban resident	9	41	42	20	57	18

Source: Author calculations of Programme for the International Assessment of Adult Competencies data.
Note: MSA = metropolitan statistical area.

Older Americans in Rural Areas Tend to Have Lower Levels of Digital Skills

Older Americans living outside metropolitan statistical areas are less likely (10 percent) to be digitally literate than those living in urban (14 percent) or suburban (18 percent) regions of a metropolitan statistical area.[29] Older Americans not living in metropolitan statistical areas are also more likely to have no digital skills (33 percent) than those in urban (22 percent) or suburban (20 percent) communities.[30] This pattern persists for Americans under the age of 50 and is seen in other work on education deserts as well (Rosenboom and Blagg 2018). This may reflect better access to the internet

and to digital technologies in urban and suburban communities than in rural communities. This makes clear the need for digital skills and access to technology in rural and other non–metropolitan statistical area communities because, particularly during the pandemic, rural dwellers need to connect to education, health care services, training, and work.

Access to Internet and Technology Is Key to Building Digital Skills

Those with a subscription to an internet service; who have access to broadband internet; and who own a laptop, desktop, or smartphone have higher digital skills than those without access to these technologies.[31] Score differences between younger and older workers based on technology and internet access is around 30 points for each subgroup in table 3. As a reminder, this gap of 30 points is more than half the gap between an individual who can complete a task by navigating across web pages or applications and someone who cannot. Access to devices and to the internet is key for learning and practicing digital skills. Score differences between younger and older workers based on technology and internet access is around 30 points for each subgroup below. As a reminder, this gap of 30 points is more than half the gap between an individual who can complete a task by navigating across web pages or applications and someone who cannot.

TABLE 3

Digital Score and Internet/Device Access

	Under age 50	Age 50 or older
Internet		
Has subscription to an internet service	269	239
Does not have internet access	253	223
Has broadband (high speed) internet service	270	240
Does not have broadband (high speed) internet service	261	234
Devices		
Indicated presence of a laptop, desktop, or notebook computer	270	239
Indicated no presence of a laptop, desktop, or notebook computer	254	225
Indicated presence of a smartphone	268	239
Indicated no presence of a smartphone	256	227

Source: Author calculations using data from the Programme for the International Assessment of Adult Competencies (PIAAC) and America Community Survey (ACS).

Notes: The analysis on internet and device access reports on score because it relies on a probabilistic out of sample estimate, with respect to the observed characteristics common to the PIAAC and ACS, of a respondents' expected digital skills score in the ACS, rather than a direct observation of a respondents' digital skills. Categorization of digital scores into skill levels requires the full distribution of individual scores, and out-of-sample prediction of digital skills cannot provide the full distribution of skills in the ACS.

Digital Skills Track with Literacy and Numeracy Skills

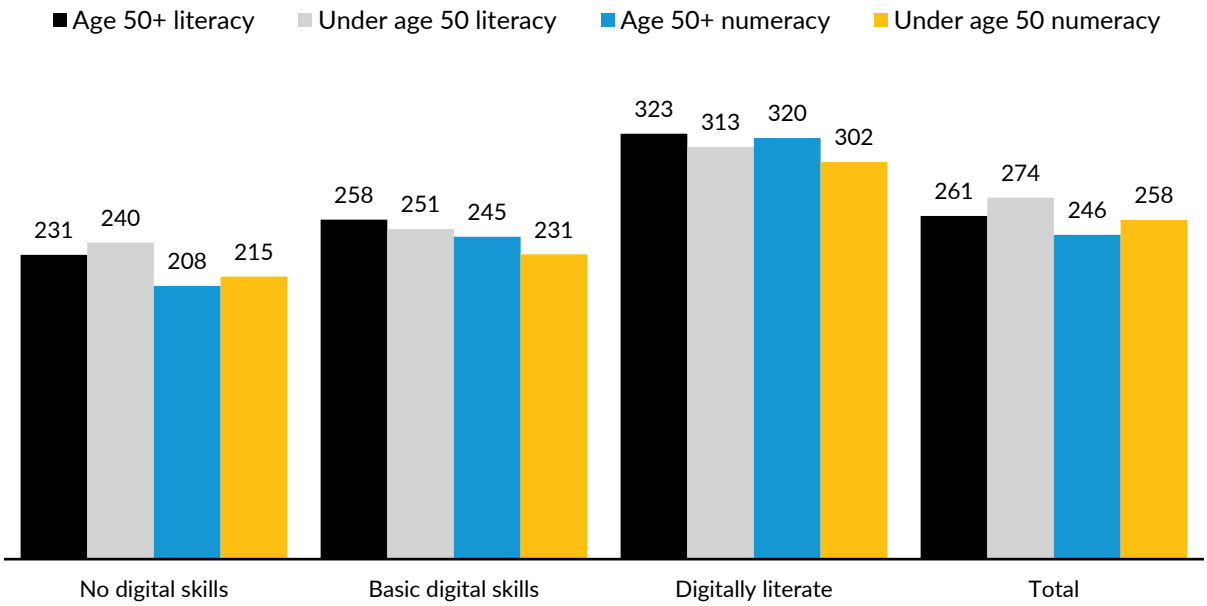
Higher levels of digital skills are associated with higher levels of numeracy and literacy for both older and younger Americans. Here we find important differences between Americans age 50 or older and

those under age 50. Although, on average, older Americans have slightly lower numeracy and literacy scores than those under age 50 (figure 4),[32] older Americans who have basic digital skills or are digitally literate have *higher numeracy and literacy scores* than those under 50.[33]

