

HAWAI'I DIGITAL LITERACY & READINESS STUDY

State of Hawai'i
Department of Labor & Industrial Relations
Workforce Development



WORKFORCEDEVELOPMENT

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ACKNOWLEDGEMENTS

The State of Hawai‘i Department of Labor and Industrial Relations Workforce study on Digital Literacy and Readiness is expected to break ground by analyzing for the first time Hawai‘i residents’ readiness for a digital economy and their relative digital literacy. As a benchmark study, the project was complex and required high levels of collaboration, rigor and teamwork among the State, digital literacy experts, and those who would implement the research. Throughout the process, the cooperation and collaboration proved excellent as the team defined the terms of the study in light of the rapidly changing digital environment, designed and tested the questionnaire instrument, collected data, analyzed and reported on results.

In particular, Team Omnitrak would like to extend its sincere appreciation to the following team members for their excellent input:

- Ms. Allicyn Tasaka, for her leadership in Workforce Development overall for the State of Hawai‘i and who leads its Workforce Initiative on Digital Literacy and Readiness
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- Omnitrak consultants on this DLIR study:
 - Dr. Irwin Kirsch, Director Center for Global Assessment, Educational Testing Service, who serves as global project director for the Organization for Economic Cooperation and Development (OECD) and its digital literacy surveys, for consulting on design issues.
 - Dr. Qimei Chen, Ph.D., Harold & Sandy Noborikawa Endowed Chair of Entrepreneurship, Marketing & Information Technology, Shidler College of Business, University of Hawai‘i at Mānoa, for her collaboration and insights on research models, needs of employers seeking transformative digital change, and the challenges of the digital divide which are incorporated in the Conclusions and Recommendations section of this report.
- All of the Hawai‘i residents who took time to participate in the survey

A sincere mahalo nui loa to the above team for assisting the State of Hawai‘i in the benchmark establishing Digital Literacy and Readiness Study (DLRS).

BACKGROUND AND RESEARCH OBJECTIVES

BACKGROUND

Earlier this year, Hawai‘i Governor David Ige shared in his State of the State Address his vision of Hawai‘i for the future – an upgraded and more sustainable local economy in which digital technology is leveraged as a critical component of success. Toward this end, the State of Hawai‘i Department of Labor and Industrial Relations (DLIR) is working to up-skill Hawai‘i’s workforce to meet growing demand for digital services.

One of DLIR’s initiatives is a greater understanding of Digital Literacy and Readiness among Hawai‘i residents between 18 to 65 across the state. Currently there is no single metric that describes Hawai‘i residents’ readiness for the digital economy nor its level of digital literacy.

The DLIR Workforce Initiative seeks a benchmark to quantify the digital readiness and literacy levels among residents of the State of Hawai‘i. The Organization for Economic Cooperation and Development produces a regular digital knowledge assessment both nationally and internationally. Its 2017 U.S. study concluded that two thirds of the American population ranged from poor to terrible to zero in computer skills. The PEW Research conducted a study on digital readiness and found similarly low levels.

This DLIR Workforce study on Digital Literacy and Readiness, contracted through a state Request for Proposal process, aims to establish an initial benchmark of Hawai‘i’s digital readiness and literacy.

RESEARCH OBJECTIVES

The objectives of this State study, the Digital Literacy and Readiness Study (DLRS) are as follows:

- To establish a baseline measurement of the digital literacy and readiness of Hawai‘i’s working age population;
- To measure the present rate of digital readiness statewide, disaggregated by demographics, education, occupation, industry, and geography;
- To determine the proportion of adults in various groups who are not digitally literate; and
- To identify the largest population segments of adults who are not digitally ready by selected demographics, education, occupation, industry, and geography.

SAMPLE AND METHODOLOGY

SAMPLE DESIGN

The sample for this study is composed of Hawai'i residents aged 18 to 65 years of age. A random sample projectable of residents across the State as well as within each county was developed to ensure representativeness of this population.

Sample Frame

Team Omnitrak used a stratified probability sample to administer this survey to residents. It was executed in two phases: 1) In Phase I, a random sample of residents was called and asked to complete the survey using a random digit dialing (RDD) sample frame. A sample sufficient to compete the proposed number of interviews was acquired from Scientific Telephone Samples (STS), a long-time Omnitrak sub-contractor. STS telephone sample is a high quality sample that includes a wide breadth and diverse sample of residents by demographic characteristics including income, educational attainment, occupation, employment sector, etc. This is important to ensure Hawai'i's diverse residents have a chance to participate; 2) In Phase II residents were administered on on-line digital skills test.

Once on the phone, Omnitrak interviewers screened for the targeted criteria as described below to participate in the survey. In addition to the random sample, Omnitrak then over-sampled residents of Hawai'i, Maui, Kaua'i, Moloka'i and Lāna'i. This geographic over-sampling increased the sample sizes and hence reduced the sampling error for each Neighbor Island county. Upon completion of data collection, the sample was weighted to be proportionate to population by State, County and major Island in alignment with U.S. Census data.

Sample Screening Criteria

Omnitrak experienced and professional interviewers screened respondents for the following:

- Adult between the ages of 18 and 65
- Resident of Hawai'i for at least 6 months of the year
- Income between \$21,000 and \$150,000

Sample Plan for State and Counties

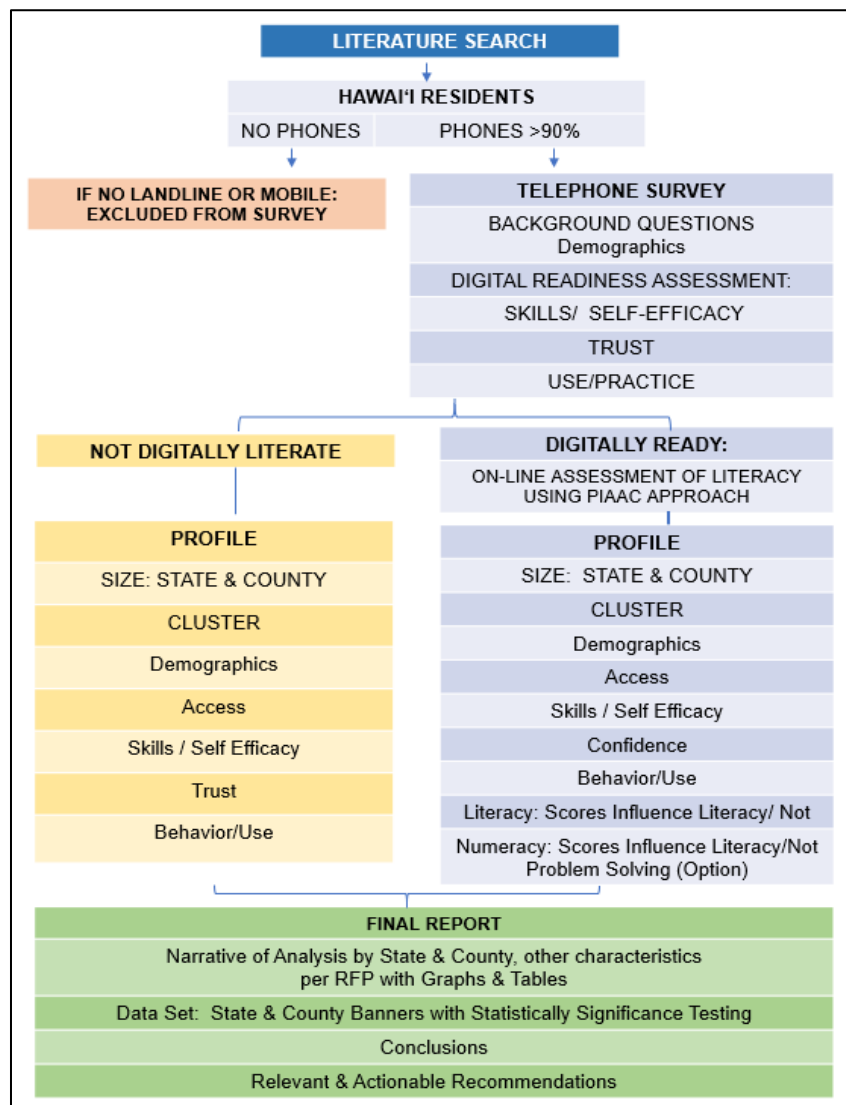
Besides representativeness, it was important in the design of the survey that the sample size for the State, County and other key segments be sufficient to yield meaningful results. The total telephone sample size carries a sampling error of +/- 3% for the State overall. Except for Kaua'i, the four counties have roughly comparable sampling errors: City and County of Honolulu +/- 5%; Hawai'i and Maui County +/- 7%, and Kaua'i +/- 10%.

CATI UNWEIGHTED SAMPLE	TOTAL	C & C HNL	Hawai'i	Maui	Moloka'i	Lāna'i	Kaua'i
# of Completed Interviews	893	403	200	135	46	8	101
Sampling Error at 95% confidence	+/-3%	+/- 5%	+/- 7%	+/-8%	+/-14%	+/-35%	+/- 10%
* The Sampling Error for Maui County with an aggregated sample of 189 is +/- 7%.							

MULTI-MODAL METHODOLOGY

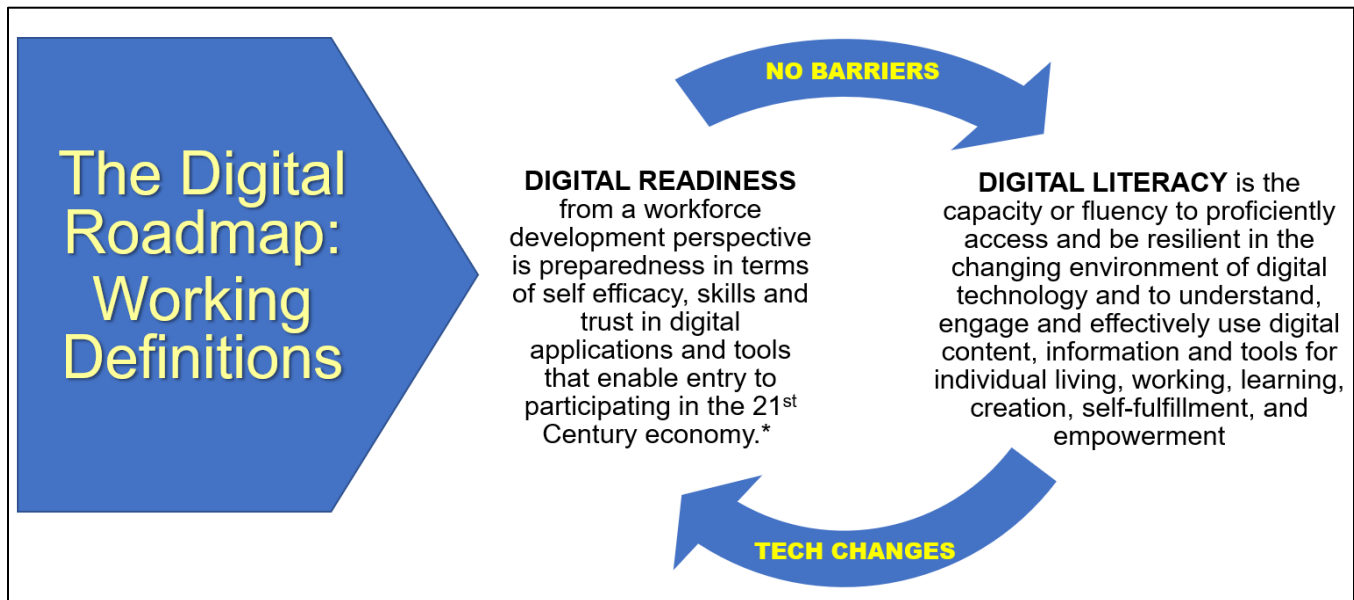
To analyze digital readiness, Omnitrak utilized a computer assisted telephone interview or CATI methodology. Because more than 90% of all households in Hawai‘i have telephone access, the CATI methodology ensured that almost all residents had an equal chance to participate in the digital readiness survey.

Upon completion of the telephone survey, Omnitrak utilized an on-line survey to measure digital literacy. This sample was developed from the sample of respondents who took the telephone survey. If telephone respondents indicated that they had digital devices to access the Internet and services to connect to the Internet, and basic navigation skills to open a link and complete a survey, they were asked if they were interested in participating in a follow-up survey. The follow-up survey measured digital skill or literacy levels. The follow-up survey has been primarily used to estimate the incidence of digital literacy within Hawai‘i’s residential 18 to 65 year old population. Respondent data from both surveys were linked enabling descriptive analysis of those qualified as digitally literate.



THE DIGITAL ROADMAP: WORKING DEFINITIONS

After presentation and discussion of differing definitions used in the digital education environment, the Department of Labor and Industrial Relations Workforce Development approved the following definitions of Digital Readiness and Digital Literacy at a meeting on May 27, 2021. These definitions reflect a workforce development perspective and will guide the current study. The study's planning group agreed that over time, advances in technology are likely to change requirements to be digitally literate. Hence, the relationship between "readiness" and "literacy" are integrated and evolving over time.



CONCLUSIONS AND RECOMMENDATIONS

STATISTICAL SUMMARY

Given the digital divide observed among different demographic segments in the descriptive analysis, additional analysis was conducted to further understand this phenomenon. Due to the impact of Covid-19 pandemic which has led the U.S. public to increasingly rely on Internet access for all aspects of daily life especially information regarding work and employment (Lai and Widmar 2020), it is imperative to gain more insights regarding the presence and nature of the current digital divide situation in Hawai‘i. Further, prior research often defines the digital divide as the technological gap among different groups of people in terms of their accessing and using information and communication technologies (e.g., Stiakakis, Kariotellis and Vlachopoulou 2009). However, such definition has gradually been replaced by the multifaceted definition where the inequalities in internet access is described as the first-level digital divide whereas the skill and use of the information and communication technologies is termed the second-level digital divide (Buchi, Just and Latzer 2015; Hargittai and Hsieh 2013; Ragnedda and Muschert, 2013). The second-level digital divide is particularly important when the Internet access has become more commonplace which leaves “how” rather than “if” the Internet is used a focal point of many prior investigations (e.g., Buchi, Just and Latzer 2015). Prior research sometimes calls the second-level digital divide “digital inequality” or “digital exclusion” (e.g., Van Deursen, Helsper, Eynon, and Van Dijk 2017). For the purpose of consistency, we use the general term “digital divide” to capture the skill and usage of digital technology in the current analysis.

The concept of digital divide is stemmed from the comparative perspective of social inequality (Van Deursen et al. 2017) and current digital divide research employs multifaceted conceptualizations which consist of access, motivation, skills and uses (e.g., Lee, Park and Hwang 2015; Pearce and Rice 2013; Van Deursen and Van Dijk 2015). As our initial analysis indicated the ubiquity of Internet access, we focus our investigation on skills which “consists of medium- and content-related elements,” and use which “involves engaging with and creating digital content” (Van Deursen et al. 2017, p. 453). We aim to examine whether Hawai‘i’s digital divide is compound and/or sequential. The compound digital divide is defined as a cumulative disadvantage within the digital skills and use, i.e., a Hawai‘i resident who lacks one particular type of digital skills also lacks another type and that a resident not using the Internet in a certain way is also found disengaged in other ways (Van Deursen et al. 2017). By comparison, sequential digital divide captures the dependency between digital skills and use, i.e., when a Hawai‘i resident lacks digital skills, he or she will not be able to take advantage of some uses of the Internet (Van Deursen et al. 2017).

In our current DLRS, we focus on four digital skills, i.e., Basic/Operational Skills; Social Skills; Creative Skills and Information/Navigation Skills that have been conceptualized, operationalized, and validated in prior research (Van Deursen, Helsper, and Eynon 2016). Such division of the digital skills will help investigate how digital skill levels facilitate different type of Internet use. Operational skills are the basic technical skills required to use the Internet, often referred to as button knowledge. Information-navigation skills relate to searching for information, including the ability to find, select, and evaluate sources of information on the Internet. Social skills encompass the ability to use online communication and interactions to understand and exchange meaning, entailing searching, selecting, evaluating, and acting on

contacts online; attracting attention online; profiling; and the social ability to pool knowledge and to exchange meaning. Creative skills are the skills needed to create content of acceptable quality to be published or shared with others on the Internet. This regards textual, music and video, photo, multimedia, and remixed content, but also the more basic level of uploading material. All skills combined provide an elaborate view of what is required for the general population to function well in an online environment” (Van Deursen et al. 2017, p. 455). Since there are many types of digital uses, we focus on two uses in the economic domain that are of particular interest to workforce development, i.e., Employment Use (job search and promotion); and Finance Use (investment, contracts) (adopted from Van Deursen et al. 2017).

Digital Skills and Digital Use

Since we adopted the four digital skills (5-item each skill type, 20-item total) and two specific digital uses (3-item each use type, 6-item total) measures from prior research (Van Deursen et al. 2017), we will need to first establish their psychometric qualities by ensuring the construct validity and reliability. Construct validity is the extent that each instrument is in fact measuring the respective underlying concept (Churchill 1979; Podsakoff et al. 2013). To assess construct validity, we conducted an Exploratory Factor Analysis on the 26 items using Principal Components Analysis as factor extraction method. The weighted data were subjected to a varimax rotation with kaiser normalization. Factors were determined by an examination of eigenvalues, scree plot and variance explained. Our EFA analysis yielded a six-factor solution (see Figure 1). All items loaded on its respective factor except for item 2 and 4 now loading under Basic Skills as opposed to Creative Skills, suggesting respondents regarded use office suite and use online content as more of a basic than creative skills; and below the .50 threshold loadings for item 3 and 5 in Social Skills. Finally, the first item “integrated downloaded tools or applications into the way you work” under Employment Use showed minimal consistency with the whole scale. Further discussions with workforce development experts suggested that such item might be confusing as some high-level respondents may ask their supporting staff to perform the use for them even if the respondents themselves were high in other measures of this dimension. We therefore deleted this item from the total scale.

In addition, we assessed the reliability of each factor with internal consistency approach using Cronbach’s alpha (see Figure 1). All factors scored .80 and above except for Creative Skills (.78) and Social Skills (.66). However, further deletion of any items from these two factors resulted in no improvement of Cronbach’s alpha, we therefore used the resulting 25 items to form the composite score for each factor to facilitate further analysis on the compound and sequential digital divides. Six composite scores were produced in this process to represent four digital skills and two digital uses (please see Figure 2 for descriptive statistics).

Compound Digital Divide

Compound digital divide is the cumulative disadvantage within the digital skills and uses, i.e., a low score of one particular type of digital skills also relates to low score of another type of digital skills or digital uses. To test this, we used a correlation matrix (see Figure 2). The pattern of correlations provided strong evidence of compound digital divide in that Basic/Operational Skills exhibited a stronger positive correlation (negative correlation with Navigation Skills) with all other three types of skills ($p < .01$); similar correlation pattern was displayed for Creative Skills ($p < .01$). The only exception was the lack of correlation between Social Skills and Information/Navigation Skill ($p = .201$) indicating the ability to

share information online for social purpose did not necessarily lead to higher level of information search and navigation proficiency. Further, Basic/Operational Skill, Creative Skill and Information/Navigation Skills all significantly correlated to Employment Use and Finance Use ($p < .01$) whereas Social Skills also correlated to Employment Use ($p < .01$) as well as Finance Use ($p < .05$) but at a lesser level.