FIGURE 4

Literacy and Numeracy by Digital Skill Level

Score received on PIAAC assessment



Source: Author calculations using data from the Programme for the International Assessment of Adult Competencies.

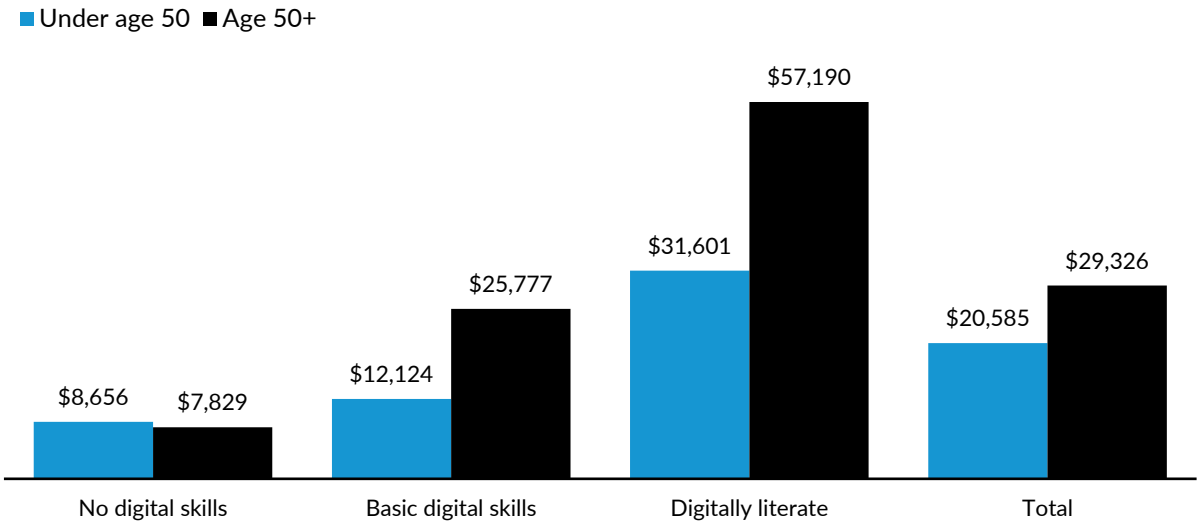
A possible explanation for this finding is that older Americans with higher literacy and numeracy skills have higher levels of education and are in jobs with more room for growth and skill-building, allowing for the cultivation of higher digital skills.

Higher Digital Skills Are Associated with Having Income above the Poverty Line and with Higher Earnings

Although ageism continues to present barriers for older workers in the workforce (Employment and Training Administration 2008; Lipnic 2018), the many assets brought by older workers (some of which are described earlier in this brief) do translate to higher earnings (figure 5). This finding comes with the caveat that older workers have, on average, been in the labor force longer than younger workers, and this possibly skews earnings as a function of seniority. However, as is discussed in the literature and supported by our interviews, time spent in the workforce is an asset and skill highly valued by employers: it translates into nontechnical skills such as professionalism and timeliness as well as knowledge in one's field.

FIGURE 5

Digital Level and Earnings, All Americans



Source: Author calculations using data from the Programme for the International Assessment of Adult Competencies.

Our analysis of earnings also revealed that people with higher levels of digital skills have higher earnings and that the pay gap associated with different levels of digitals skills is much bigger for older workers than for younger workers.[34] Some of this may be explained by labor market sorting (higher earners are more likely to develop digital skills for reasons associated with being a higher earner), but it also suggests that the value of digital skills in terms of earnings is higher for older workers. This trend may be seen most clearly when comparing older workers with younger workers; among those without digital skills, older workers earn slightly less than younger workers, on average. But among those with basic skills, older workers make more, and digitally literate older workers make substantially more on average than younger workers who are digitally literate. This reflects the importance of having digital skills as an older worker. It also may reflect digitization of the workplace over time and suggest that older workers who were able to learn digital skills as job requirements shifted saw higher earnings gains than those who weren't.

TABLE 4

Digital Score and Poverty Status

	Under age 50	Age 50 or older
Above federal poverty level	269	237
At or below federal poverty level	260	223
Difference	9	14

Source: Author calculations using data from the Programme for the International Assessment of Adult Competencies and America Community Survey.