Sequential Digital Divide

Sequential digital divide predicts the dependency between digital skills and uses. Using a linear regression, we examined the impact of four types of digital skills as antecedents of each type of digital use in Model 1, and in Model 2, we entered the other type of digital use as an additional antecedent to examine possible sequential digital divide caused by other type of digital use (see Figure 3). Variance Inflation factor (VIF) was used to ensure no multicollinearity was detected ($VIF < 1.929$). For Employment Use, in Model 1, Basic/Operational Skills ($b = .320, p < .01$) and Creative Skills ($b = .342, p < .01$) had significant and positive impacts on Employment Use whereas the effects of Social Skills and Information/Navigation Skills were not significant. Further, adding Finance Use ($b = .242, p < .01$) to Model 2 proved to significantly increase the predictive power of our model. For Finance Use, we constructed Model 1 by regressing Finance Use on four types of digital skills. Results showed that Basic/Operational Skills ($b = .259, p < .01$), Creative Skills ($b = .221, p < .01$) and Information/Navigation Skills ($b = -.106, p < .01$) all had a significant effect on Finance Use. However, Social Skills appeared to have no effect ($b = .011, p = .808$). Further adding Employment Use ($b = .177, p < .01$) to Model 2 help substantially increase the predictive power of the model. The regression analyses helped evidence the presence of the sequential digital divide in that digital uses were largely dependent on digital skills especially basic operational level skills and creative content generation skills. Information search skills helped enhance the finance-related use but not employment-related use. Finally, social skills had no sequential digital divide effect on digital uses. These findings point out that not all digital skills will help increase economic domain digital uses and that workforce development efforts should be strategically designed to target specific digital skills in specific segments to achieve desired sequential digital uses.

CONCLUSIONS

To conclude, findings from the statewide Digital Literacy and Readiness Survey (DLRS) RFP-21-002, undertaken for DLIR's workforce initiative and executed by Omnitrak have revealed many striking insights regarding Hawai'i Workforce's digital literacy and readiness.

Specifically, findings from the DLRS shed light on the current level of digital readiness and digital literacy among Hawai'i residents. Specifically, using cluster analysis, we identify five distinct groups of Hawai'i residents who fall along a continuum of digital readiness from relatively more ready to relatively unprepared. Those who are less ready (the unprepared 17%; the old guard 23%; total 40%) tend to be less willing to embrace technology in learning and is in general needing help setting up new device and have low confidence in their computer skills. By contrast, those who are more ready (the digital learners 26%; the technical DIYers 15%; the social users 19%; total 60%) are more likely to be ardent or active learners, confident about their technology skills and are familiar with online learning. In comparison to the national level of digital readiness (Pew Research Center 2015), where the less ready accounted for only 19% whereas the more ready amount to 81%, Hawai'i seems to have a higher than national level of digitally

unprepared residents. Such deviation provides compelling empirical evidence for DLIR to offer workforce training to improve these unprepared Hawai‘i residents’ digital readiness.

Findings from the DLRS also point to a high degree of statewide familiarity with online learning. For instance, over 70% of the respondents are familiar with online educational resources such as Podcasts and Distance learning tools. In addition, more than 90% of the respondents regard themselves as learners. These observations show that online learning culture is currently strong among Hawai‘i’s residents, which will allow DLIR to effectively use online tools and workshops to train Hawai‘i’s workforce. However, our findings also caution that not all Hawai‘i residents will be able to utilize online learning. Those older, less educated and lower income groups still prefer in-person training. Specifically, our respondents on average find the acceptable training frequency could be as high as one day per week.

Further, while Hawai‘i residents demonstrate an overall confidence in their use of digital devices (93% feel very or somewhat confident when using computers, smartphones or other electronic devices to perform online task), we observed industrial sector variations. That is, digital confidence is relatively low among residents who work in sectors such as building/construction, agriculture, service, and financial/banking. In addition, residents working in food service and agriculture sectors seem especially skeptical in terms of whether electronic devices can help improve their productivity. Overall blue-collar workers, those retired or unemployed, or homemakers express the highest need of support to setup electronic devices. Residents working in food service, and other services, as well as those in agriculture, transportation and financial/banking are also challenged in navigating online sites. These findings alert DLIR that when promoting a statewide digital transformation, industrial sector disparity might be observed. These may in turn become barriers to the deployment of such transformation. As such, it might be helpful to consider a customized digital transformation plan for each individual sector.

Similar to the Pew Research Center’s national study in 2016, the digital trust of Hawai‘i residents remains low. Specifically, 61% of our respondents mentioned that it is very or somewhat difficult to know if the online information is trustworthy in comparison to 60% in Pew study. Since the national level of digital trust in the Pew Research Center’s survey is measured six years ago, in reality, the level of Hawai‘i residents’ digital trust could be lagging more in comparison to the current national average. Since digital trust is crucial for the sharing economy, and for Hawai‘i residents to work with future systems built on blockchain technology either as contributors or consumers, it therefore becomes a major area to emphasize in workforce development.

Most crucially, findings from this survey reveal that Hawai‘i’s workforce seems to experience a digital readiness/skill divide. Hawai‘i Residents with higher income, higher education level, younger and living in O‘ahu are more likely to benefit from the digital technology in general and online learning in particular. Moreover, our findings suggest that such digital divide is likely to be accelerated as the segments high in digital readiness are also increasingly more likely to have higher digital skills and actively seek out new opportunities to grow. For instance, 76% of the digital learners actively seek opportunities to grow whereas only 45% old guards are motivated to do so. Similarly, 77% digital learners take courses in a personal interest area whereas the percentage drops to 19% to old guards and 3% to unprepared. We expect that such digital divide, coupled with the digital access and learning channel preference, could

become more severe given the impact of Covid-19 when “much of daily life (such as work and school) moved online, leaving families with lower incomes more likely to face obstacles in navigating this increasing digital environment” (Vogels 2021). Further, our additional analysis evidences the existence of both compound and sequential digital divides (Van Deursen et al. 2017), showing that digital skills (except social skills) and digital uses are interlocked and even reciprocal. The widening of the digital divide therefore both heightens the challenges DLIR’s workforce initiative faces to engage the less digital ready segments in online trainings, and the urgency to design effective, county-specific interventions to help manage the digital divide acceleration.

To this end, we propose a Ho‘oikaika Framework for Hawai‘i Digital Literacy and Readiness (see Appendix 1). This framework not only captures how the current DLRS has helped to address DLIR’s four major objectives, but also points to additional opportunities for a more in-depth analysis on the causal link among digital readiness, digital literacy/skills and Ho‘oikaika outcomes.

Recommendations: A WIOA Perspective

The vision for Hawai‘i’s Strategic workforce development is to “ensure all employers have competitively-skilled employees, and all residents have sustainable employment and self-sufficiency,” which is designed to align with and facilitate the DLIR’s vision and key mission to promote diversification and policies that support economic growth, particularly on innovation. Many of these innovative opportunities require Hawai‘i’s workforce to be both digitally ready and digitally literate.

The current study therefore helps fulfilling DLIR’s mandate under the U.S. Workforce Innovation and Opportunity Act of 2014 (WIOA) in providing, for the first time, reliable empirical data on the size and characteristics of the digitally ready and not ready in the State. By filling this knowledge gap, DLIR’s workforce team have provided leadership on evidence-based needs to align federal workforce investments in targeted job training. Since the workforce system is a network of core programs providing Hawai‘i workforce employment, education, training and support services while facilitating Hawai‘i businesses with the skilled workers they need to compete in the global economy, it is therefore crucial to raise Hawai‘i workforce’s digital readiness to facilitate their transition to increasingly digitized workflows enabled by technology and software .

Specifically, findings from this DLRS can inform establishment of Hawai‘i workforce preparation activities, which “are those services that are designed to help an individual acquire the combination of basic academic skills, critical thinking, digital literacy, job training and self-management skills. While adult education has traditionally supported the development of basic academic skills, workforce preparation will now be required to develop competencies and obtain skills necessary to successfully transition to and complete postsecondary education, advanced job training and employment. These competencies are commonly incorporated into definitions of employability skills.” Our findings not only directly assess the current level of digital readiness and literacy of Hawai‘i residents, but also point out that the State may want to direct more workforce preparation investment to help those segments who are not currently digital ready and who are low in digital skills. This is because Hawai‘i residents who are digitally ready are more likely to be proactive learners. Therefore, they will be more likely to seek out workforce training especially those designed to increase productivity and advancements in their careers;

and more flexible in terms of training modality as they are familiar with online learning. By contrast, Hawai‘i residents who are low in digital readiness may need extra assistance in identifying a training program to match their digital literacy level and in person learning preference. When designing Workplace Adult Education and Literacy Activities Programs for these segments such as Hawai‘i’s Individualized Career Achievement Network (iCAN), additional local sites might need to be secured and sustained beyond its existing sites. As such, DLIR can further align its workforce development program to the “Making Skills Everyone’s Business: A Call to Transform Adult Learning in the United States” strategies identified in the US Department of Education report.

Recommendations: A Workforce Resilience Perspective

While the federal emphasis is more on leveling up the digital divide, Hawai‘i’s workforce strategic plan (2020-2024) stresses the overarching need for “Resilience,” e.g., “building greater resilience in Hawai‘i’s workforce to be ready for anything.” Workforce resilience consists of five components: 1) A diversified economy that includes multiple robust industries; 2) Ability and speed for various economic sectors to recover after a downturn; 3) Ability for employers to adapt to a changing economy and maintain or grow their organizations as the marketplace shifts; 4) Ability for workers to adapt to a changing economy and transition to other jobs; 5) Ability for workers to continue to seek advancement even in economically challenging circumstances. To do so, the DLIR workforce initiative proposes two critical priorities. The first is to support workers with barriers to employment as defined by WIOA and discussed earlier; and the second is to build the workforce of the future through a focus on upskilling, policy and growth in targeted industries.

Based on the key findings from the current DLRS, we maintain that digital readiness and literacy will serve as critical ingredients in help determine the best deployment of action plans designed to raise workforce resilience. To start, in order to prepare the workforce of the future, Hawai‘i needs to upskill workers with 21st century skills, which further calls for development of innovative training programs that enhance workers’ lateral and upward mobility. In the digital era, digital readiness and digital skills are key tools for such upward opportunities. Although the online learning culture is currently strong among Hawai‘i’s residents, local residents currently have modest basic online skills (such as navigation or operation) and low creative skills as well as low online employment or finance use. These findings prompt DLIR to engage employers in creating the workforce of the future and to design targeted programs to improve Hawai‘i workforce’s digital skills required specifically for innovation and advancement.

Another important initiative to help prepare the workforce of the future is to support growth in target industries that diversify Hawai‘i’s workforce beyond tourism, such as health and wellness; education; creative sector’ technology sector; agribusiness; and the military. The key to Hawai‘i’s industry diversification is digitalization. Digitalization help creates jobs. According to the Organization for Economic Co-operation and Development (OECD), four out of ten new jobs globally between 2006 to 2016 were created in highly digital-intensive industrial sectors (OECD 2019). Digitalization also exerts a “creative destruction” phenomenon as technological advancement such as machine learning and artificial intelligence has been adopted to reduce the number of workforces. Studies show that new industries have mainly appeared in locations having large share of high-skilled workers (Berger and Frey 2017), particularly digital skills as digitalization has occurred in varying level at all industrial sectors, e.g., in

healthcare, electronic health records, telemedicine and Covid-19 contact tracing; in government, eHawaii.gov and GenTax for integrated tax processing; in food service, blockchain technology for supply chain streamlining and food recall. Given the industrial sector variations revealed in our findings in terms of Hawai'i workforce's digital confidence, special attention is suggested to these disparities when pursuing Hawai'i's industry diversification.

Recommendations: A Digital Transformation Perspective

At a micro-level, Digital Transformation is “the adoption and improvement of digital technology by a company to improve business processes, value for customers and innovation.” Covid-19 has propelled corporations' need to speed up their digital transformation (Bloomberg, 2020, see Appendix 3) in order to stay agile and resilient facing the uncertainty brought forward by the global pandemic. At this level, employees' roles and digital skills are crucial in facilitate such transformation. Appendix 4 shows the six building blocks industrial companies can use to create digital strategy and generate value from digital transformation (Angevine, Keomany, Thomsen, and Zimmel 2021).

At a more macro-level, Digital Transformation “is about adopting disruptive technologies to increase productivity, value creation, and the social welfare” (Ebert and Duarte 2018). Appendix 5 includes some examples of such disruptive technologies adopted in digital transformations. At this level, the whole society would work together to achieve digital transformation in the following areas:

- Social goals such as to “foster the development of a more innovative and collaborative culture in industry and society”; “change the education system to provide new skills and future orientation to persons so that they can achieve excellence in digital work and society”; “create and maintain digital communication infra-structures and ensure their governance, accessibility, quality of service and affordability”; “strengthen digital data protection, transparency, autonomy and trust”; “improve the accessibility and quality of digital services offered to the population.”
- Economic goals such as to “implement new and innovative business models”; “increase income generation, productivity and value addition in economy.”
- Regulatory environment such as to “improve the regulatory framework and technical standards” (Ebert and Duarte 2018).

These macro-level digital transformation goals are greatly in line with the WIOA's mandate and the DLIR's strategic commitment to building resilience in Hawai'i's workforce. Findings from this DLRS illuminates the most crucial segments to start given the accelerated digital divide and the most critical industries to focus on given the sector disparity in digital confidence.

To this end, we designed the three-stage Ho'ouikaika Framework (see Appendix 2) for Hawai'i Digital Transformation. The business survey stage will help establish a baseline measurement of current digital transformation stage of Hawai'i businesses and understand digital skills needed by the employers; the experimentation stage will examine the effectiveness of DLIR's workforce resilience training in a laboratory environment to enhance the reliability of the intervention; the implementation stage will investigate whether these resilience interventions will help prepare Hawai'i's workforce of the future and help Hawai'i businesses succeed in their digital transformation.

One example for consideration is agribusiness. Although residents working in food service and agriculture sectors seem particularly skeptical in terms of whether electronic devices can help improve their productivity, agribusiness might be poised to be one of the most essential players in Hawai‘i’s future industry diversification. This is because Hawai‘i is located more than 2,500 miles from the continental United States and more than 85% of our food is imported from the mainland, which makes Hawai‘i particularly vulnerable to disruptions such as natural disasters that might interrupt the food supply. The recent pandemic has further revealed the essential need for Hawai‘i to be more self-sufficient in food production. Given the State’s goal of doubling Hawai‘i’s food production by 2030, dramatic development and innovation in the agribusiness sector will need to happen in order to meet this strategic mandate. A recent investigation (Terrell 2021) demonstrates that although Hawai‘i has more than 7,000 farms, only about 100 of them are big enough to sell as bulk to grocery stores, which leaves 90% of those farms in need of a viable venue to bring their food to people in Hawai‘i. Although making Hawai‘i food independent should start with getting more food produced locally, it is also about having better technology and systems to get food from small farms to the plates of consumers (Terrell 2021). As such, a major digital transformation of Hawai‘i’s food delivery system could result in significant improvement.

Today, food delivery has become a global market valued about \$150 billion, more than triple from 2017, and in the U.S. alone, this market has doubled during the pandemic (Wong 2021). Most of all this growth could be attributed to the digital transformation that has occurred in food delivery where food ordering apps and tech-enabled driver networks help streamline the demand and supply. Hawai‘i’s agribusiness could learn from the rapid digital evolution of food delivery to help small farmers become productive suppliers in Hawai‘i’s food supply ecosystem. All of these innovations and transformations will have to start from improving Hawai‘i workforce’s digital readiness and literacy.

SUMMARY OF FINDINGS

THE DIGITAL READINESS CONTINUUM

As digital readiness has expanded beyond its initial hardware-oriented definition (computer equipment capable of accessing the internet, as well as first Internet and then specifically to broadband access), other dimensions including self-efficacy, attitudes and behaviors have become important considerations in preparing residents for the digital age. To identify and group Hawai'i residents' level of digital readiness, this Digital Literacy and Readiness Study (DLRS) analyzed underlying similarities and differences based on respondents' self-assessment on seven (7) self-reported aspects of readiness:

- Confidence in using digital devices
- Ability to get new technology to work
- Productivity from using electronic info devices
- Ability to determine the trustworthiness of online info
- Perception of info overload from electronic devices
- Use of digital tools for learning
- Familiarity with contemporary "education tech" terms

Results from these areas were then analyzed to determine groupings along a digital readiness continuum.

Given that the 21st century anticipates continuing changes in technology and the fact that more and more educational tools are on-line, the model for developing readiness groups puts relatively more weight on self-efficacy especially pro-active curiosity to learn new things and thereby grow, and relatively less on functionality alone. The DLRS suggests Hawai'i residents are clustered into 5 groups based on the above seven (7) main factors. Those on the less prepared end of the Digital Readiness Scale, tend to be tech averse and less learning oriented, while those who are most ready tend to be ardent about growth through learning. In between are somewhat more traditional learners; those who are strong networkers but less curious about learning, and techies who are active learners though primarily in functional areas.

- **The Unprepared 17%** of residents 18 to 65 years old – They have the lowest level of tech adoption and tech ownership. They are least likely to learn (both online and others). They do not have confidence in their computer skills, need help setting up new tech devices, and least likely to feel productive using electronic device. They are not familiar with "ed tech" terms. This group is more likely to reside on the Neighbor Islands than on O'ahu, to be women, be between 45 to 65, have a higher incidence of retirees, have lower levels of education and lower income, and tend to be English as a second language speakers.
- **The Old Guard 23%** - More traditional in how they acquire information and learn, this group has the lowest level of tech adoption and tech ownership. They are least likely to learn (both online and through other channels). They do not have confidence in their computer skills, need help setting up new tech devices, and are least likely to feel productive using electronic device. They are not familiar with "ed tech" terms. Those in the Old Guard cluster skew male, are likewise between 45 to 65 years old, work in blue collar jobs, are self-employed, have a lower education and have a higher incidence born outside of Hawai'i.

- **The Social Users 19%** - While quite digitally adept, social users are not active learners and therefore don't particularly use the Internet for learning and self-development. They own technology, especially digital devices with Internet connections. Though confident in using electronic devices, they are most bothered by too much digital info. Best at sharing video content, "Social Users" use the digital environment to enable social networking as the name suggests. This group is characterized as Millennials or Gen X, meaning that they are between 18 and 35 years, are non-Japanese or Filipino Asians, are middle income (\$50,000 to \$100,000 and tend to be in Sales occupations.
- **The Technical Do-It-Yourselfers 15%** - They are active learners. Although they do not take online courses, they do engage in online learning informally. They are confident about their technology skills, especially when setting up new electronic devices. They are not bothered by too much digital info. They are most aware of "ed tech" terms. Tech DIY-ers reside on O'ahu, have higher education and higher income, work in professional occupations, and are single. In terms of their skill set, they are best at applying digital proficiency to find jobs.
- **The Digital Learners 26%** - They are ardent learners and learn from both online courses and other online sources. They have technology and are confident about their technology skills. They are more productive by using electronic information devices. They are aware of "ed tech" terms. Digital Learners are more concentrated on O'ahu, have higher education and higher income, are more likely to be professionals and in management, and are born in State. In terms of skills, they are best at digital creative skills.

The schematic below illustrates the Hawai'i Digital Literacy Continuum per above:



If the five digital readiness groups are aggregated by levels of readiness, Hawai'i shows 40% who are less prepared (The Unprepared and the Old Guard), and 60% who are more prepared (Social Users, Technical DIYers, and Digital Learners). Survey data used to group residents were collected between June to August 2021, more than a year after Hawai'i's Governor issued his first stay at home order due to the COVID-19 pandemic on March 23, 2020. National data showed that the pandemic environment in the U.S. resulted in increased use of internet services as residents turned to tele-work, tele-medicine and internet shopping.

Nonetheless, Hawai'i shows relatively lower rates of digital readiness than a national benchmark digital readiness survey conducted by the Pew Charitable Trust in 2015. Results from that study showed 19% who were less prepared – half as many as Hawai'i – and 81% who were more prepared - +21 percentage points more than in Hawai'i. Despite the size of the groupings, their relative characteristics proved somewhat similar in terms of lower education and income more likely among those digitally less ready.

Hawai'i (Omnitrak data from 2021)			U.S. MAINLAND (Pew Charitable Trust Data from 2015)		
Cluster	%	More likely characteristics	Cluster	%	More likely characteristics
LESS 40%	The Unprepared	17% -Neighbor Islands -Women -45 to 65 years / Retired -Lower education, lower income -Primary language non-English	The Unprepared	14%	-Women -50 and older -Lower income -Less formal education
	Old Guard	23% -Male -45 to 65 years; Blue collar/self employed -Lower education/ -Not born in Hawai'i	Traditional Learners	5%	-Women -Minorities -50 and older -Lower income/ less education
MORE 60%	Social Users	19% -18-34 years -Other Asians (non-Japanese/ Filipino) -Middle income (\$50-100K) -Sales / Best at sharing video content	The Reluctant	33%	-Men -50 and older -Lower income -Less formal education
	Technical DIYers	15% -O'ahu -Higher education/ higher income -Single/ Professional -Best digital skills to find jobs	Cautious Clickers	31%	-Higher income -Some college -30s and 40s
	Digital Learners	26% -O'ahu -Higher education/ higher income -Born in Hawai'i -Professional/ Best digital creative skills	The Digitally Ready	17%	-Higher income -Higher education -30s & 40s
			81%		

PROFILE OF READINESS GROUPINGS STATEWIDE

The above slide summarizes significant demographic differences by groupings. The tables below further detail the characteristics of each cluster. As can be seen, generally the more digitally ready groups are more likely to be 18 to 34 years, in professional jobs, higher income households of \$100,000 and more, of Japanese ancestry, and on O'ahu. Less digitally ready groups are differentiated by age (35 to 54 years of age); have education levels short of a college degree; have lower household income, and were born outside of Hawai'i.

Demographic Characteristics Of Digital Readiness Groups (Statewide)

% SUM VERTICALLY	Unprepared (17%)	Old Guard (23%)	Social Users (19%)	Technical DIYers (15%)	Digital Learners (26%)
COUNTY					
Oahu	58%	67%	66%	78%	78%
Neighbor Island (Net)	42%	33%	34%	22%	22%
Hawai'i County	21%	16%	10%	10%	11%
Maui County	16%	9%	14%	9%	9%
Kaua'i County	5%	7%	10%	2%	2%
GENDER					
Male	34%	62%	47%	52%	48%
Female	66%	38%	53%	48%	52%
AGE					
18-34	13%	21%	55%	61%	42%
35-54	48%	41%	31%	29%	36%
55-65	39%	37%	14%	10%	22%
Average (in years)	48.3	47.6	34.9	33.5	39.7
EDUCATION					
HS Graduate or less	53%	28%	41%	24%	23%
Business/Trade School/Some Col	27%	53%	34%	49%	42%
College Graduate/Post-Graduate	20%	19%	25%	27%	35%
HOUSEHOLD INCOME					
Less than \$50,000	41%	23%	27%	29%	18%
\$50,000 but less than \$100,000	41%	46%	53%	26%	30%
\$100,000 but less than \$150,000	12%	21%	9%	36%	27%
\$150,000 and over	6%	10%	11%	10%	25%
YEARS IN HAWAII					
Born in Hawai'i	55%	55%	59%	65%	72%
Not Born in Hawai'i (Net)	45%	45%	41%	35%	28%
1 to 20 years	11%	24%	26%	24%	13%
20 years or more	35%	21%	15%	11%	14%
ETHNICITY					
Caucasian	22%	18%	20%	18%	14%
Japanese	10%	18%	9%	32%	27%
Hawaiian/part Hawaiian	23%	29%	20%	28%	25%
Filipino	16%	5%	9%	10%	8%
Other Asian	7%	6%	27%	3%	4%
Mixed	14%	4%	2%	7%	13%
Other	9%	18%	13%	1%	7%
HOUSEHOLD SIZE					
1-2	45%	41%	23%	42%	37%
3-4	34%	40%	57%	42%	40%
5+	21%	19%	20%	16%	23%
Average	3.5	3.2	3.6	3.1	3.3

In terms of current employment by type of job and industry, the digital readiness groupings are differentiated as follows:

- **The Unprepared** – Those least digitally ready tend to be retired, with 17% within this grouping indicating that job status. By industry, the Unprepared have a higher representation within the real estate sales sector (9%).
- **Old Guard** – This group, the second least ready on the Digital Readiness Continuum, is differentiated on five employment characteristics. They have the largest representation of both blue collar workers, with 1 in 5 reporting jobs as a laborer/ construction/farming (19%) and of residents

who are self-employed at 1 in 10 (10%). In addition, the Old Guard includes the second largest representation of retirees (13%). By industry sector, this less digitally ready group is comprised of eight percent from retailing and seven percent from maintenance – both significantly higher than in other groupings.

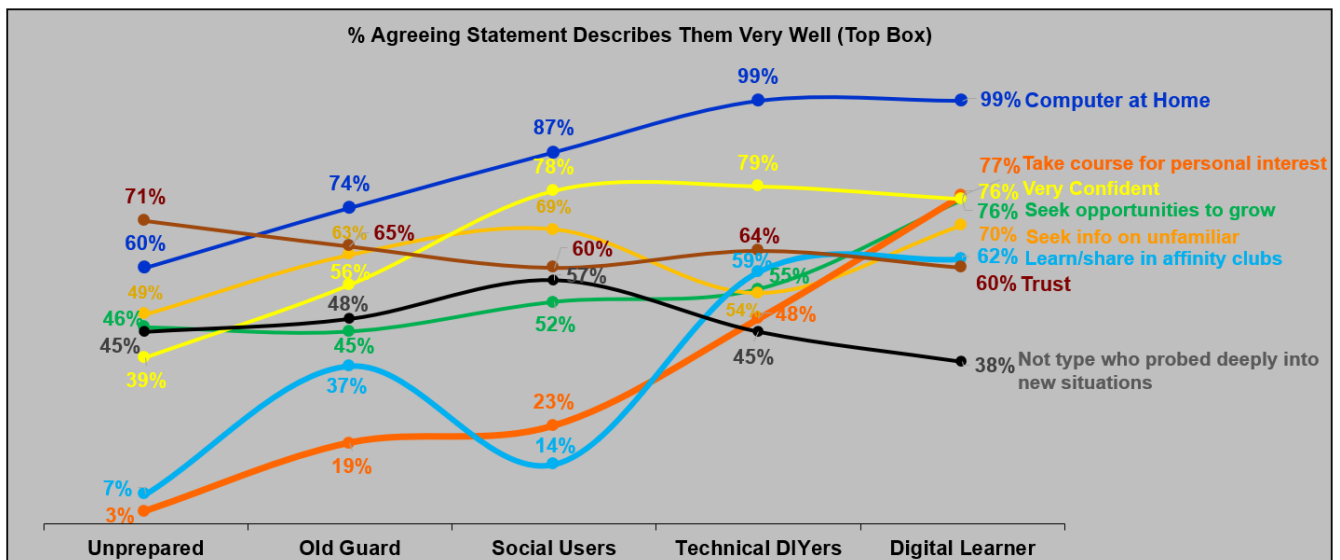
- **Social Users** – The most distinguishing job characteristics of this sector is the fact that a plurality of 17% are in Sales. This is by far the largest percentage across the groupings – About three times more than in the Digital Learners, Old Guard or Unprepared.
- **Technical DIYers** – Although this group has no statistically significant differences by industry sector, they are dominantly professionals (47%). The second largest occupation in this group is not employed (16%), which is a different category from retired.
- **Digital Learners** – By job, this most digital ready group dominantly work as professionals. They are also differentiated by industrial sector: While a plurality of 1 in 5 have jobs in the health sector (22%), 1 in 6 Digital Learners (18%) are in government and 6% in other services.

	Unprepared (17%)	Old Guard (23%)	Social Users (19%)	Technical DIYers (15%)	Digital Learners (26%)
OCCUPATION					
Professional	23%	20%	24%	47%	43%
Blue Collar (laborer/farmer/construction, etc.)	10%	19%	11%	5%	4%
Administrative/Clerical	12%	7%	12%	5%	12%
Management	6%	7%	10%	9%	8%
Sales	5%	6%	17%	1%	6%
Technical	5%	3%	6%	8%	6%
Self-employed	3%	10%	7%	2%	1%
Partner/Owner/Proprietor	3%	2%	1%	1%	6%
Service for hotel/restaurant, etc.	6%	2%	2%	-	1%
Other	1%	4%	0%	0%	4%
Students	-	-	-	4%	1%
Homemaker/Caregiver	8%	2%	2%	1%	2%
Not Employed	3%	6%	4%	15%	3%
Retired	17%	13%	3%	2%	4%
INDUSTRY					
Health	18%	10%	19%	21%	22%
Government	6%	8%	9%	16%	18%
Education (Non-government/private)	5%	5%	15%	16%	11%
Construction / Building	13%	12%	12%	3%	3%
Tourism	7%	8%	6%	1%	2%
Retailing	6%	8%	5%	1%	2%
Transportation	6%	5%	2%	3%	1%
Other Service	4%	5%	4%	0%	6%
Food Service	7%	3%	2%	5%	2%
Legal / Law / Enforcement / Security	2%	6%	2%	3%	4%
Real Estate	9%	2%	1%	-	4%
Financial services / banks	4%	4%	1%	1%	4%
Maintenance	2%	7%	3%	1%	2%
Computer / Technology	2%	0%	4%	5%	2%
Agriculture	1%	3%	1%	4%	3%
Non-Profit	0%	1%	1%	4%	1%
Manufacturing / Distribution	1%	2%	3%	4%	1%
Other	6%	12%	11%	12%	11%

DIGITAL ATTITUDES AND BEHAVIORS

As indicated earlier, inputs into the Digital Readiness model included respondents' digital attitudes and behaviors. These responses were taken from different questions, as shown in the footnote to the graphs below. Depending on the question, the percentages show respondents answering "Yes" e.g., have a computer of any type at home; or top box ratings of 4 on a 4-point scale, e.g., "describes me very well" or "very confident."

- In four areas, an almost straight line increase is seen among the readiness groups. The incidence of having a home computer stands at 60% among The Unprepared, rising to 99% among the Technical DIYers and the Digital Ready. In terms of taking courses in areas of personal interest, the change slope is steeper: from 3% among the Unprepared to 77% among Digital Learners. Similarly, 46% of Unprepared vs. 76% of Digital Learners seek out opportunities to grow. While 39% of Unprepared are very confident in their digital skills, 76% are among Digital Learners.



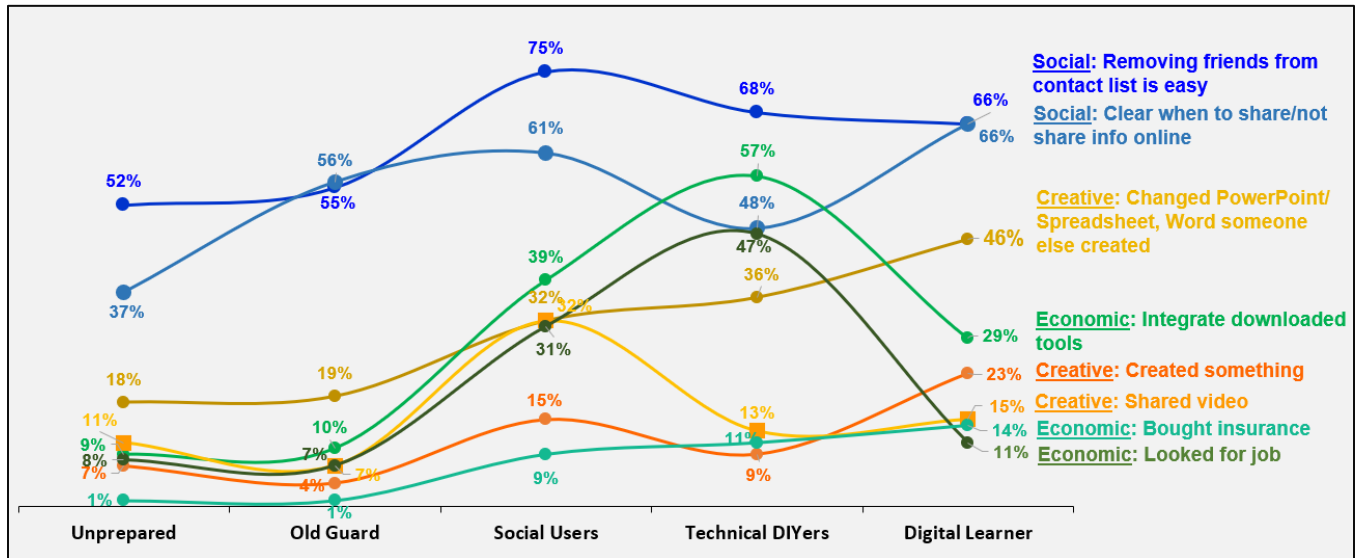
Aggregating these attitudes and behaviors, the groups' mindset can be described as follows:

- Digital Learners** at the most prepared end of the Digital Readiness Continuum seek opportunities to grow through knowledge. Knowledge acquisition is part of their lifestyle and a pathway to growth. Whether through online courses or exchanging information with affinity groups – be it a book or sports club – they are pro-active in wanting more information and a better understanding of both personal interests and the unfamiliar. With high self-efficacy in their digital skills, they are able to learn on their own by engaging in online courses. It appears that many professionals and senior/ executive manager belong to this group.

- **Technical DIYers**, the second most ready group, are most technically proficient and are very confident in their abilities. However, they are generally less curious to seek information on the unfamiliar and less likely than Digital Learners to take courses for personal interests. They acquire knowledge informally online and tend toward a DIY approach to gain functionality rather than structured learning through formal online courses. Their occupations suggest that this group could include programmers and computer technicians.
- **Social Users** are more focused on information to share with their network and less likely than Digital Learners or Technical DIYers to take courses for personal interest or to learn through affinity groups. While curious about the unfamiliar, their interest is more cursory as they are less likely to see knowledge as a path to growth and have less need to probe deeply into new topics/situations. Digitally adept networkers are more likely to be in Sales occupations.
- **The Old Guard** is more equipped for the digital age than The Unprepared, but they are not motivated to take online courses in personal interest areas or to learn by sharing information in affinity groups. Most don't seek opportunities to grow through knowledge acquisition and tend to be more traditional in their learning approach. They are more likely to be in jobs relying on physical labor rather than working at their desk.
- **The Unprepared** group is both unequipped for and unengaged in preparing for the digital economy. They have lowest confidence in using digital devices and lowest incidence in learning whether online or through clubs. Demographically they skew older and retired. Given their current status, converting them to learning digital skills is likely to be most challenging.

DIGITAL SKILL LEVELS

Digital skills by readiness groupings are somewhat counter-intuitive. The most technologically proficient are not necessarily the most digitally ready. Rather, technical skills are highest overall for Technical DIYers who have high digital functionality. Although Digital Learners may not need to use the internet for economic matters, they have the highest usage on the Creative Factor – being able to change PowerPoint presentations, spreadsheets or Word documents created by someone else as well as creating something from existing online images, music, etc. Further, they trust their ability to make internet judgments. Social users have fair sharing and networking skills. Not surprisingly, digital functionality among the Old Guard and Unprepared are low.



The less digital ready are not without skills. In fact, many have a level of proficiency using social skills on the Internet. A majority report being able to remove friends from contact lists and a more than a third (37%) say they exercise judgment on when to share information online and when not to share. However, their Creative and Economic skills are definitely lower than for Social Users, Technical DIYers, and Digital Learners with about 1 in 10 or fewer being able to share videos (11%), integrate downloaded tools (9%), buy insurance (9%), look for a job on-line (8%), or create something (7%).

KEY CONCLUSIONS BY COUNTY

KEY CONCLUSIONS BY COUNTY

Throughout this report, study results for each question in the survey are shown for the State as a whole and then by each of four Counties – City and County of Honolulu, Hawai‘i County, Maui County and Kaua‘i County. While these details enable State and County workforce administrators to understand differences in needs by County, this section presents high level conclusions by County as an overview.

Summary of County Digital Readiness by County

The above analyses on Pages 25-26 show the statewide characteristics and distribution of each digital readiness grouping across the State. For example, 78% of all Digital Learners live on O‘ahu, an over-representation since the 2020 U.S. Census shows 70% of Hawai‘i’s population are O‘ahu residents. In contrast, the table below estimates the size of each digital readiness cluster within each county. In other words, among all O‘ahu residents, an estimated 14% are Unprepared and 29% are Digital Learners. This DLRS data enables counties to determine the types of programs needed within their counties and gives insight to decision making on fund allocations.

	Unprepared (17%)	Old Guard (23%)	Social Users (19%)	Technical DIYers (15%)	Digital Learners (26%)	TOTAL Sums Horizontally (Unweighted n=)
COUNTY						
O‘ahu	14%	22%	18%	17%	29%*	100% (n=353)
NEIGHBOR ISLAND (NET)	23%*	25%*	22%*	11%	19%	100% (n=438)
Hawai‘i County	26%*	28%*	14%	12%	20%	100% (n=182)
Maui County	24%	19%	23%	12%	21%	100% (n=164)
Kaua‘i County	17%	31%*	37%*	7%	9%	100% (n=92)

*Shows a statistically significant difference by cluster.

The table below summarizes potential key areas of focus for each county. O‘ahu has the opportunity to grow readiness by focusing on creative, employment and financial skills and harnessing the digitally ready to help others. Hawai‘i and Kaua‘i programs might focus more on online skills as the foundation in addition to creative, employment and financial skills, with the former focusing on Unprepared and Old Guard and the latter on the Old Guard and Social Users. Native Hawaiians on both Islands have opportunities to grow digitally. To enhance readiness, Maui might target the Unprepared and Social Users.