Notes: The analysis on poverty reports on score because it relies on a probabilistic out of sample estimate, with respect to the observed characteristics common to the PIAAC and ACS, of a respondent's expected digital skills score in the ACS rather than a direct observation of a respondents' digital skills. Categorization of digital scores into skill levels requires the full distribution of individual scores, and out of sample prediction of digital skills cannot provide the full distribution of skills in the ACS.

Finally, older workers above the poverty line have stronger digital skills than those below, and the difference is larger than for younger workers (table 4).[35] Next we will discuss differences in digital score by occupation.

Older Workers Have Lower Levels of Digital Skills Than Younger Workers across Nearly All Occupations

In today's economy, most jobs require digital skills. A recent Brookings Institution report created a "digital score" that reflects a combination of the level of digital knowledge the occupation requires, the importance of digital skills for the job, and how frequently technology is used on the job (Muro et. al. 2017). Using this score, the authors found that the share of all jobs with a high digital score more than quadrupled between 2002 and 2016, from 4.8 to 23.0 percent. The share of jobs with a middle-range digital score also increased (from 39.5 to 47.5 percent), and the share of jobs with a low digital score (jobs that require less knowledge of digital skills and use those skills less intensively on the job) fell from 55.7 to 29.5 percent. A 2021 Aspen Institute survey of employers found that employers also recognize this shift, which accelerated during the pandemic, with 77 percent of respondents saying that the need for digital skills during 2020 increased a lot or a moderate amount.[36] A 2017 Burning Glass study found that 78 percent of middle-skill jobs require basic digital skills (Burning Glass Technologies 2017). And research prior to the pandemic suggested that this growing demand will continue, with a McKinsey Global Institute study projecting that by 2030, the number of work hours using basic digital skills will increase 69 percent (Bughin et al. 2018). Of course, as mentioned, the pandemic accelerated this trend, so prior projections may even be too conservative.

Digital skills are also increasingly needed to search for jobs (Bergson-Shilcock 2017; Hecker and Loprest 2019). A 2011 study found that 73 percent of unemployed internet users used the internet to look for work, and more recent research shows that those lacking basic computer skills cannot use online job-search tools (Bernstein and Vilter 2018).

Muro and colleagues (2017) found that the increase in jobs requiring digital skills varied considerably across industries and occupations but that the digital requirements of jobs increased across the board, including for jobs not traditionally thought of as requiring digital skills. For example, between 2002 to 2016, the mean digital score of jobs in the nursing and residential care industry grew 9 points, the mean digital score of jobs in retail grew 12 points, and the mean digital score of jobs in construction grew 21 points. Muro and colleagues (2017) describe this growth in demand for digital skills as a "U-shaped" growth trend, meaning that high–digital skill, high-wage jobs and low–digital skill, low-wage jobs grew much faster than middle–digital skill, middle-wage jobs. Occupations with low or high digital skill requirements tended to grow at a faster rate than jobs requiring a middle level of digital skills.[37]

Our analysis included an exploration comparing the average digital skill level of older workers, by occupation of their current job, with the average digital skill level of younger workers (table 5). Although this analysis does not explore the digital score value that one would need to have to succeed

in a particular occupation, there are interesting differences between older and younger workers' skill levels by occupation that warrant further explanation.

The average digital skill levels of older workers lag behind those of workers under age 50 in nearly all occupations. Clerical support workers; business and administration professionals; and legal, social, and cultural professionals see the most significant differences in digital skill levels between workers age 50 and over and workers under age 50. This suggests the need to close these gaps in digital skills if we want older workers to be competitive in the labor market today and in the future. This is especially true given findings that nearly all jobs are increasing in their requirements of employees' use of digital skills, including more "entry-level" jobs at the low end of the wage and skill distribution. Muro and colleagues' (2017) U-shaped finding highlights that there are a set of higher-wage jobs requiring higher levels of digital skills that are growing quickly and that to succeed in these jobs, the digital skill levels of older workers in these occupations must increase.

TABLE 5

Comparing Digital Skills of Older and Younger Workers for Select Occupations

Occupation	Under age 50	Age 50 or older	Difference
Other clerical support workers	289	245	-44***
Business and administration professionals	298	265	-33***
Legal, social, cultural professionals	295	264	-31***
Teaching professionals	302	272	-30***
Science and engineering professionals	299	271	-29***
Personal services workers	263	237	-27***
Sales workers	279	252	-27***
Health associate professionals	280	254	-26***
Health professionals	285	264	-21**
Managers	297	278	-19***
Protective/armed services workers	284	265	-19*
Information, communications, and technology professionals and mathematics and statistics professionals	309	292	-17
Skilled trades	267	250	-17**
Construction	270	254	-16
Drivers/transportation adjacent	256	242	-14**
Assemblers	245	241	-4
Market-oriented skilled forestry, fishery and hunting workers	260	264	+4

Source: Author calculations using data from the Programme for the International Assessment of Adult Competencies.
Notes: The analysis on occupation reports on score, rather than level, in order to more easily depict smaller differences in digital skills between PIAAC respondents working in different occupations. Asterisks denote level of significance of comparisons between average digital score across age groups and within occupation; one asterisk denotes significance at the 10 percent level, two asterisks denote significance at the 5 percent level, and three asterisks denote significance at the 1 percent level.

The occupational analysis overall paints a complicated picture. It is key to remember that nearly *all* occupations continue to grow in demand for digital skills, and although gaps persist between older and younger workers and between subgroups of older workers, there is a need to deliver effective services to these individuals. Efforts to close these gaps might be most efficient if targeted to occupational areas with the largest gaps. The largest gap in digital skills between older and younger workers is for

other clerical and support workers, which is 44 points. As a reminder, this gap of 44 points is almost equal to the gap between an individual who can complete a task by navigating across web pages or applications and someone who cannot.

Recommendations and Discussion: Strategies for Addressing the Needs of Older Workers in a Rapidly Digitizing World

The increasingly digital nature of the workplace, the higher earnings returns to those with digital skills, and the urgency of the pandemic recovery make increasing the digital skill levels of older Americans pressing.

Interviewees emphasized older Americans' assets, but these assets may not be fully realized in the labor market until digital skill gaps are closed. For example, older workers have years of experience and wisdom in their field and in the workplace in general. Further, they have strong nontechnical skills, such as adhering to company policies and "fitting in," and exhibit high verbal communication skills. They also were, in nearly all interviews, described as willing and eager to learn digital skills, and interviewees mentioned that the digital skills of older Americans have improved drastically over the past decades, especially during the pandemic, where older individuals were primarily motivated to learn digital skills in order to connect virtually with family and access certain services. But as this analysis shows, gaps still remain. Existing digital skill gaps might serve as a missing puzzle piece, preventing older Americans from fully utilizing their assets and from accessing education, training, and the labor market.

Many organizations and programs across the country have invested heavily in closing these gaps, by lending computers and internet hotspots, starting digital skills programs (including digital skill assessments), or creating drop-by office hours to help people format a resume on a computer. But little is known about the effectiveness of such approaches. This section draws on our interviews to elevate examples of promising practices from the literature and the field.

Lessons for Policymakers

TARGET FUNDING AND STRATEGIES FOR OLDER WORKERS

The literature suggests, and our interviews support, funding and strategies specifically targeted for older workers. A 2015 AARP publication reviewed several public workforce programs serving older workers and found that more funding for job training and employment services programs catered directly or exclusively to older Americans would be beneficial (Wandner, Balducchi, and O'Leary 2015). Prioritizing resources to serve older workers exclusively is important; older Americans often fall through the cracks of programs because of ageism and because they are thought of as closer to retirement and thus less of a good economic investment. Dedicated funding streams allow for targeted instruction of this group, ensuring they are served and their unique needs are met.

The Senior Community Service Employment Program, for example, serves exclusively older low-income workers, serving roughly 100,000 eligible (age 55 and older) workers each year with a budget of $600 million (Wandner, Balducchi, and O'Leary 2015). Participants work part time (averaging 20 hours a week) at minimum wage at participating employers to gain subsidized work experience. Evidence suggests that the financial benefits of this program outweigh the costs (by way of increased wages of participants) and that the program fills gaps in the workforce system where older workers are not being served by focusing exclusively on this population (Mikelson 2017). Other research supports this finding: a 2020 Brookings Institution publication recommends (1) recruiting and training staff at American Job Centers who specialize in working with older clients and (2) creating programming (such as job placement programs) that are designed specifically for older workers, pointing to AARP's Experience for Hire pilot program as an example (Abraham and Houseman 2020). Experience for Hire holds job fairs exclusively for older workers, where employers and candidates are matched before the fair and where older workers' assets are emphasized to participating businesses.

Job boards and employment websites can target older workers by conducting outreach to the population and by listing employers and positions that might be particularly open to hiring older workers. AARP operates one such job board.[38] In American Job Centers, there are protocols that train older worker specialists; dedicating staff to work exclusively on this population allows for maximum customization of services and counseling (Eyster, Johnson, and Toder 2008).

CLOSE ACCESS GAPS

As one respondent mentioned, a digital skills course can be futile if a student is unable to go home and practice what he or she learned. Lack of access, either in broadband service or the presence of technology in the home, prevents individuals from learning and practicing digital skills. One respondent mentioned that in one rural area, hotspots distributed during the pandemic were not sufficient to close access gaps because the area lacked physical broadband infrastructure.