	STATE	HONOLULU	HAWAII	MAUI	KAUAI
DIGITAL READINESS: Knowledge Gaps to Target	>Creative >Employment >Financial Skills	>Creative >Employment >Financial Skills	>Basic skills >Social skills >Online learning >Awareness of opportunities	>Creative >Employment >Financial Skills >Basic skills	>Basic skills >Social skills >Online learning >Awareness of opportunities
CLUSTER OPPORTUNITIES: Improvement and Champion	<u>For improvement:</u> Social Users Unprepared Old Guard	<u>For helping others:</u> Tech DIYers Digital Learners	<u>For improvement:</u> Unprepared Old Guard	<u>For improvement:</u> Unprepared Social Users <u>For helping others:</u> Digital Learners	<u>For improvement:</u> Old Guard Social Users
DEMOGRAPHICS TO TARGET	>35 years old >High school ed	>35 years old >High school ed	>Over 35 years old >Native Hawaiian >High school ed >Trade School	>Over 35 years old >High school ed	>Over 35 years old >Native Hawaiian >High school ed >Trade School

City & County of Honolulu

Residents in this county are confident in their digital skills, are most likely to embrace digital technology, practice these skills, and ultimately agree with the value they provide. Although this county reports the highest digital literacy level, all areas Statewide could improve knowledge gaps in Creative, Employment, and Financial skills online.

O‘ahu’s two most digitally ready clusters --- Digital Learners and Tech DIYers --- can be encouraged to act as community ambassadors who can help others improve their skills. In particular, interisland knowledge transfers are both important and needed to raise digital readiness levels on Neighbor Islands. The more digitally ready could share digital topics with other counties to further adoption. In addition, outreach to residents over 35 years old and those with a high school degree or less are important, as these groups Statewide will need extra assistance.

Hawai‘i County

This county will need the greatest support in digital skills. Programs might begin by improving basic online skills (opening a tab, downloading, bookmarks, key shortcuts). Next, as practical application is often the best method of adoption, a focus on podcasts and open online courses could appeal to Hawai‘i Island residents and help facilitate online skills. Improving specific social skills (sharing a post or the audience for the post) can help further increase digital adoption. As neighbor island counties also tend to have fewer learning opportunities, increasing awareness of virtual opportunities could facilitate interest.

The recommended focus for Hawai‘i County are The Unprepared and Old Guard clusters as this county contained relatively high proportions of these groups. A strategy focused on the Old Guard, which are likely to be Native Hawaiian and those with Business/Trade School educations, should focus on improving skills as they are often motivated to learn. The Unprepared segment will not only need attention to build basic skills training, but also – most importantly – will need to be motivated to learn by persuading them first of the value of digital skills.

Maui County

Aside from the City & County of Honolulu, residents here are the most prepared, and digitally skilled residents could also act as ambassadors to help improve literacy of less skilled groups. Areas of focus should center around Creative, Employment, and Financial online skills for all residents, as well as expanding basic online skills to less prepared groups.

For Maui County, the recommended focus for training and skills development are The Unprepared and Social Users. As there is a sufficiently strong base of Digital Learners within the County, they could be enlisted to share the importance and value of digital technologies. In addition, county residents over 35 years old and those with lower levels of education should also be engaged with the goal of addressing digital knowledge gaps.

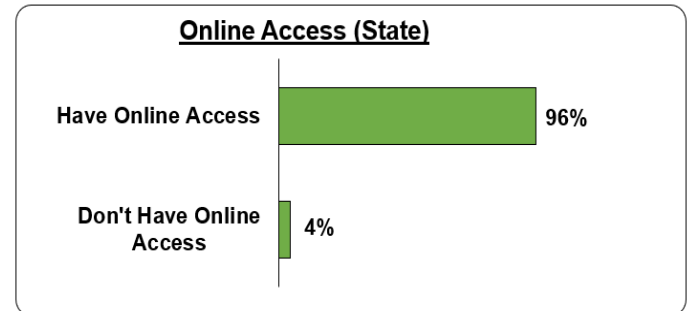
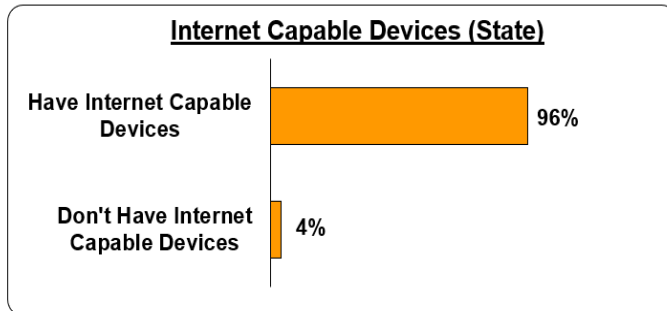
Kaua'i County

Similar to Hawai'i County, residents on Kaua'i should also be supported in basic online skills and learning opportunities, as residents here reported lower engagement compared to O'ahu and Maui.

Efforts on Kaua'i should focus on Social Users and the Old Guard. The good news is that these groups have either a high propensity to learn or some digital skills to build on. A strategy that addresses these gaps in basic digital skills and the need to motivate learning and knowledge transfer will be important to move Kaua'i residents overall along the digital readiness continuum. Once again, trusted community members can help to re-enforce these digital skills. In addition, outreach to those over 35 years old / high school education will be important to Kaua'i. Since these characteristics are likely to be targeted Statewide, Kaua'i has the opportunity to supplement statewide outreach. Further, it is recommended that Kaua'i county also reach out to Native Hawaiian and those with Business/Trade school educations to further improve digital literacy.

OVERALL FINDINGS ON DIGITAL READINESS

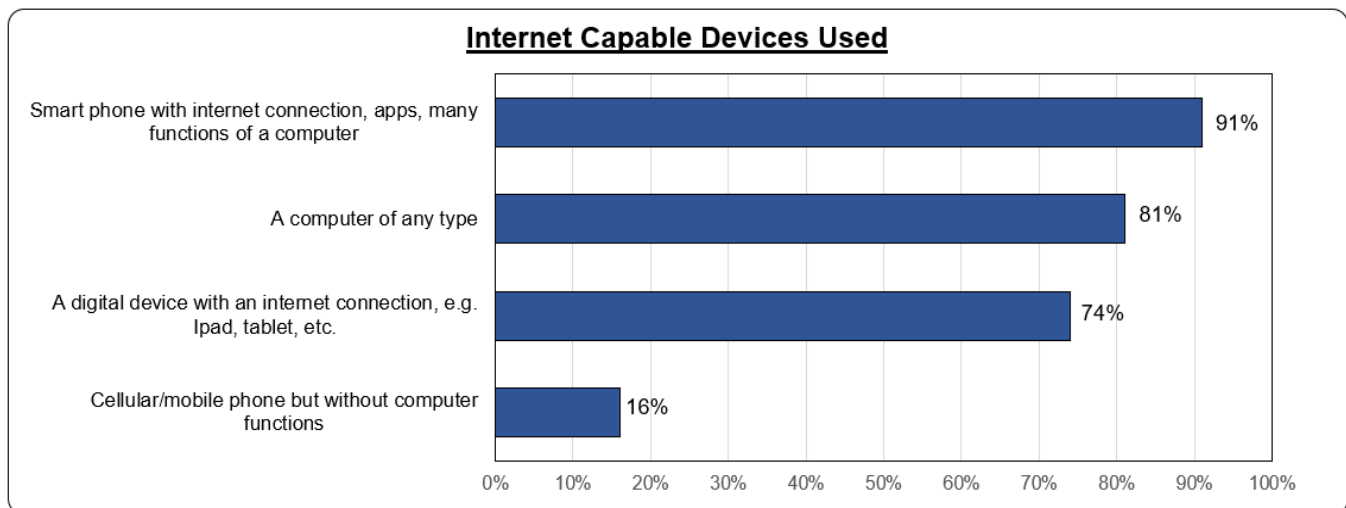
BASICS TO ACCESS THE DIGITAL ENVIRONMENT



	O'AHU	HAWAI'I	MAUI	KAUA'I
HAVE Internet Capable Devices	98%	89%	92%	100%
DON'T HAVE Internet Capable Devices	2%	11%	8%	-
Base	625	122	102	44

	O'AHU	HAWAI'I	MAUI	KAUA'I
HAVE Online access	97%	92%	96%	98%
DON'T HAVE Online access	3%	8%	4%	2%
Base	625	122	102	44

Historically, digital readiness was defined by possession of digital devices and access to internet services. However, these are no longer defining criteria. Large majorities of residents have the necessary equipment to access on the internet. In 2021 in Hawaii, 96% have at least one piece of hardware with internet capacity while only four percent do not. Specifically, 9 in 10 (91%) have a smart phone with an internet connection, and just slightly fewer or 1 in 8 (81%) have a computer of any type in their home.



Base: 893
QP2.A. Which, if any of the following do you have at home? Do you have...?

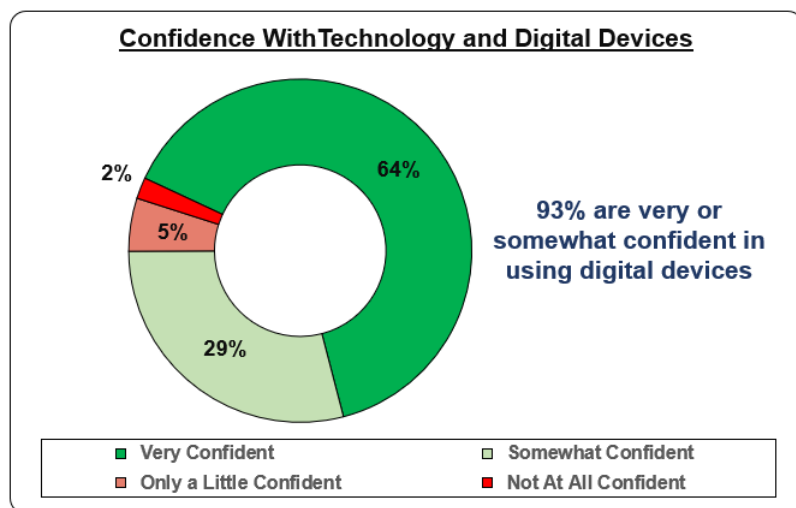
	O'AHU	HAWAI'I	MAUI	KAUA'I
Smart phone with internet connection, apps, many functions of a computer	94%	86%	83%	96%
A computer of any type	84%	71%	74%	75%
A digital device with an internet connection, e.g., iPad, tablet, etc.	76%	66%	73%	73%
Cellular/mobile phone but without computer functions	16%	21%	15%	13%
Base	625	122	102	44

In addition, almost all or 96% of Hawai‘i residents Statewide have some type of internet access and only four percent (4%) do not or don’t know. The majority of 57% reported broadband internet services, 29% cellular “hotspots,” and 10% other means of internet access. Among those using broadband, 61% use cable, 20% fiber optics, and 13% DSL.

Multiple Mentions	TOTAL	O‘AHU	HAWAI‘I	MAUI	KAUA‘I
Subscribe to higher-speed broadband internet service at home	57%	56%	55%	63%	53%
Use your cellular phone as a "hotspot" for internet access	29%	30%	25%	26%	28%
Use another means of internet access in your home	10%	10%	14%	5%	14%
Subscribe to "dial-up" internet service a home	2%	2%	0%	2%	2%
Base	1285	935	159	126	65

CONFIDENCE WITH TECHNOLOGY AND DIGITAL DEVICES

Hawai‘i residents overall are confident in their use of digital devices, as approximately two-thirds say they are very confident, while 29 percent are somewhat confident. Only seven percent of residents are not confident in their technology and digital device use. Residents on the Neighbor Islands and those over 35 years old had the lowest confidence in using these devices.



Base: 834 Smartphone owners only

QP8: Overall, how confident do you feel using computers, smartphones, or other electronic devices to do things you need to do online? Do you feel...[INSERT]?

Statistically Significant Demographics

	GEOGRAPHY			
	Oahu	Hawaii	Maui	Kauai
Confident (NET)	95%	88%	89%	89%
Not Confident (NET)	5%	12%	11%	11%
Base	389	191	177	98

	AGE		
	18-34	35-54	55-65
Confident (NET)	99%	90%	88%
Not Confident (NET)	1%	10%	12%
Base	139	382	334

Areas to improve confidence in technology and digital devices are among residents of Hawai‘i, Maui, and Kaua‘i counties and among those 35 years and older. Other demographic areas did not show any statistically significant findings.

Although all residents employed across industries had similar levels of confidence overall (Very + Somewhat), those employed in Agriculture, Manufacturing, Food Service, and Maintenance work had the lowest levels of those *Very Confident*. Regarding occupation, those in ‘Blue Collar’ work (Laborers,

Farmers, Construction, etc.) and those unemployed (looking for work, unemployed, and homemakers) also reported lower confidence in using technology.

		GEOGRAPHY				AGE		
	TOTAL	Oahu	Hawaii	Maui	Kauai	18-34	35-54	55-65
Confident (NET)	93%	95%	88%	89%	89%	99%	90%	88%
Not Confident (NET)	7%	5%	12%	11%	11%	1%	10%	12%
Base	834	593	107	90	43	325	306	203

	EDUCATION			INCOME			ETHNICITY				
	HS or Less	Business/ Some College	College / Post	<\$50K	\$50K - \$100K	\$100K+	Caucasian	Japanese	Hawaiian	Filipino	Other
Confident (NET)	89%	93%	97%	90%	94%	95%	93%	93%	93%	96%	92%
Not Confident (NET)	11%	7%	3%	10%	6%	5%	7%	7%	7%	4%	8%
Base	236	291	268	237	291	268	145	151	196	92	251

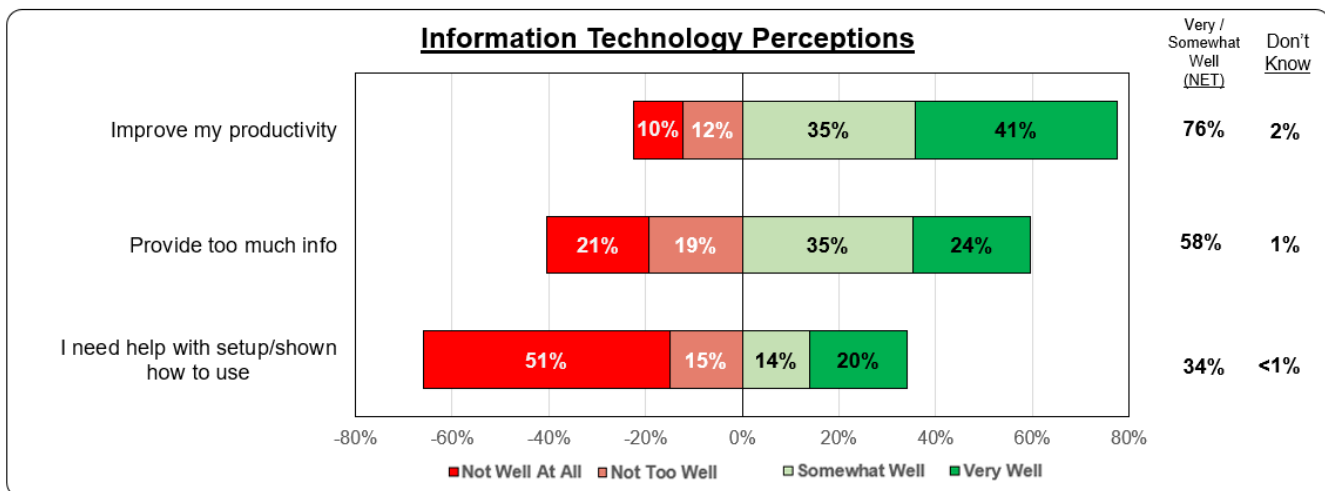
	INDUSTRY																	
	Health	Gov	Edu	Building Con- struction	Tourism	Retailing	Trans- port	Other Service	Food Service	Legal	Real Estate	Finan- cial Banking	Maint- enance	IT Tech	Agri- culture	Non- Profit	Manu- facture	Other
Confident (NET)	96%	99%	94%	89%	95%	91%	97%	82%	92%	98%	100%	84%	99%	100%	89%	100%	100%	99%
Very Confident	70%	75%	79%	68%	76%	60%	72%	61%	41%	79%	65%	61%	50%	93%	26%	90%	34%	74%
Base	114	83	66	60	31	34	24	27	20	22	21	20	19	17	17	12	13	71

	OCCUPATION								
	Professional	Blue Collar	Administrative Clerical	Management	Sales	Technical	Self- employed	Other	Not Employed/ Retired/Homemaker/ Caregiver
Confident (NET)	95%	92%	100%	95%	98%	98%	94%	89%	82%
Very Confident	67%	58%	71%	68%	87%	88%	77%	54%	47%
Base	245	79	80	64	54	53	35	63	121

QP8. Overall, how confident do you feel using computers, smartphones, or other electronic devices to do things you need to do online? Do you feel...?

ELECTRONIC DEVICES IMPACT ON PRODUCTIVITY

Hawai'i residents perceive technology favorably. Three in four (76%) say that electronic devices enhance their productivity and only about a third (34%) say they require assistance in setting up their devices. In contrast, a majority of slightly more than half (58%) are overwhelmed with the amount of information provided by them, suggesting an area for improvement.



Base: 893
 QP7. Now I'd like to ask you a few questions about how you deal with information and communications technology? How well does the statement [INSERT] describe you? Does it describe you Very Well, Somewhat Well, Not too Well or Not Well at All?

O'ahu residents, those under 54 years of age, those with some college or graduates, and those with middle-higher income; were more likely to view technology favorably. While those over 55 years old or lower educational attainments tended to need assistance with technological devices. Residents employed in the Food Service industry were least inclined to say technology improved their productivity, while those who say they often needed help setting up devices were employed in Transportation, Real Estate, or Financial. Among occupation, those in 'Blue Collar' work and those unemployed were less likely to perceive technology as improving their productivity and often needed assistance in utilizing it.