Policymakers can allocate funds that close such gaps, including federal funding through the American Rescue Plan Act of 2021. One idea is to make broadband a public utility, ensuring it exists everywhere in the United States (Hecker and Briggs 2021) at affordable rates. Another is to allocate funds that support the lending or giving of devices, such as laptops, to learners. But such policies must account for local capacity and reflect input from community members. As one of our interviewees suggested, blindly throwing money at the problem may ignore local needs (such as, in this example, a lack of capacity for setting up and distributing computers that were gifted to a small local community-based organization, making the gift useless). One example of a policy that takes into account local needs in addressing access is the recently introduced Digital Equity Act, a federal proposal that would provide communities with funding to measure and address their own broadband and digital needs and funding for digital skills training.[39]

Lessons for Practitioners

Interviewees attested that the digital skills of older people increased during the pandemic because they were forced to learn them, but interviewees also acknowledged that gaps remain. Interviewees mentioned that older Americans sought digital skill help in order to engage socially (for example, to Facetime with their grandkids), but these skills may be transferrable to broader education and workforce spaces. Best practices should be used to ensure these skills further close digital skill gaps.

BUILD CONFIDENCE

Confidence is a key barrier to learning digital skills. Nearly all interviewees described confidence-building as crucial to empowering older Americans to learn digital skills, and this is well reflected in the literature (Hunsaker et al. 2019; Quan-Haase et al. 2018). As one interviewee put it, "you can have all the access and hardware, but it doesn't mean you're comfortable using it." Low confidence in technology can manifest as a fear of hacking, which interviewees described can make older individuals wary to learn and use technology. And very low levels of skills, such as unfamiliarity with the use of a mouse or keyboard, also leads to older individuals feeling unconfident and thus hesitant to begin learning. One interviewee mentioned that ageism and discrimination in the labor market, either real or perceived, also shakes older workers' confidence. One interviewee said that getting over that initial hump is tricky, but once it is done, older workers are eager and excited to learn.

Interviewees offered promising strategies to build confidence. One-on-one instruction, time for questions (and an environment, such as a group classroom, where they are welcome), and structuring learning in cohorts of older workers were all mentioned as key. A process study of the Senior Community Service Employment Program found that lighter-touch, often-automated services are not sufficient; rather, older workers want and need in-person, individualized assistance (Wandner, Balducchi, and O'Leary 2015). Further, when instructors have an understanding of older workers' needs (or when they are older workers themselves), learners have greater confidence and engagement. One interviewee mentioned how having a young person teach a class might cause older learners to feel embarrassed to ask certain questions.

LEVERAGE OPPORTUNITIES FOR PEER LEARING AND SUPPORT

Cohort-based approaches can provide opportunities for older workers to learn from each other and for multigenerational learning. Digital skills programs that include cohorts of only older workers participants were mentioned several times by interviewees as very helpful because they allowed older workers to work together and teach each other and to develop camaraderie. This is evidenced in existing literature as well: older adults tend to help one another master new skills (Ng 2007). Cohorts of only older workers might create a safer environment for learners to ask questions of instructors and one another. Multigenerational cohorts may also offer opportunities for mutual learning and reverse mentorship: one interview respondent noted how an older worker with a master's degree retraining for a new career helped younger students with the technical content, and younger students helped him with the online components of the course.

Job clubs, formal or informal groups of job seekers offering mutual assistance on job search and preparation, were evaluated rigorously in the 1970s and 80s and in more recent literature and were shown to have positive impacts on employment and earnings for older workers (Nakai et al. 2018; Wandner, Balducchi, and O'Leary 2015). Job clubs made up of only older workers may also be a useful cohort-based approach, although a cohort-based approach limited to older workers may promote further stigmatization and cut against the goal of a multigenerational workforce.

ASSESS DIGITAL FLUENCY

Interviewees mentioned that understanding what level of digital skills older learners have is difficult because there are no common definitions (Hecker and Loprest 2019). One interviewee illustrated this, saying, "we found that offering a program called Intro to Excel isn't great because people come in with wildly different levels. Some people come in who don't know how to use a mouse or keyboard, and some are more advanced." Assessments can be useful in helping instructors understand and meet learners where they are, and more than one interviewee described using an assessment tool to gauge the digital skill levels of incoming participants.

TEACH DIGITAL SKILLS IN TASK-LEVEL MODULES

For older Americans unfamiliar with technological terms, devices, and navigation, breaking classes into bite-sized, task-level modules can be an effective approach to learning digital skills. Most interviewees described this approach as useful in some way; it makes the technology feel less abstract and intimidating and instead teaches participants to think of it as a tool to complete a discrete task. Hecker and Loprest (2019) and other extant literature echo this finding. One interviewee described one such approach, with the task being designing a tote bag online, and mentioned that having the activity be discrete and fun drew in many older participants.

Conclusion

This brief documents the digital skill levels of older Americans, finding that although a majority of older Americans have basic digital skills, older Americans in general have lower levels of digital skills than younger Americans, and significant variation exists within subgroups of older Americans. Although the pandemic motivated older Americans to learn digital skills, there is a need for targeted funding and programs to meet their needs moving forward in order to remain connected to support services, public assistance, the social world, education and training opportunities, and the labor market. This is vital because nearly all occupations, including ones that have not traditionally required digital skills, are increasingly requiring them, and remote and hybrid work is becoming more common.

As increasing access to technology and digital skills becomes more of a focus in the recovery from the pandemic, policymakers and practitioners should leverage findings from this brief to ensure that efforts take into account existing equity gaps and target occupations that are growing.

Notes

[1] US Bureau of Labor Statistics, "Ability to Work from Home: Evidence from Two Surveys and Implications for the Labor Market in the COVID-19 Pandemic," *Monthly Labor Review*, June 2020, https://www.bls.gov/opub/mlr/2020/article/ability-to-work-from-home.htm#_ednref1.

[2] UpSkill America at the Aspen Institute Economic Opportunities Program, "How Companies Transformed during 2020 and the Impact on Frontline Workers," March 2021, https://www.aspeninstitute.org/wp-content/uploads/2021/03/How-Companies-Transformed-During-2020-and-the-Impact-on-Frontline-Workers.pdf.

[3] Theresa Agovino, "COVID-19 Deals a Dual Threat to Older Workers," Society for Human Resource Management, July 18, 2020, https://www.shrm.org/hr-today/news/all-things-work/pages/covid-19-deals-a-dual-threat-to-older-workers.aspx.

[4] Problem Solving in Technology-Rich Environments Domain," National Center for Education Statistics, accessed July 6, 2021, https://nces.ed.gov/surveys/piaac/problem-solving.asp.

[5] 45.1 percent of those in the "no digital skills" category refused to take the PSTRE assessment via computer. It is possible that some of these individuals may have had digital skills. However, as is described by Mamedova and Pawlowski (2018), it is not possible to distinguish other reasons for not taking the computer-based assessment from digital literacy reasons, and so all respondents who refused to take the assessment on a computer are classified as having no digital skills.

[6] See OECD (2013).

[7] When discussing occupational findings, we report on digital score, not level, in order to more easily depict smaller differences in digital skills between PIAAC respondents working in different occupations.

[8] We are unable to predict digital skill levels for individuals in the ACS. Out-of-sample prediction is a probabilistic estimate of a respondent's expected digital skills score rather than a direct observation of a respondents' digital skills. Moreover, it is probabilistic only with respect to the observed characteristics common to both datasets. This means that out-of-sample prediction of digital skills cannot provide the full distribution of skills in the ACS. They can only provide the expected value (average) skill level for different subgroups. Since categorization of digital scores into skill levels requires the full distribution of individual scores, the prediction out of sample cannot be used to assign ACS respondents to digital skill levels.

[9] "Older Workers Are Willing and Eager to Learn New Skills," AARP Research, May, 2021, accessed August 15, 2021, https://www.aarp.org/content/dam/aarp/research/surveys_statistics/econ/2021/older-workers-new-skills-covid-19-pandemic-infographic.doi.10.26419-2Fres.00445.002.pdf.

[10] "Disconnected: Seven Lessons on Fixing the Digital Divide," Federal Reserve Bank of Kansas City, accessed July 2, 2021, https://www.kansascityfed.org/community/digital-divide/disconnected-sevenlessons/.

[11] For 2020 data, see Rebecca Perron, "Understanding Older Workers During the Coronavirus Pandemic," AARP Research, May 2021, https://www.aarp.org/research/topics/economics/info-2021/older-workers-new-skills-covid-19-pandemic.html. For 2017 data, see Rebecca Perron, "The Value of Experience Study," AARP Research, July 2018, https://www.aarp.org/research/topics/economics/info-2018/multicultural-work-jobs.html?CMP=RDRCT-PRI-OTHER-WORKJOBS-052118.

[12] The Aging Worker Initiative, conducted between 2009 and 2012, was another federal program that provided grants to programs serving older workers exclusively. See also "Older Workers," Clearinghouse for Labor Evaluation and Research, accessed September 9, 2021, https://clear.dol.gov/topic-area/workers.

[13] Respondents falling in this category scored between 291 and 500 on the PSTRE assessment.

[14] Respondents falling in this category were not given the computer-based assessment of digital skills because they indicated they had no computer experience, failed the initial computer screener, or refused the computer test.

[15] Respondents falling in this category scored between 0 and 290 on the PSTRE assessment.

[16] Statistically significant at the 10 percent level for all category pairs except for white and Asian/Pacific Islander.

[17] Statistically significant at the 10 percent level for all category pairs except for Black and "other race."

[18] Statistically significant at the 10 percent level.

[19] Not statistically significant at the 10 percent level, respectively.

[20] Statistically significant at the 5 percent level.

[21] The "other race" category includes American Indian/Alaska Native and an "other" designation. The inability to conduct further specific subgroup analyses within this category is an important limitation of this dataset.

[22] Not statistically significant at the 10 percent level.

[23] Statistically significant at the 10 percent level.

[24] Statistically significant at the 5 percent level.

[25] Not statistically significant at the 10 percent level.

[26] Statistically significant at the 1 percent level.

[27] Statistically significant at the 10 percent level.

[28] Statistically significant at the 1 percent level.

[29] Statistically significant at the 5 percent level.

[30] Statistically significant at the 1 percent level.