Very / Somewhat Well (NET)	GEOGRAPHY					AGE		
	TOTAL	Oahu	Hawaii	Maui	Kauai	18-34	35-54	55-65
Electronic devices improve my productivity	79%	82%	72%	70%	78%	85%	81%	68%
Electronic devices provide too much info	60%	58%	65%	66%	70%	61%	60%	60%
Electronic devices need to setup/shown how to use	35%	33%	41%	44%	36%	10%	41%	62%
Base	864	604	119	98	43	318	315	232

Very / Somewhat Well (NET)	EDUCATION			INCOME			ETHNICITY				
	HS or Less	Business/ Some College	College / Post	<\$50K	\$50K - \$100K	\$100K+	Caucasian	Japanese	Hawaiian	Filipino	Other
Electronic devices improve my productivity	68%	83%	86%	69%	87%	80%	74%	77%	80%	89%	79%
Electronic devices provide too much info	58%	58%	63%	58%	62%	61%	57%	53%	68%	73%	56%
Electronic devices need to setup/shown how to use	48%	29%	31%	41%	32%	33%	42%	29%	42%	19%	35%
Base	274	288	265	270	323	272	156	153	201	91	263

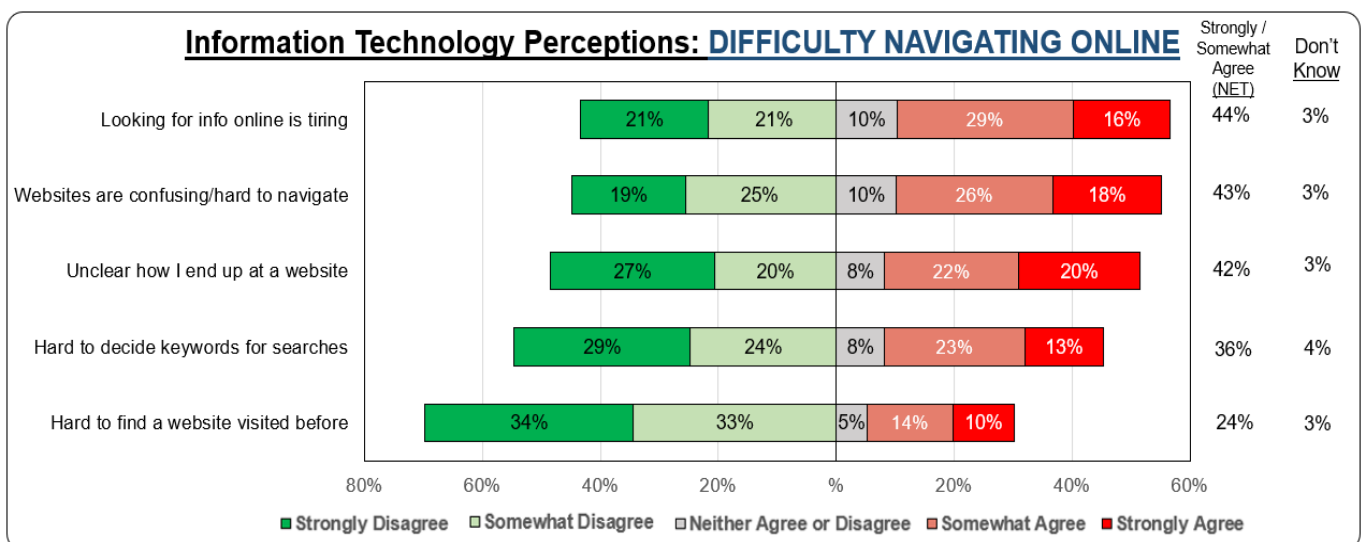
Very / Somewhat Well (NET)	INDUSTRY																	
	Health	Gov	Edu	Building Construction	Tourism	Retailing	Transport	Other Service	Food Service	Legal	Real Estate	Financial Banking	Maintenance	IT Tech	Agriculture	Non-Profit	Manufacture	Other
Electronic devices improve my productivity	81%	86%	90%	88%	87%	85%	75%	89%	41%	95%	82%	88%	91%	75%	63%	75%	89%	85%
Electronic devices provide too much info	54%	65%	47%	57%	74%	65%	80%	79%	69%	33%	50%	60%	41%	81%	81%	79%	53%	48%
Electronic devices need to setup/shown how to use	26%	29%	32%	29%	46%	29%	52%	64%	37%	12%	50%	54%	42%	21%	51%	6%	13%	28%
Base	111	81	64	60	34	33	30	24	26	23	21	20	19	12	17	15	13	81

Very / Somewhat Well (NET)	OCCUPATION								
	Professional	Blue Collar	Administrative Clerical	Management	Sales	Technical	Self-employed	Other	Not Employed/Retired/Homemaker
Electronic devices improve my productivity	85%	76%	85%	86%	91%	95%	74%	73%	58%
Electronic devices provide too much info	54%	60%	68%	55%	62%	66%	52%	64%	65%
Electronic devices need to setup/shown how to use	32%	45%	37%	34%	28%	13%	43%	22%	50%
Base	243	90	79	65	53	48	45	64	139

QP7. Now I'd like to ask you a few questions about how you deal with information and communications technology? How well does the statement... describe you? Does it describe you Very Well, Somewhat Well, Not too Well or Not Well at All?

PERCEPTIONS OF NAVIGATING ONLINE

Regarding challenges navigating online environments, perception is somewhat split. Significant minorities of between 42 – 44 percent find websites tiring or confusing, and are unclear how they arrived at the site. However, a majority do not experience these concerns. Difficulty with keyword searches or visiting previously viewed sites were mentioned by fewer residents (about a third or less).



Base: 893

QX12. Next, Do you Strongly Agree, Somewhat Agree, Neither Agree or Disagree, Somewhat Disagree or Strongly Disagree that....?

Older residents and those with a high school degree or less were more likely to report difficulty navigating online sites. Those over 55 years old were particularly more likely to report they found websites to be confusing and were unclear how they ended up at a particular site. Residents with high school degrees or less education, tended to report it was difficult to decide on the search terms to use or to find a site they had previously visited. Overall, residents working in Transportation, Agriculture, Food Service, and Other Services had trouble navigating online sites. Those in Blue Collar employment, Self-employed, and Not employed, reported difficulty in Online navigation.

Strongly / Somewhat Agree (NET)		GEOGRAPHY				AGE		
	TOTAL	Oahu	Hawaii	Maui	Kauai	18-34	35-54	55-65
Looking for info online is tiring	44%	45%	36%	47%	48%	43%	49%	41%
Websites are confusing/hard to navigate	43%	44%	35%	50%	46%	36%	42%	56%
Unclear how I end up at a website	42%	43%	34%	41%	45%	35%	43%	49%
Hard to decide keywords for searches	36%	36%	29%	43%	40%	35%	34%	41%
Hard to find a website visited before	24%	24%	17%	30%	32%	26%	24%	22%
Base	893	625	122	102	44	333	324	237

Strongly / Somewhat Agree (NET)	EDUCATION			INCOME			ETHNICITY				
	HS or Less	Business/ Some College	College / Post	<\$50K	\$50K - \$100K	\$100K+	Caucasian	Japanese	Hawaiian	Filipino	Other
Looking for info online is tiring	49%	47%	40%	44%	44%	45%	43%	44%	53%	38%	41%
Websites are confusing/hard to navigate	49%	41%	37%	46%	42%	43%	51%	31%	48%	49%	40%
Unclear how I end up at a website	45%	44%	38%	42%	39%	45%	36%	39%	59%	24%	39%
Hard to decide keywords for searches	44%	31%	29%	45%	27%	39%	35%	40%	41%	34%	31%
Hard to find a website visited before	33%	24%	17%	28%	23%	22%	21%	16%	33%	22%	25%
Base	281	300	273	277	339	277	166	155	207	93	272

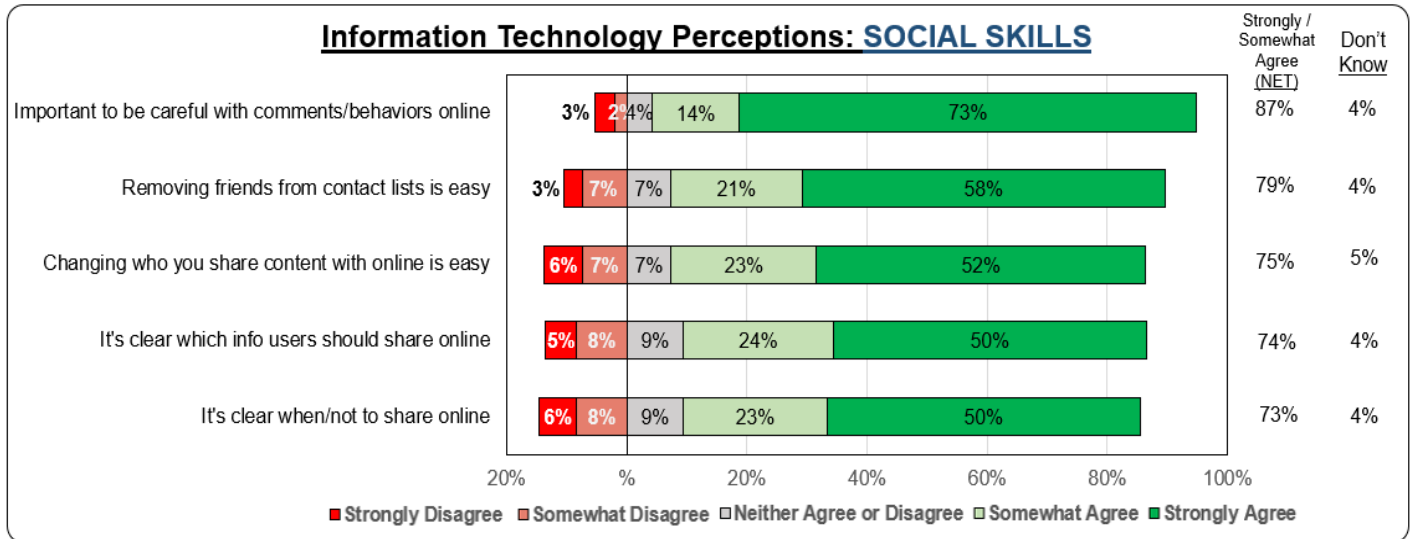
Strongly / Somewhat Agree (NET)	INDUSTRY																	
	Health	Gov	Edu	Building Construction	Tourism	Retailing	Transport	Other Service	Food Service	Legal	Real Estate	Financial Banking	Maintenance	IT Tech	Agriculture	Non-Profit	Manufacture	Other
Looking for info online is tiring	48%	45%	32%	49%	33%	27%	42%	75%	76%	21%	13%	54%	30%	62%	79%	54%	56%	53%
Websites are hard to navigate	35%	42%	26%	40%	54%	34%	61%	69%	61%	23%	18%	62%	40%	47%	72%	64%	55%	28%
Unclear how I end up at a website	38%	55%	28%	29%	45%	18%	56%	54%	46%	54%	32%	64%	29%	50%	69%	30%	20%	52%
Hard to decide keywords for searches	36%	35%	18%	34%	37%	9%	64%	57%	62%	24%	19%	27%	30%	37%	13%	27%	16%	31%
Hard to find a website visited before	31%	24%	12%	14%	27%	7%	47%	36%	57%	17%	9%	21%	1%	29%	73%	3%	22%	32%
Base	115	83	67	60	36	34	30	28	27	23	21	20	19	17	17	15	13	82

Strongly / Somewhat Agree (NET)	OCCUPATION								
	Professional	Blue Collar	Administrative Clerical	Management	Sales	Technical	Self-employed	Other	Not Employed/ Retired/ Homemaker
Looking for info online is tiring	43%	51%	50%	36%	30%	35%	73%	52%	46%
Websites are confusing/hard to navigate	36%	50%	55%	42%	30%	45%	29%	41%	52%
Unclear how I end up at a website	40%	42%	53%	32%	25%	30%	73%	44%	47%
Hard to decide keywords for searches	28%	50%	38%	14%	29%	19%	43%	35%	51%
Hard to find a website visited before	23%	35%	30%	16%	24%	11%	40%	28%	21%
Base	252	91	81	65	54	53	45	64	145

QX12. Next, Do you Strongly Agree, Somewhat Agree, Neither Agree or Disagree, Somewhat Disagree or Strongly Disagree that....?

DIGITAL SOCIAL JUDGMENT & SKILLS

Approximately a quarter or fewer residents, say they do not have a firm grasp on social sharing/communicating online. Residents were most skilled at removing friends from contact lists followed by sharing content with specific individuals. Overall, 87 percent agreed that it was important to be careful with online comments and behaviors.



Base: 893

QX12. Next, Do you Strongly Agree, Somewhat Agree, Neither Agree or Disagree, Somewhat Disagree or Strongly Disagree that...?

Residents over 35 years old and those with a high school education or less reported lower levels in online social skills compared to others. Those of Filipino ancestry reported higher levels of skills in these areas compared to other ethnicities. Residents in Building/Construction and Real Estate sectors, reported the most trouble with online social skills compared to others. Similar to online navigation, Blue Collar employment, Self-employed, and those Not Employed, also report difficulty in this area.

Strongly / Somewhat Agree (NET)	GEOGRAPHY					AGE		
	TOTAL	Oahu	Hawaii	Maui	Kauai	18-34	35-54	55-65
Important to be careful with comments/behaviors online	87%	88%	81%	92%	79%	89%	88%	85%
Removing friends from contact lists is easy	79%	80%	74%	75%	78%	82%	83%	68%
Changing who you share content with online is easy	75%	79%	66%	64%	66%	89%	72%	60%
It's clear which info users share online	74%	78%	60%	73%	69%	88%	70%	61%
It's clear when to share/not sure online	73%	75%	66%	71%	67%	85%	70%	60%
Base	893	625	122	102	44	333	324	237

Strongly / Somewhat Agree (NET)	EDUCATION			INCOME			ETHNICITY				
	HS or Less	Business/Some College	College / Post	<\$50K	\$50K - \$100K	\$100K+	Caucasian	Japanese	Hawaiian	Filipino	Other
Important to be careful with comments/behaviors online	77%	93%	93%	85%	86%	91%	86%	92%	94%	95%	78%
Removing friends from contact lists is easy	64%	86%	85%	73%	79%	84%	76%	76%	84%	81%	78%
Changing who you share content with online is easy	70%	79%	76%	66%	77%	81%	69%	75%	79%	67%	78%
It's clear which info users share online	69%	78%	76%	68%	76%	78%	61%	75%	85%	78%	73%
It's clear when to share/not sure online	69%	76%	75%	69%	78%	71%	65%	70%	80%	77%	73%
Base	281	300	273	277	339	277	166	155	207	93	272

QX12. Next, Do you Strongly Agree, Somewhat Agree, Neither Agree or Disagree, Somewhat Disagree or Strongly Disagree that...?

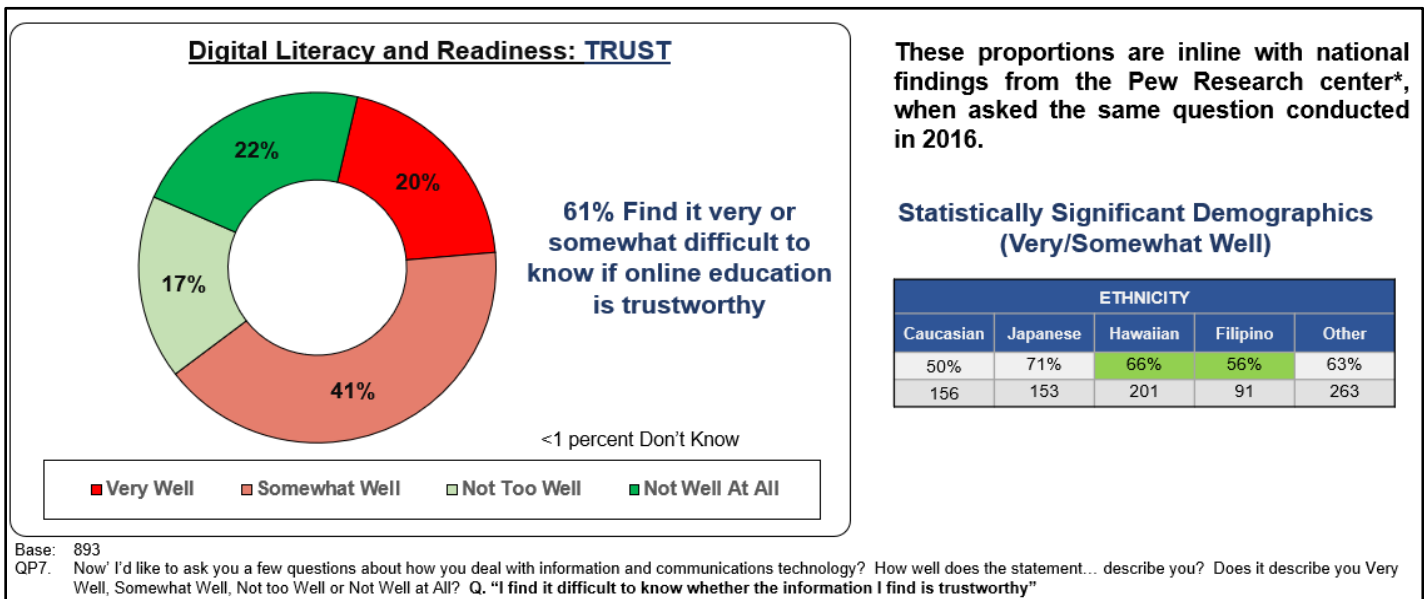
Strongly / Somewhat Agree (NET)	INDUSTRY																	
	Health	Gov	Edu	Building Construction	Tourism	Retailing	Transport	Other Service	Food Service	Legal	Real Estate	Financial Banking	Maintenance	IT Tech	Agriculture	Non-Profit	Manufacture	Other
Careful with behaviors online	97%	95%	79%	77%	95%	92%	100%	71%	100%	95%	82%	95%	93%	97%	90%	100%	86%	92%
Updating contact lists	96%	88%	83%	75%	89%	78%	69%	100%	55%	97%	79%	81%	92%	78%	62%	73%	90%	83%
Sharing content online is easy	82%	79%	87%	89%	71%	59%	86%	91%	54%	96%	73%	74%	61%	88%	67%	96%	49%	86%
Clear which info users share online	74%	75%	85%	71%	62%	53%	87%	90%	83%	96%	55%	80%	92%	69%	80%	94%	93%	81%
Clear when to share/not sure online	70%	69%	78%	74%	74%	51%	85%	60%	71%	92%	75%	80%	93%	85%	75%	79%	96%	90%
Base	115	83	67	60	36	34	30	28	27	23	21	20	19	17	17	15	13	82

Strongly / Somewhat Agree (NET)	OCCUPATION								
	Professional	Blue Collar	Administrative Clerical	Management	Sales	Technical	Self-employed	Other	Not Employed/Retired/Homemaker
Careful with behaviors online	97%	86%	97%	91%	60%	92%	87%	90%	76%
Updating contact lists	87%	70%	93%	94%	88%	84%	69%	80%	52%
Sharing content online is easy	84%	78%	84%	74%	74%	79%	78%	76%	53%
Clear which info users share online	80%	82%	81%	63%	69%	76%	72%	79%	63%
Clear when to share/not sure online	73%	81%	82%	78%	57%	75%	91%	76%	62%
Base	252	91	81	65	54	53	45	64	145

QX12. Next, Do you Strongly Agree, Somewhat Agree, Neither Agree or Disagree, Somewhat Disagree or Strongly Disagree that...?

DIGITAL TRUST

A majority of residents (61%) say it is very or somewhat difficult to know whether information online is trustworthy. Within this majority, 20 percent say this describes them very well, and 41 percent somewhat well. These proportions are in line with national findings from the Pew Research center*, when asked the same question conducted in 2016. Residents of Hawaiian or Filipino ancestry were more likely to say they found it difficult to trust online information.