[31] Comparisons in digital score across access to internet/device and within age group are statistically significant at the 1 percent level.

[32] Statistically significant at the 1 percent level.

[33] Statistically significant at the 1 percent level.

[34] Comparisons in average earnings across age group and within digital skill category are statistically significant at the 5 percent level.

[35] Comparisons in digital score across age group and within poverty category are statistically significant at the 1 percent level.

[36] UpSkill America at the Aspen Institute Economic Opportunities Program, "How Companies Transformed during 2020 and the Impact on Frontline Workers," March 2021, https://www.aspeninstitute.org/wp-content/uploads/2021/03/How-Companies-Transformed-During-2020-and-the-Impact-on-Frontline-Workers.pdf.

[37] Muro et al.'s U-shaped job growth for digital skill levels is reminiscent of work by David Autor and his colleagues on job polarization and U-shaped growth in low and high skill jobs more generally (Autor, Katz, and Kearney 2006). However, Holzer (2010) shows that these "job polarization" results are highly sensitive to how jobs are classified.

[38] See "AARP Job Search | Job Openings Everywhere," AARP, accessed September 8, 2021, https://jobs.aarp.org/index.php?page=search&action=advanced_search&keywords=&city_state_zip=&zip_radius=5000&epp=on

[39] See https://www.digitalequityact.org/.

References

Abraham, Katharine, and Susan Houseman. 2020. *Policies to improve workforce services for older Americans.* Washington, DC: Brookings Institution

Autor, David, Larry Katz, and Melissa Kearney. 2006. "The Polarization of the US Labor Market." *American Economic Review* 96 (2): 189–94.

Bennett, Jesse. 2021. *Long-term Unemployment Has Risen Sharply in U.S. amid the Pandemic, Especially among Asian Americans*. Washington, DC: Pew Research Center.

Bergson-Shilcock, Amanda. 2017. *Foundational Skills in the Service Sector*. Washington, DC: National Skills Coalition.

Bernstein, Hamutal, and Carolyn Vilter. 2018. *Upskilling the Immigrant Workforce to Meet Employer Demand for Skilled Workers*. Washington, DC: Urban Institute.

Bughin, Jacques, Eric Hazan, Susan Lund, Peter Dahlström, Anna Wiesinger, and Amresh Subramaniam. 2018. "Skill Shift: Automation and the Future of the Workforce." Washington, DC: McKinsey Global Institute.

Burning Glass Technologies. 2017. *The Digital Edge: Middle-Skill Workers and Careers*. Boston: Burning Glass Technologies.

Butrica, Barbara A., and Stipica Mudrazija. 2021. "Skills-Based Hiring and Older Workers." Washington, DC: Urban Institute.

Council of Economic Advisers. 2015. "Mapping the Digital Divide." Washington, DC: White House Council of Economic Advisers.

Employment and Training Administration. 2008. *Report of the Taskforce on the Aging of the American Workforce.* Washington, DC: US Department of Labor, Employment and Training Administration.

Eyster, Lauren, Richard W. Johnson, and Eric Toder. 2008. *Current Strategies to Employ and Retain Older Workers*. Washington, DC: Urban Institute.

Hecker, Ian, and Amanda Briggs. 2021. "Overlooked and Underconnected: Exploring Disparities in Digital Skill Levels by Race among Older Youth in the US." Washington, DC: Urban Institute.

Hecker, Ian, and Pamela Loprest. 2019. "Foundational Digital Skills for Career Progress." Washington, DC: Urban Institute.

Holzer, Harry. 2010. "Is the Middle of the U.S. Job Market Really Disappearing?: A Comment on the "Polarization" Hypothesis." Washington, DC: Center for American Progress.

Hunsaker, Amanda, Minh Hao Nguyen, Jaelle Fuchs, Teodora Djukaric, Larissa Hugentobler, and Eszter Hargittai. 2019. "'He Explained It to Me and I Also Did It Myself." *Socius: Sociological Research for a Dynamic World* 5.

Johnson, Richard W., Jannette Kawachi, and Eric Lewis. 2009. *Older Workers on the Move: Recareering in Later Life*. Washington, DC: Urban Institute.

Kakulla, Brittne. 2021. *Personal Tech and the Pandemic: Older Adults Are Upgrading for a Better Online Experience.* Washington, DC: AARP Research

Lipnic, Victoria A. 2018. "The State of Age Discrimination and Older Workers in the U.S. 50 Years after the Age Discrimination in Employment Act (ADEA)." Washington, DC: US Equal Employment Opportunity Commission.

Losh, Susan Carol. 2013. "American Digital Divides: Generation, Education, Gender, and Ethnicity in American Digital Divides," in *Digital Literacy: Concepts, Methodologies, Tools, and Applications*, edited by Information Resources Management Association, 932–58. Hershey, PA: Information Resources Management Association.

Mamedova, Saida, and Emily Pawlowski. 2018. "A Description of U.S. Adults Who Are Not Digitally Literate." NCES 2018-161. Washington, DC: US Department of Education, National Center for Education Statistics.