Hawaiian and Filipino residents were also more likely to have lower trust and express difficulty in finding trusted information online. Other demographic groups reported similar levels of digital trust compared to their peers. Trust in digital information varied by industry and occupation. Residents employed in Finance or Manufacturing were the most skeptical online and were most likely to say it is difficult to find trusted information. Those employed in Sales also reported difficulty in finding trusted information online compared to other occupations.

Very / Somewhat Well (NET)		GEOGRAPHY				AGE		
	TOTAL	Oahu	Hawaii	Maui	Kauai	18-34	35-54	55-65
Finding trustworthy info is difficult	62%	63%	58%	64%	61%	64%	61%	62%
Base	864	604	119	98	43	318	315	232

Very / Somewhat Well (NET)	EDUCATION			INCOME			ETHNICITY				
	HS or Less	Business/ Some College	College / Post	<\$50K	\$50K - \$100K	\$100K+	Caucasian	Japanese	Hawaiian	Filipino	Other
Finding trustworthy info is difficult	64%	65%	57%	63%	63%	60%	50%	71%	66%	56%	63%
Base	274	288	265	270	323	272	156	153	201	91	263

Very / Somewhat Well (NET)	INDUSTRY																	
	Health	Gov	Edu	Building Con- struction	Tourism	Retailing	Trans- port	Other Service	Food Service	Legal	Real Estate	Finan- cial Banking	Maint- enance	IT Tech	Agri- culture	Non- Profit	Manu- facture	Other
Finding trustworthy info is difficult	57%	61%	65%	45%	68%	78%	57%	81%	60%	45%	56%	76%	73%	47%	49%	69%	91%	68%
Base	111	81	64	60	34	33	30	24	26	23	21	20	19	12	17	15	13	81

Very / Somewhat Well (NET)	OCCUPATION								
	Professional	Blue Collar	Administrative Clerical	Management	Sales	Technical	Self- employed	Other	Not Employed/ Retired/Homemaker/ Caregiver
Finding trustworthy info is difficult	67%	42%	49%	59%	88%	68%	57%	65%	63%
Base	243	90	79	65	53	48	45	64	139

QP7. Now I'd like to ask you a few questions about how you deal with information and communications technology? How well does the statement... describe you? Does it describe you Very Well, Somewhat Well, Not too Well or Not Well at All?

IMPACT OF SELF EFFICACY ON DIGITAL SKILLS, USAGE & TRUST

One of the dimensions of digital readiness that this study analyzes is self-efficacy. While it incorporates attitudes toward different aspects of digital skills and the environment, the overall general question that measures efficacy is this: *“Overall, how confident do you feel using computers, smartphones or other electronic devices to do things you need to do online - Very confident, somewhat confident, only a little confident, not at all confident?”*

The tables below clearly illustrate the importance of self-efficacy. Hawai‘i residents who are more confident online in fact do have higher digital skills, proficiency and trust. Conversely, residents with lower levels of digital trust are more likely to find the digital environment *“tiring,”* providing *“too much info,”* *“confusing,”* and *“hard to decide keywords for searches.”* They thus are less engaged in the digital learning environment.

What this data shows is that it is not only important in workforce development to teach skills training but also that it is essential to set the stage for skills development by emphasizing the personal benefits and opportunities that digital readiness and literacy offers different individuals, depending on their needs and their life stage. For younger people, for example, this may be economic growth or upwardly mobility; for older people it may be digital health tools, and for still others it may be socializing activities that digital skills can help to facilitate. Higher confidence and self-efficacy can boost engagement to acquire digital learning and that in turn enhances digital readiness and self-development for the digital economy,

DIGITAL SKILLS	DIGITAL CONFIDENCE	
	High	Low
Devices improve my productivity	84%	42%
Devices need to setup/shown how to use	37%	87%
Looking for info online is tiring	16%	35%
Websites are confusing/hard to navigate	15%	35%
Unclear how I end up at a website	18%	35%
Hard to decide keywords for searches	13%	28%
Hard to find a website visited before	7%	22%
Base	755	76

DIGITAL TRUST	DIGITAL CONFIDENCE	
	High	Low
Finding trustworthy info is difficult	59%	74%
Base	755	76

DIGITAL USAGE	DIGITAL CONFIDENCE	
	High	Low
Lifelong learners	98%	84%
Enjoy gathering unfamiliar information	96%	84%
Seek out new opportunities to grow	93%	70%
Open a tab in my browser	57%	18%
Open downloaded files	35%	3%
Downloaded/saved photo	35%	9%
Bookmarked a website	31%	6%
Used key shortcuts	29%	3%
Base	755	76

DIGITAL SKILLS	DIGITAL TRUST	
	Low	High
Devices provide too much info	66%	51%
Devices need to setup/shown how to use	38%	29%
Looking for info online is tiring	49%	36%
Websites are confusing/hard to navigate	47%	37%
Hard to decide keywords for searches	42%	28%
Hard to find a website visited before	28%	18%
Base	538	317

DIGITAL USAGE	DIGITAL TRUST	
	Low	High
Glad no longer in school/classes	71%	54%
No probing into new situations	53%	34%
Easily distracted when concentrating	51%	35%
Base	538	317

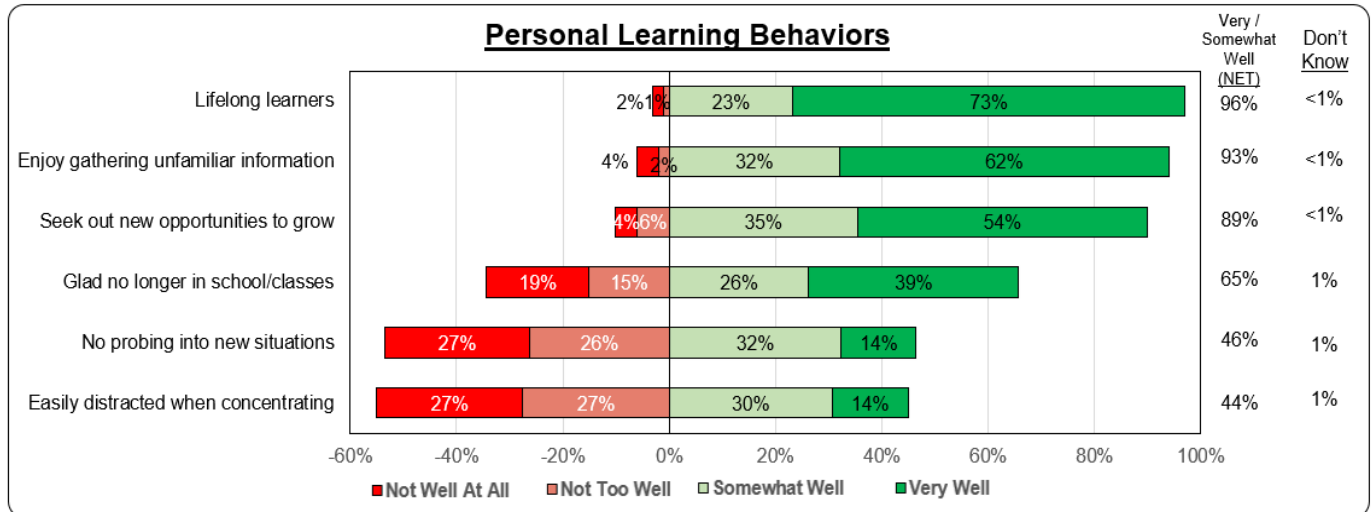
QP8. Overall, how confident do you feel using computers, smartphones, or other electronic devices to do things you need to do online? Do you feel...[INSERT]?

QP7. Now I'd like to ask you a few questions about how you deal with information and communications technology? How well does the statement [INSERT] describe you? Does it describe you Very Well, Somewhat Well, Not too Well or Not Well at All? Q. "I find it difficult to know whether the information I find is trustworthy"

LEARNING OPPORTUNITIES AND DIGITAL USAGE FOR KNOWLEDGE ACQUISITION

SELF PERCEPTIONS: PERSONAL LEARNERS

Hawai'i residents self-report that they are very open to new information and actively seek out learning. About 9 of 10 Hawai'i residents describe themselves as Lifelong learners; individuals who Enjoy gathering information, and residents who Seek opportunities for growth. On the other hand, almost half (46%) say they Do not probe into new situations, and about 3 in 7 (44%) report being Easily distracted when concentrating.



Although all residents say they are open to learning experiences, those on Kaua'i and younger residents are more likely to be open to learning experiences compared to others. In addition, college graduates and those with higher incomes are also more receptive to learning opportunities. Those employed in Building/Construction and Maintenance reported a lower propensity for learning attributes. Residents in Blue Collar occupations and those Not employed tended to have lower inclinations for learning attributes.

Very / Somewhat Well (NET)	GEOGRAPHY					AGE		
	TOTAL	Oahu	Hawaii	Maui	Kauai	18-34	35-54	55-65
Lifelong learners	96%	96%	98%	96%	93%	98%	96%	95%
Enjoy gathering unfamiliar information	93%	93%	96%	92%	96%	91%	97%	93%
Seek out new opportunities to grow	89%	90%	82%	89%	94%	95%	89%	80%
Glad no longer in school/classes	65%	67%	58%	62%	59%	62%	62%	72%
No probing into new situations	46%	45%	50%	47%	44%	48%	37%	54%
Easily distracted when concentrating	44%	45%	38%	43%	52%	51%	45%	34%
Base	893	625	122	102	44	333	324	237

Very / Somewhat Well (NET)	EDUCATION			INCOME			ETHNICITY				
	HS or Less	Business/Some College	College / Post	<\$50K	\$50K - \$100K	\$100K+	Caucasian	Japanese	Hawaiian	Filipino	Other
Lifelong learners	93%	97%	99%	94%	97%	99%	94%	98%	95%	98%	96%
Enjoy gathering unfamiliar information	90%	91%	98%	90%	95%	95%	95%	91%	90%	95%	96%
Seek out new opportunities to grow	77%	94%	95%	82%	91%	94%	81%	94%	91%	89%	89%
Glad no longer in school/classes	70%	61%	62%	61%	67%	65%	59%	72%	60%	68%	67%
No probing into new situations	50%	50%	40%	51%	45%	41%	35%	56%	48%	46%	45%
Easily distracted when concentrating	39%	48%	43%	49%	42%	44%	40%	48%	44%	46%	45%
Base	281	300	273	277	339	277	166	155	207	93	272

QP3. Now I'd like read you some questions about how you approach different situations when you want to learn something new. First, [READ STATEMENT] How well does the statement... describe you? Does it describe you Very Well, Somewhat Well, Not too Well or Not Well at All?

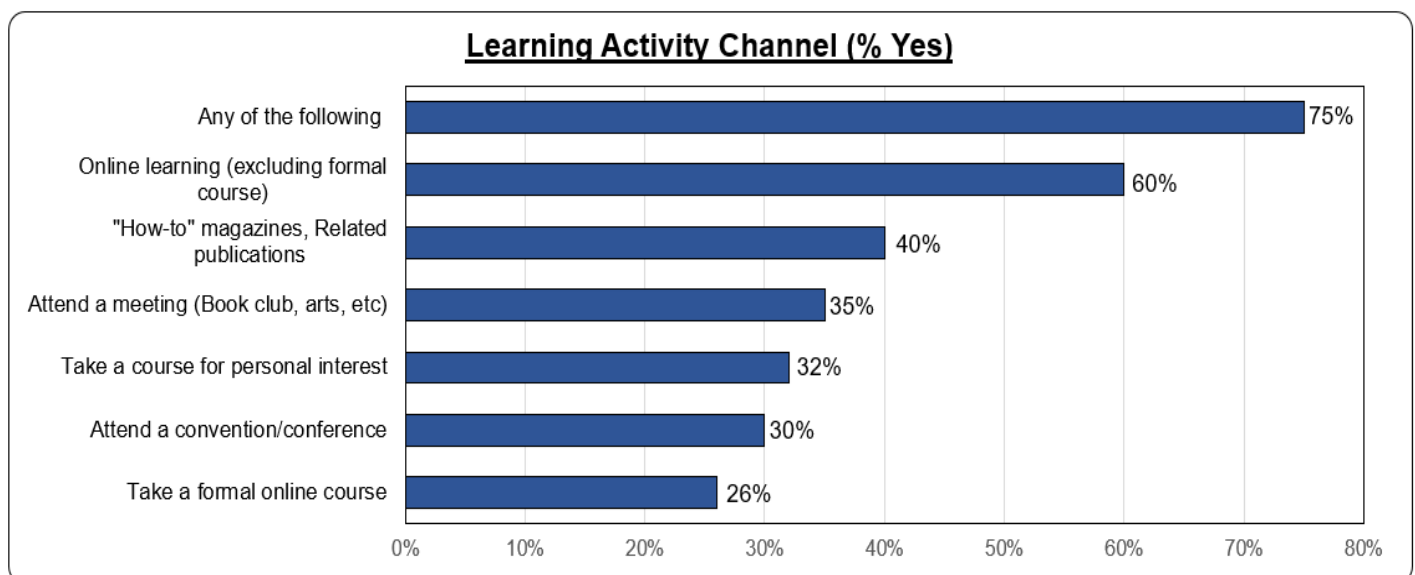
Very / Somewhat Well (NET)	INDUSTRY																	
	Health	Gov	Edu	Building Construction	Tourism	Retailing	Transport	Other Service	Food Service	Legal	Real Estate	Financial Banking	Maintenance	IT Tech	Agriculture	Non-Profit	Manufacture	Other
Lifelong learners	99%	98%	100%	99%	100%	92%	79%	90%	83%	100%	100%	96%	100%	97%	100%	99%	100%	100%
Enjoy unfamiliar information	89%	96%	94%	92%	96%	89%	82%	91%	78%	100%	100%	96%	92%	97%	100%	100%	100%	95%
Seek out new opportunities to grow	90%	96%	96%	94%	98%	90%	76%	85%	83%	97%	99%	89%	100%	97%	95%	100%	100%	83%
Glad no longer in school	60%	62%	33%	78%	65%	60%	74%	72%	62%	68%	86%	71%	72%	54%	35%	60%	57%	75%
No probing in new situations	39%	49%	43%	27%	51%	47%	56%	28%	42%	27%	26%	61%	80%	23%	53%	47%	54%	62%
Easily distracted when concentrating	42%	49%	52%	29%	45%	36%	40%	42%	46%	25%	26%	34%	53%	75%	57%	41%	26%	46%
Base	115	83	67	60	36	34	30	28	27	23	21	20	19	17	17	15	13	82

Very / Somewhat Well (NET)	OCCUPATION								
	Professional	Blue Collar	Administrative Clerical	Management	Sales	Technical	Self-employed	Other	Not Employed/Retired/Homemaker
Lifelong learners	99%	90%	99%	96%	100%	98%	98%	100%	91%
Enjoy unfamiliar information	93%	82%	96%	95%	98%	99%	98%	94%	92%
Seek out new opportunities to grow	93%	86%	95%	92%	98%	97%	81%	92%	72%
Glad no longer in school	64%	81%	57%	71%	52%	60%	59%	53%	66%
No probing in new situations	42%	44%	53%	37%	57%	33%	47%	53%	58%
Easily distracted when concentrating	40%	38%	52%	41%	54%	30%	57%	42%	47%
Base	252	91	81	65	54	53	45	64	145

QP3. Now I'd like read you some questions about how you approach different situations when you want to learn something new. First...How well does the statement...describe you? Does it describe you Very Well, Somewhat Well, Not too Well or Not Well at All?

ONLINE LEARNING OPPORTUNITIES

In terms of acting on learning opportunities, the most popular channel was via *Online Learning* (60%), followed by *How-to publications* (40%). The remaining channels were mentioned by a third or less residents: *Attend a meeting*, *Take a course for personal interest*, and *Attend a convention*. *Taking a formal online course* was mentioned by only a quarter of residents.



Base: 893

QP4. In the year 2019, before the pandemic, did you...?

Online learners were more likely to be College graduates, higher income, and of Native Hawaiian ancestry. Those who have taken a formal online course tended to be located on O‘ahu, have graduated from College, and have Higher income.

Residents in Government, Legal, Financial, and Other Services were most likely to participate in online opportunities while Professional, Administrative, and Management occupations also tended to participate in these areas.

(% Yes)		GEOGRAPHY				AGE		
	TOTAL	Oahu	Hawaii	Maui	Kauai	18-34	35-54	55-65
Any of the following	75%	79%	72%	65%	61%	79%	73%	73%
Online learning (excluding formal course)	60%	65%	53%	46%	47%	63%	61%	54%
How-to magazines, Related publications	40%	38%	45%	42%	42%	28%	44%	52%
Attend a meeting (Book club, arts, etc)	35%	37%	40%	27%	20%	38%	32%	36%
Take a course for personal interest	32%	37%	24%	26%	11%	45%	27%	21%
Attend a convention/conference	30%	35%	16%	24%	14%	36%	24%	29%
Take a formal online course	26%	30%	17%	19%	8%	31%	25%	21%
Base	893	625	122	102	44	333	324	237

(% Yes)	EDUCATION			INCOME			ETHNICITY				
	HS or Less	Business/ Some College	College / Post	<\$50K	\$50K - \$100K	\$100K+	Caucasian	Japanese	Hawaiian	Filipino	Other
Any of the following	64%	79%	82%	73%	69%	85%	73%	88%	79%	76%	66%
Online learning (excluding formal course)	41%	69%	67%	50%	55%	75%	53%	79%	63%	61%	51%
How-to magazines, Related publications	31%	44%	47%	38%	36%	47%	49%	45%	43%	23%	35%
Attend a meeting (Book club, arts, etc)	24%	43%	41%	33%	33%	40%	43%	57%	36%	17%	23%
Take a course for personal interest	26%	37%	38%	28%	29%	41%	28%	53%	30%	29%	26%
Attend a convention/conference	25%	40%	28%	23%	27%	41%	24%	49%	28%	30%	24%
Take a formal online course	15%	27%	32%	21%	20%	38%	21%	34%	26%	40%	20%
Base	281	300	273	277	339	277	166	155	207	93	272

(% Yes)	INDUSTRY																	
	Health	Gov	Edu	Building Con- struction	Tourism	Retailing	Trans- port	Other Service	Food Service	Legal	Real Estate	Finan- cial Banking	Maint- enance	IT Tech	Agri- culture	Non- Profit	Manu- facture	Other
Any of the following	70%	86%	67%	83%	59%	57%	68%	69%	54%	96%	79%	78%	90%	84%	91%	70%	65%	83%
Online learning	63%	74%	54%	49%	53%	47%	49%	68%	38%	80%	55%	75%	71%	58%	72%	39%	63%	68%
How-to magazines	30%	58%	38%	36%	42%	29%	42%	29%	43%	51%	34%	59%	64%	16%	55%	26%	43%	32%
Attend a meeting	46%	39%	38%	26%	21%	25%	24%	30%	25%	41%	35%	24%	51%	54%	35%	44%	10%	35%
Take a course	45%	35%	34%	28%	28%	14%	12%	53%	23%	39%	20%	38%	34%	83%	20%	18%	44%	36%
Attend a conference	32%	41%	17%	34%	19%	17%	11%	41%	28%	20%	47%	27%	38%	61%	54%	19%	44%	43%
Formal online course	34%	44%	28%	14%	11%	9%	13%	43%	12%	36%	38%	46%	15%	26%	28%	11%	12%	28%
Base	115	83	67	60	36	34	30	28	27	23	21	20	19	17	17	15	13	82

(% Yes)	OCCUPATION								
	Professional	Blue Collar	Administrative Clerical	Management	Sales	Technical	Self-employed	Other	Not Employed/ Retired/ Homemaker
Any of the following	84%	72%	67%	76%	54%	69%	81%	76%	72%
Online learning	70%	49%	56%	64%	39%	61%	63%	64%	51%
How-to magazines	47%	28%	34%	47%	9%	44%	31%	55%	47%
Attend a meeting	50%	23%	27%	32%	7%	32%	16%	45%	43%
Take a course	39%	21%	31%	40%	29%	39%	18%	45%	31%
Attend a conference	34%	38%	21%	41%	21%	36%	29%	31%	26%
Formal online course	35%	8%	32%	30%	22%	26%	6%	37%	13%
Base	252	91	81	65	54	53	45	64	145

QP4.A Next, I have a few questions related to your personal interests, outside of a job. work. This might include interests related to a hobby, your home, health, religion, your community of other areas of personal interest to you. In the year 2019, before the pandemic, did you...?

TIME SPENT ON LEARNING ACTIVITIES

Although most users participated in online and in-person learning activities, and read publications for personal learning, many spent a limited amount of time on these activities. While a third say they spent less than a day, on average, residents spent 44 days learning through these channels.

Around 1 in 5 or 19 percent were avid learners, spending +51 days a year or around one day a week participating in these learning activities.

Time Spent on Learning Activities	
Less than 1 day	33%
1 - 5 days	16%
6 - 10 days	10%
11 - 20 days	8%
21 - 30 days	9%
30 - 50 days	5%
51 - 60 days	3%
60+ days	16%
Average (in days)	44 days
Base	599

Residents located on O‘ahu, those between 18 to 34 years old, with a high school degree or less, and those earning lower incomes (less than \$50K), were likely to spend less time on learning activities compared to other groups. Those reporting the longest time spent in learning activities tended to work in the Government, Tourism, and Transportation industries, and held jobs in Administrative/Clerical, Management, or Technical fields.

		GEOGRAPHY				AGE		
	TOTAL	Oahu	Hawaii	Maui	Kauai	18-34	35-54	55-65
Average (in days)	44.2	38.9	38.8	69.0	100.3	36.9	43.4	56.1
10 days or less	59%	62%	57%	44%	41%	60%	57%	62%
11 days to 1 month	17%	15%	14%	24%	28%	20%	16%	12%
1 to 2 months	8%	8%	11%	8%	0%	9%	8%	8%
Over 2 months	16%	14%	18%	24%	30%	11%	19%	18%
Base	584	424	81	55	23	215	219	150

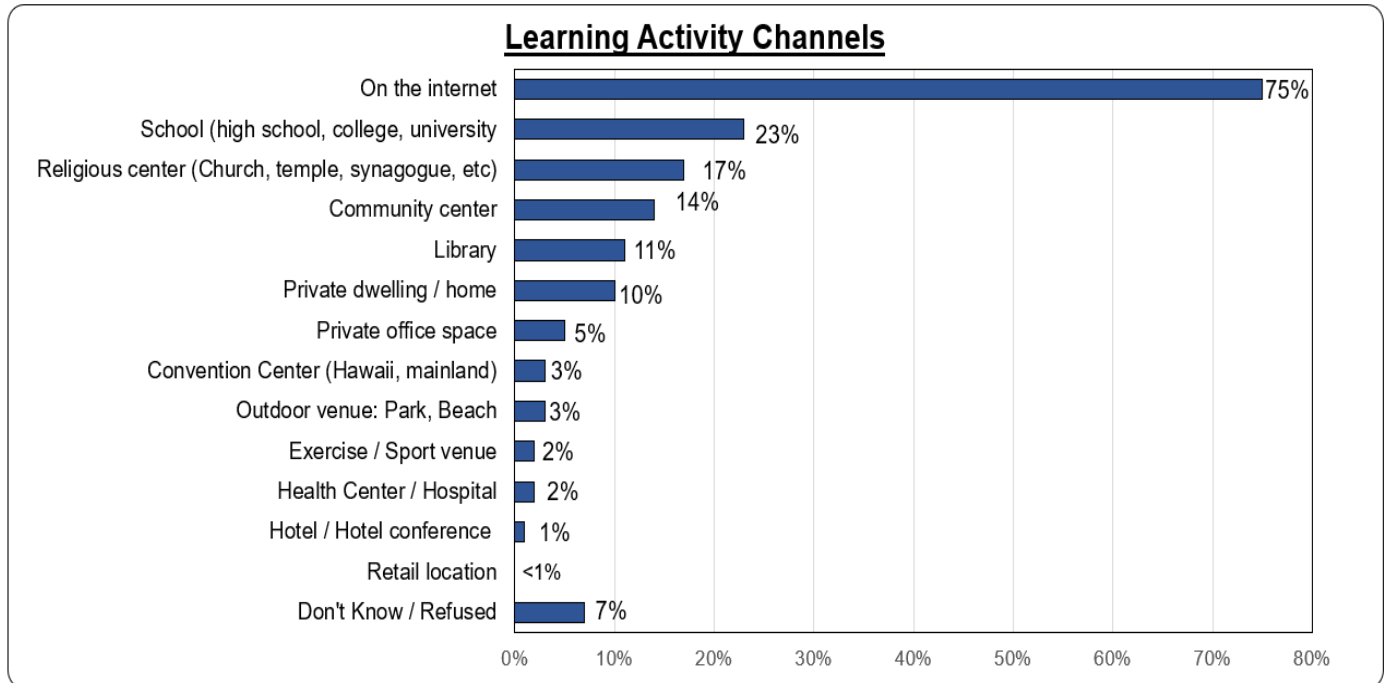
	EDUCATION			INCOME			ETHNICITY				
	HS or Less	Business/ Some College	College / Post	<\$50K	\$50K - \$100K	\$100K+	Caucasian	Japanese	Hawaiian	Filipino	Other
Average (in days)	41.5	36.3	53.3	39.4	38.8	53.6	35.4	39.5	48.0	55.4	46.8
10 days or less	60%	59%	58%	66%	53%	59%	69%	60%	52%	58%	58%
11 days to 1 month	16%	21%	13%	11%	23%	15%	15%	16%	18%	22%	16%
1 to 2 months	7%	10%	8%	7%	11%	7%	6%	7%	15%	4%	6%
Over 2 months	17%	11%	21%	16%	14%	19%	11%	17%	15%	16%	20%
Base	156	212	204	174	203	206	103	126	143	48	163

	INDUSTRY																	
	Health	Gov	Edu	Building Con- struction	Tourism	Retailing	Trans- port	Other Service	Food Service	Legal	Real Estate	Finan- cial Banking	Maint- enance	IT Tech	Agri- culture	Non- Profit	Manu- facture	Other
Average (in days)	30.3	65.4	32.2	64.6	93.3	20.7	71.5	11.0	21.6	88.1	21.9	42.2	26.7	30.1	31.1	31.9	10.5	28.9
10 days or less	63%	50%	52%	68%	31%	47%	58%	77%	67%	26%	40%	78%	47%	54%	78%	73%	39%	69%
11 days to 1 month	16%	13%	32%	6%	25%	28%	0%	21%	3%	32%	52%	12%	4%	12%	2%	5%	58%	18%
1 to 2 months	7%	11%	4%	3%	9%	22%	10%	0%	12%	23%	2%	0%	34%	28%	11%	1%	3%	5%
Over 2 months	14%	26%	12%	23%	35%	2%	31%	1%	18%	19%	6%	10%	14%	6%	10%	20%	--	8%
Base	115	83	67	60	36	34	30	28	27	23	21	20	19	17	17	15	13	82

	OCCUPATION								
	Professional	Blue Collar	Administrative Clerical	Management	Sales	Technical	Self- employed	Other	Not Employed/ Retired/ Homemaker
Average (in days)	37.6	47.0	72.2	56.5	39.7	78.5	7.4	28.2	42.0
10 days or less	53%	68%	52%	51%	53%	44%	87%	63%	68%
11 days to 1 month	27%	4%	9%	28%	12%	12%	7%	12%	12%
1 to 2 months	4%	11%	21%	2%	21%	11%	1%	12%	6%
Over 2 months	16%	18%	19%	19%	14%	32%	4%	13%	13%
Base	252	91	81	65	54	53	45	64	145

QP4.B Thinking about all of the activities you said you did in 2019, before the pandemic, about how much time in total did you spend on these personal interest activities.

LEARNING CHANNELS USED



Base: 672

QP5. Thinking about the learning activities or courses you have taken for personal interest, where did these learning activities take place? Did you do this...?

A large majority of 3 in 4 residents (75%) reported learning through the internet. Other channels were significantly less utilized: Schools (23%); religious centers (17%); community centers (14%), and libraries (11%). Residents most likely to learn online were located on Kaua'i, between 35 to 54 years old, earn middle to higher incomes, or Native Hawaiian. Those in Government, Tourism, Legal services, or Management were most likely to learn online compared to other industries. Workers in Sales or Self-employment were least likely to utilize online channels for learning.

(% Yes)	TOTAL	GEOGRAPHY				AGE		
		Oahu	Hawaii	Maui	Kauai	18-34	35-54	55-65
On the internet	75%	76%	69%	71%	88%	68%	85%	72%
School (high school, college, university)	23%	28%	8%	16%	5%	36%	15%	14%
Religious center (Church, temple, etc.)	17%	19%	14%	10%	17%	25%	8%	17%
Community center	14%	12%	16%	25%	19%	14%	12%	16%
Library	11%	12%	10%	11%	7%	18%	6%	9%
Private dwelling / home	10%	8%	17%	12%	23%	8%	13%	10%
Base	672	492	88	65	26	262	237	173

(% Yes)	EDUCATION			INCOME			ETHNICITY				
	HS or Less	Business/ Some College	College / Post	<\$50K	\$50K - \$100K	\$100K+	Caucasian	Japanese	Hawaiian	Filipino	Other
On the internet	70%	77%	82%	59%	78%	86%	74%	83%	76%	51%	79%
School (high school, college, university)	18%	29%	24%	22%	22%	25%	12%	44%	24%	15%	18%
Religious center (Church, temple, etc.)	29%	12%	15%	16%	15%	20%	9%	25%	17%	17%	17%
Community center	12%	15%	16%	11%	18%	13%	11%	17%	17%	5%	14%
Library	18%	9%	10%	9%	11%	13%	14%	19%	10%	1%	8%
Private dwelling / home	12%	11%	9%	12%	9%	10%	14%	8%	11%	5%	11%
Base	180	236	223	202	233	236	121	136	164	71	181

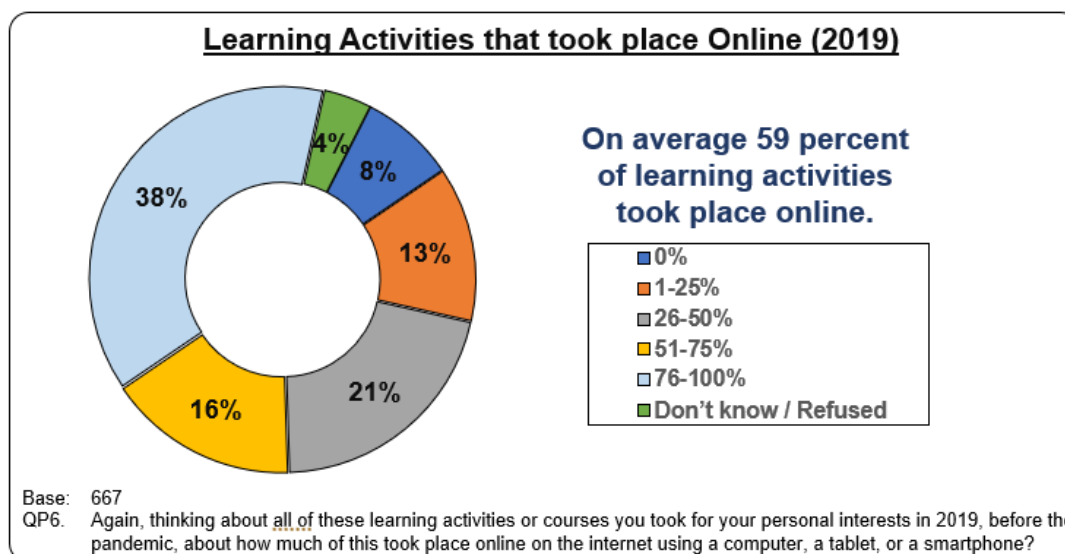
(% Yes)	INDUSTRY																	
	Health	Gov	Edu	Building Construction	Tourism	Retailing	Transport	Other Service	Food Service	Legal	Real Estate	Financial Banking	Maintenance	IT Tech	Agriculture	Non-Profit	Manufacture	Other
On the internet	75%	89%	75%	85%	91%	72%	67%	46%	84%	93%	76%	70%	73%	61%	72%	63%	100%	81%
School	38%	27%	42%	21%	14%	5%	--	13%	14%	24%	--	20%	8%	14%	2%	7%	3%	23%
Religious center	20%	7%	9%	27%	9%	27%	10%	30%	23%	30%	43%	22%	5%	--	32%	3%	9%	7%
Community center	14%	16%	11%	6%	11%	33%	14%	16%	29%	7%	32%	8%	3%	6%	4%	13%	9%	23%
Library	12%	10%	10%	2%	8%	2%	13%	7%	17%	22%	2%	8%	8%	--	7%	8%	6%	12%
Private dwelling / home	6%	10%	3%	5%	3%	27%	26%	63%	9%	12%	11%	8%	20%	3%	13%	--	--	6%
Base	115	83	67	60	36	34	30	28	27	23	21	20	19	17	17	15	13	82

(% Yes)	OCCUPATION								
	Professional	Blue Collar	Administrative Clerical	Management	Sales	Technical	Self-employed	Other	Not Employed/ Retired/ Homemaker
On the internet	75%	75%	88%	87%	49%	99%	62%	92%	67%
School	32%	5%	27%	12%	6%	36%	1%	26%	32%
Religious center	15%	18%	21%	20%	15%	10%	9%	24%	26%
Community center	16%	5%	19%	22%	21%	14%	3%	13%	15%
Library	10%	2%	12%	6%	--	15%	16%	7%	26%
Private dwelling / home	9%	3%	14%	12%	38%	4%	10%	12%	12%
Base	252	91	81	65	54	53	45	64	145

QP5. Thinking about the learning activities or courses you have taken for personal interest, where did these learning activities take place? Did you do this...?

SHARE OF LEARNING CHANNELS USED

Due to the Covid-19 pandemic's impact on behavior in 2020, residents were asked to estimate the proportion of their learning activity that took place online in 2019. Around half say that most (+51%) of their learning activities took place virtually or online. Only eight percent of activities were conducted completely in-person with no online presence. On average, 59 percent of activities took place virtually or online.



Residents of Hawai'i island and Maui county, were more likely to focus their learning in-person or away from online channels compared to those on O'ahu. Older residents (55+ years old), those with a high school education or less, and lower income households (less than \$50K), were also more likely to learn in-person and away from digital channels.

	TOTAL	GEOGRAPHY				AGE		
		Oahu	Hawaii	Maui	Kauai	18-34	35-54	55-65
0%	8%	6%	16%	18%	7%	5%	9%	12%
1-25%	13%	11%	17%	17%	10%	6%	12%	22%
26-50%	21%	22%	19%	15%	36%	28%	20%	14%
51-75%	16%	18%	12%	8%	17%	19%	15%	12%
76-100%	38%	39%	34%	34%	30%	35%	42%	35%
Average (including 0)	59.4	62.0	51.7	50.9	59.0	62.1	61.9	52.0
Base	672	492	88	66	27	262	237	173

	EDUCATION			INCOME			ETHNICITY				
	HS or Less	Business/Some College	College / Post	<\$50K	\$50K - \$100K	\$100K+	Caucasian	Japanese	Hawaiian	Filipino	Other
0%	20%	3%	5%	17%	7%	2%	12%	4%	5%	13%	10%
1-25%	14%	9%	16%	12%	9%	16%	14%	10%	16%	9%	12%
26-50%	20%	25%	21%	23%	19%	23%	17%	36%	23%	26%	11%
51-75%	14%	17%	17%	10%	21%	17%	14%	12%	13%	7%	27%
76-100%	29%	45%	40%	29%	42%	41%	42%	36%	41%	20%	39%
Average (including 0)	47.7	66.3	61.5	50.1	64.0	62.4	59.3	58.9	60.2	49.3	62.3
Base	180	236	224	203	233	236	121	136	164	71	181

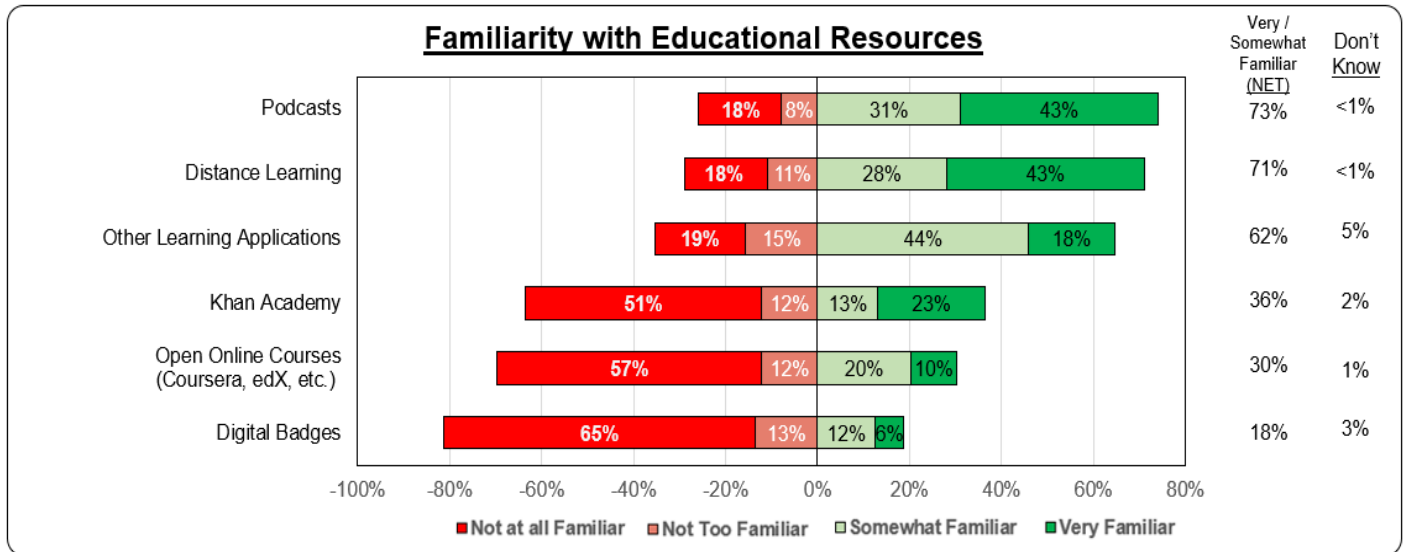
	INDUSTRY																	
	Health	Gov	Edu	Building Construction	Tourism	Retailing	Transport	Other Service	Food Service	Legal	Real Estate	Financial Banking	Maintenance	IT Tech	Agriculture	Non-Profit	Manufacture	Other
0%	5%	3%	4%	1%	4%	--	8%	2%	--	5%	23%	22%	1%	--	28%	36%	--	13%
1-25%	10%	14%	19%	11%	29%	5%	19%	11%	38%	4%	26%	9%	--	7%	--	7%	15%	7%
26-50%	36%	22%	29%	36%	13%	43%	7%	14%	10%	12%	10%	14%	--	1%	22%	8%	52%	17%
51-75%	15%	12%	13%	8%	11%	16%	17%	62%	31%	2%	19%	4%	8%	11%	2%	13%	--	32%
76-100%	34%	46%	35%	44%	43%	37%	49%	11%	21%	78%	23%	47%	65%	71%	49%	35%	32%	30%
Average (including 0)	60.4	62.3	54.4	61.6	60.3	65.8	64.0	61.9	53.9	84.2	41.7	58.2	86.3	83.2	58.6	47.3	59.2	58.6
Base	81	72	45	50	21	20	20	19	14	22	17	16	17	14	15	11	8	68

	OCCUPATION								
	Professional	Blue Collar	Administrative Clerical	Management	Sales	Technical	Self-employed	Other	Not Employed/Retired/Homemaker
0%	9%	6%	2%	4%	--	--	29%	3%	17%
1-25%	13%	7%	24%	17%	8%	8%	5%	7%	15%
26-50%	23%	30%	18%	22%	31%	16%	9%	25%	20%
51-75%	17%	12%	11%	17%	27%	14%	28%	14%	15%
76-100%	38%	38%	40%	39%	34%	58%	29%	51%	31%
Average (including 0)	58.2	61.2	59.6	62.5	67.2	74.9	53.6	69.0	49.5
Base	212	66	54	50	29	37	37	49	105

QP6. Again, thinking about all of these learning activities or courses you took for your personal interests in 2019, before the pandemic, about how much of this took place online on the internet using a computer, a tablet, or a smartphone?