Mikelson, Kelly. 2017. *The Role of SCSEP in Workforce Training for Low-Income Older Workers*. Washington, DC: Urban Institute.

Muro, Mark, Sifan Liu, Jacob Whiton, and Siddharth Kulkarni. 2017. *Digitalization and the American Workforce.* Washington, DC: Brookings Institution.

Moroney, Maureen, and Alison Jarvis. 2020. "Loneliness and Digital Inclusion: A Literature Review." Middlesbrough, UK: Aging Better Middlesbrough.

Nakai, Yoshie, Stephen C. Hill, Andrea F. Snell, and Jared Z. Ferrell. 2018. "A Job Club for Older Job Seekers: Change in Attitude and Perceived Utility During Training." *Journal of Career Development* 45 (6): 551–65.

Nanda, Neha, Bruno Gasperini, and Luke Patterson. 2016. "Older Workers' Labor Force Transitions from Work Retirement: Findings from Recent Studies, 2010–2015." Washington, DC, and Columbia, MD: US Department of Labor and IMPAQ International.

Ng, Chi-hung. 2007. "Motivation among Older Adults in Learning Computing Technologies: A Grounded Model." *Educational Gerontology* 1: 1–14.

OECD (Organisation for Economic Co-operation and Development. 2013. "The Methodology of the Survey of Adult Skills (PIAAC) and the Quality of Data," In *The Survey of Adult Skills: Reader's Companion*, edited by OECD, 47–62. Paris: OECD.

Quan-Haase, Anabel, Carly Williams, Maria Kicevski, Isioma Elueze, and Barry Wellman. 2018. "Dividing the Grey Divide: Deconstructing Myths about Older Adults' Online Activities, Skills, and Attitudes." *American Behavioral Scientist* 62 (9): 1207–28.

Robinson, Laura, Shelia R. Cotton, Hiroshi Ono, Anabel Quan-Haase, Gustavo Mesch, Wenhong Chen, Jeremy Schulz, et al. 2015. "Digital Inequalities and Why They Matter." Information, Communication, and Society 18 (5): 569–82.

Rosenboom, Victoria, and Kristin Blagg. 2018. "Disconnected from Higher Education: How Geography and Internet Speed Limit Access to Higher Education." Washington, DC: Urban Institute.

Tomer, Adie, and Lara Fishbane. 2020. "Bridging the Digital Divide through Digital Equity Offices." Washington, DC: Brookings Institution.

Wandner, Stephen A., David E. Balducchi, and Christopher J. O'Leary. 2015. *Selected Public Workforce Development Programs in the United States*. Washington, DC: AARP Public Policy Institute.

———. 2018. "Public Employment Policy for an Aging Workforce." *Gerontology and Geriatric Medicine* 4: 1–13.

About the Authors

Ian Hecker is a former policy analyst in the Income and Benefits Policy Center at the Urban Institute, where he studied the shifting nature of low- and middle-wage jobs to help understand and replicate effective policies and programs. Hecker's research covered apprenticeship programs, the Workforce Innovation and Opportunity Act, funding mechanisms for supporting skills development, and automation and the future of work. Hecker graduated with a BA in public policy from the University of Michigan.

Shayne Spaulding is a senior fellow in the Income and Benefits Policy Center, where her work focuses on the evaluation of workforce development and postsecondary education programs. She has spent more than 20 years in the workforce development field as an evaluator, technical assistance provider, and program manager. She holds an MPP from Johns Hopkins University.

Daniel Kuehn is a senior research associate in the Income and Benefits Policy Center. His research focuses on apprenticeship, workforce development, and the STEM labor market. Kuehn holds a PhD in economics from American University, an MPP from George Washington University, and a BA in economics and sociology from the College of William and Mary.

Acknowledgments

This brief was funded by the AARP Public Policy Institute. We are grateful to them and to all our funders, who make it possible for Urban to advance its mission.

The views expressed are those of the authors and should not be attributed to the Urban Institute, its trustees, or its funders. Funders do not determine research findings or the insights and recommendations of Urban experts. Further information on the Urban Institute's funding principles is available at urban.org/fundingprinciples.

We appreciate the partnership of Jen Schramm, Susan Weinstock, and their colleagues at the AARP Public Policy Institute. Thanks to Urban colleagues Pamela Loprest and Barb Butrica for their review of the report and to Michael Marazzi for copyediting.

500 L'Enfant Plaza SW
Washington, DC 20024

www.urban.org

ABOUT THE URBAN INSTITUTE

The nonprofit Urban Institute is a leading research organization dedicated to developing evidence-based insights that improve people's lives and strengthen communities. For 50 years, Urban has been the trusted source for rigorous analysis of complex social and economic issues; strategic advice to policymakers, philanthropists, and practitioners; and new, promising ideas that expand opportunities for all. Our work inspires effective decisions that advance fairness and enhance the well-being of people and places.