PODCASTS AND DISTANCE LEARNING

Over 7 of 10 Hawai'i residents are very or somewhat familiar with Podcasts and Distance learning, the most popular resources, followed by other learning application (62%). The Khan Academy and Open Online Courses were next in familiarity (30-36%) followed distantly by Digital Badges (18%).



Base: 893

QP9. I'm going to read you a list of educational resources and ask you to tell me how familiar, if at all, you are with each. Are you Very Familiar, Somewhat Familiar, Not Too Familiar or Not At All Familiar with...?

Older residents, those without a college degree, and those earning less than \$100K in household income were generally less familiar with education resources. Residents located on Hawai'i, Maui, or Kaua'i county also tended to be less familiar with these resources, particularly in Podcasts and the Khan Academy. Workers employed in Healthcare, Government, Education, or Legal services tended to be most familiar with online educational resources. Those in Building or Construction were most familiar with Open online courses. By occupation, Professionals were most familiar overall with these tools while those Not employed were least familiar. Those in Technical fields were most familiar with Open Online courses.

Very / Somewhat Familiar (NET)		GEOGRAPHY				AGE		
	TOTAL	Oahu	Hawaii	Maui	Kauai	18-34	35-54	55-65
Podcasts	73%	79%	60%	59%	63%	84%	75%	56%
Distance Learning	71%	72%	69%	66%	69%	75%	76%	58%
Other Learning Applications	62%	64%	53%	58%	67%	73%	62%	46%
Khan Academy	36%	40%	28%	30%	19%	58%	29%	15%
Open Online Courses (Coursera, etc.)	30%	32%	27%	24%	21%	40%	30%	16%
Digital Badges	18%	19%	16%	19%	18%	18%	23%	13%
Base	893	625	122	102	44	333	324	237

Very / Somewhat Familiar (NET)	EDUCATION			INCOME			ETHNICITY				
	HS or Less	Business/ Some College	College / Post	<\$50K	\$50K - \$100K	\$100K+	Caucasian	Japanese	Hawaiian	Filipino	Other
Podcasts	56%	80%	82%	63%	74%	83%	67%	84%	69%	83%	72%
Distance Learning	54%	77%	86%	60%	67%	87%	64%	83%	77%	63%	66%
Other Learning Applications	52%	68%	70%	51%	61%	73%	63%	73%	64%	48%	58%
Khan Academy	28%	35%	49%	23%	39%	46%	33%	47%	31%	26%	39%
Open Online Courses (Coursera, etc.)	18%	34%	34%	26%	32%	31%	25%	33%	27%	46%	28%
Digital Badges	12%	21%	23%	12%	19%	24%	19%	25%	18%	10%	17%
Base	281	300	273	277	339	277	166	155	207	93	272

Very / Somewhat Familiar (NET)	INDUSTRY																	
	Health	Gov	Edu	Building Construction	Tourism	Retailing	Transport	Other Service	Food Service	Legal	Real Estate	Financial Banking	Maintenance	IT Tech	Agriculture	Non-Profit	Manufacture	Other
Podcasts	79%	84%	70%	80%	74%	66%	51%	86%	72%	92%	69%	53%	66%	84%	68%	92%	96%	84%
Distance Learning	80%	95%	83%	57%	69%	59%	55%	80%	86%	94%	49%	88%	57%	59%	54%	81%	94%	75%
Other Learning Apps	74%	66%	90%	66%	43%	57%	43%	67%	60%	81%	47%	60%	48%	69%	63%	77%	67%	63%
Khan Academy	46%	42%	72%	32%	16%	23%	13%	40%	34%	37%	15%	25%	20%	83%	39%	56%	43%	38%
Open Online Courses	33%	39%	27%	54%	21%	29%	12%	24%	11%	38%	31%	26%	16%	50%	34%	29%	29%	32%
Digital Badges	24%	22%	29%	15%	12%	8%	3%	42%	18%	50%	7%	7%	14%	38%	16%	30%	4%	24%
Base	115	83	67	60	36	34	30	28	27	23	21	20	19	17	17	15	13	82

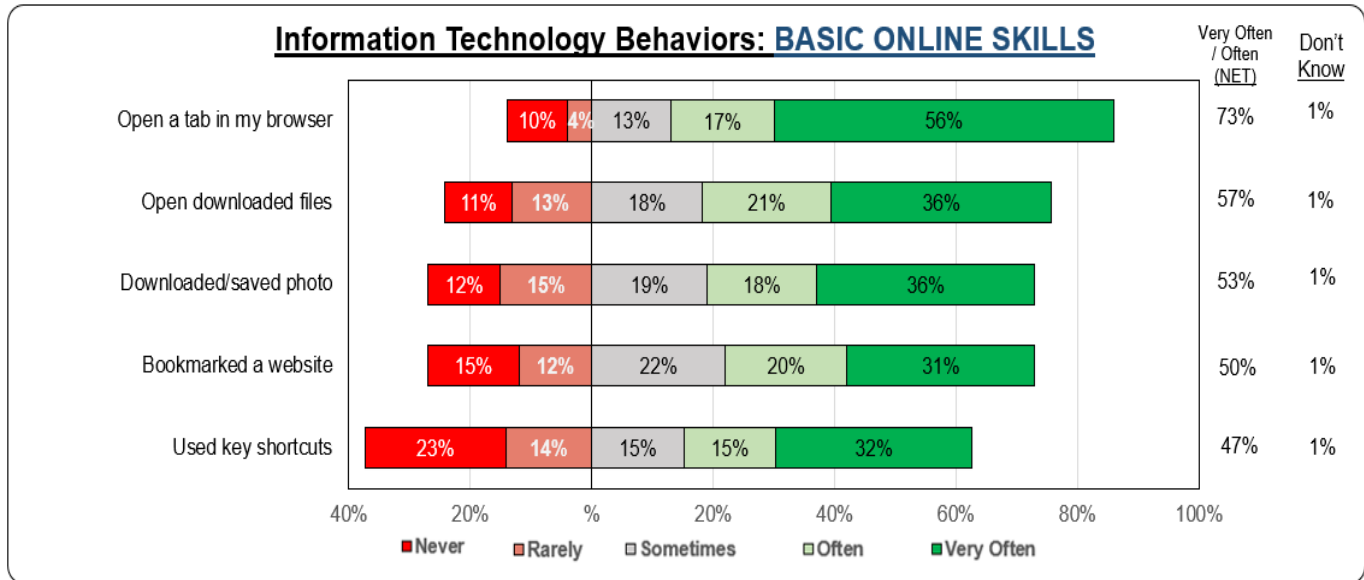
Very / Somewhat Familiar (NET)	OCCUPATION								
	Professional	Blue Collar	Administrative Clerical	Management	Sales	Technical	Self-employed	Other	Not Employed/ Retired/ Homemaker
Podcasts	82%	71%	75%	79%	72%	76%	76%	76%	52%
Distance Learning	88%	51%	83%	84%	62%	64%	61%	79%	55%
Other Learning Apps	77%	49%	51%	55%	91%	72%	51%	69%	51%
Khan Academy	52%	29%	30%	34%	57%	39%	21%	32%	23%
Open Online Courses	34%	22%	36%	31%	18%	49%	15%	36%	17%
Digital Badges	27%	11%	21%	23%	19%	23%	15%	14%	7%
Base	252	91	81	65	54	53	45	64	145

QP9. I'm going to read you a list of educational resources and ask you to tell me how familiar, if at all, you are with each. Are you Very Familiar, Somewhat Familiar, Not Too Familiar or Not At All Familiar with...?

DIGITAL SKILLS: ON-LINE BASIC, CREATIVE, & ECONOMIC SKILLS (FOR EMPLOYMENT AND FOR FINANCE)

USE OF BASIC ONLINE SKILLS

About half or more residents use basic online skills very often or often, such as opening a downloaded file, saving a photo, and using a bookmark. Opening a tab in a browser (73%) was the most frequently cited skill, while using a key shortcut was the least used (47%).



Overall, those over 35 years old and residents located on the Neighbor Island were least likely to regularly use basic online skills. Households earning less than \$100K and those without a college degree also tended to use these basic skills less frequently, particularly in opening a tab and bookmarking a site in a browser. Residents working in Transportation, Food Service, Maintenance, or Agriculture were likely to report lower levels of basic online skills compared to other industries. Blue Collar occupations, Self-employed, and those Not Employed also tended to report lower levels of online skills.

Very Often / Often (NET)		GEOGRAPHY				AGE		
	TOTAL	Oahu	Hawaii	Maui	Kauai	18-34	35-54	55-65
Open a tab in my browser	73%	77%	66%	59%	64%	82%	76%	56%
Open downloaded files	57%	62%	47%	40%	54%	71%	55%	40%
Downloaded/saved photo	53%	58%	48%	37%	46%	65%	52%	38%
Bookmarked a website	50%	55%	43%	36%	38%	52%	53%	44%
Used key shortcuts	47%	52%	34%	35%	39%	63%	48%	24%
Base	893	625	122	102	44	333	324	237

Very Often / Often (NET)	EDUCATION			INCOME			ETHNICITY				
	HS or Less	Business/Some College	College / Post	<\$50K	\$50K - \$100K	\$100K+	Caucasian	Japanese	Hawaiian	Filipino	Other
Open a tab in my browser	61%	77%	86%	56%	75%	86%	70%	84%	69%	61%	74%
Open downloaded files	50%	56%	64%	46%	62%	63%	52%	72%	43%	68%	58%
Downloaded/saved photo	45%	55%	58%	46%	55%	58%	45%	64%	47%	59%	56%
Bookmarked a website	34%	61%	59%	39%	54%	57%	51%	58%	43%	39%	55%
Used key shortcuts	41%	49%	50%	41%	47%	55%	40%	60%	40%	58%	47%
Base	281	300	273	277	339	277	166	155	207	93	272

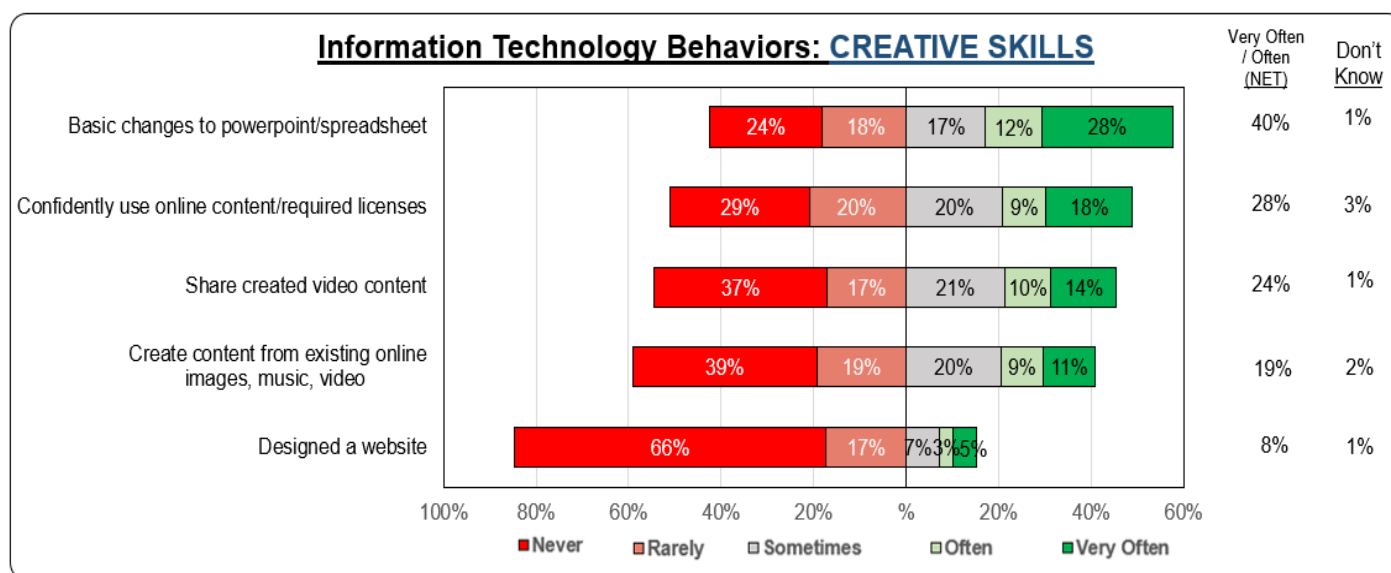
Very Often / Often (NET)	INDUSTRY																	
	Health	Gov	Edu	Building Construction	Tourism	Retailing	Transport	Other Service	Food Service	Legal	Real Estate	Financial Banking	Maintenance	IT Tech	Agriculture	Non-Profit	Manufacture	Other
Open a tab in my browser	94%	92%	91%	76%	76%	71%	66%	84%	42%	99%	71%	95%	45%	89%	59%	79%	80%	62%
Open downloaded files	75%	72%	72%	58%	51%	54%	47%	69%	36%	66%	80%	49%	27%	77%	22%	78%	65%	51%
Downloaded/saved photo	43%	68%	69%	62%	50%	57%	52%	67%	36%	62%	49%	48%	40%	67%	33%	39%	83%	51%
Bookmarked a website	58%	62%	73%	37%	54%	67%	51%	76%	15%	67%	28%	43%	63%	78%	24%	75%	72%	56%
Used key shortcuts	66%	58%	49%	56%	32%	38%	26%	62%	45%	63%	45%	49%	28%	79%	28%	72%	42%	49%
Base	81	72	45	50	21	20	20	19	14	22	17	16	17	14	15	11	8	68

Very Often / Often (NET)				OCCUPATION									
				Professional	Blue Collar	Administrative Clerical	Management	Sales	Technical	Self-employed	Other	Not Employed/Retired/Homemaker	
Open a tab in my browser				91%	58%	87%	84%	84%	95%	37%	71%	49%	
Open downloaded files				62%	43%	74%	73%	77%	87%	31%	43%	35%	
Downloaded/saved photo				53%	51%	68%	62%	69%	73%	28%	47%	40%	
Bookmarked a website				56%	27%	74%	62%	80%	84%	42%	44%	26%	
Used key shortcuts				59%	37%	59%	48%	44%	74%	28%	44%	24%	
Base				212	66	54	50	29	37	37	49	105	

QX10. Either at work or at home, how frequently have you readily....? Would you say Very Often, Often, Sometimes, Rarely or Never?

CREATIVE ON-LINE SKILLS

Although many users have strong confidence in their digital abilities, fewer than half use creative skills online very or somewhat often. Updating a power point/spreadsheet was the most popular skill (40%) while all other skills were reported by less than a third of all residents.



Base: 893

QX10. Either at work or at home, how frequently have you readily....? Would you say Very Often, Often, Sometimes, Rarely or Never?

Age and education were the primary factors in creative online skills with older residents and those with a high school degree or less reporting less use of these online skills.

Employees in Transportation, Maintenance, and Agriculture were least likely to report using Creative online skills compared to those in other industries. Residents in Blue Collar occupations and those Not Employed also tended to use less Creative online skills.

Very Often / Often (NET)		GEOGRAPHY				AGE		
	TOTAL	Oahu	Hawaii	Maui	Kauai	18-34	35-54	55-65
Basic changes to powerpoint /spreadsheet	40%	46%	24%	27%	25%	48%	44%	22%
Confidently use online content/required licenses	28%	29%	30%	21%	20%	32%	31%	19%
Share created video content	24%	26%	19%	19%	18%	35%	24%	8%
Create content from existing online images, music, video	19%	21%	19%	13%	17%	26%	21%	8%
Designed a website	8%	10%	3%	5%	4%	11%	7%	5%
Base	893	625	122	102	44	333	324	237

Very Often / Often (NET)	EDUCATION			INCOME			ETHNICITY				
	HS or Less	Business/ Some College	College / Post	<\$50K	\$50K - \$100K	\$100K+	Caucasian	Japanese	Hawaiian	Filipino	Other
Basic changes to powerpoint/spreadsheet	29%	44%	50%	22%	44%	52%	33%	54%	36%	32%	41%
Confidently use online content/required licenses	19%	36%	31%	26%	27%	30%	27%	33%	24%	24%	30%
Share created video content	32%	19%	24%	20%	25%	28%	13%	14%	24%	27%	37%
Create content from existing online images, music, video	17%	17%	25%	15%	20%	23%	11%	10%	28%	21%	22%
Designed a website	8%	11%	6%	7%	9%	8%	6%	3%	7%	5%	14%
Base	281	300	273	277	339	277	166	155	207	93	272

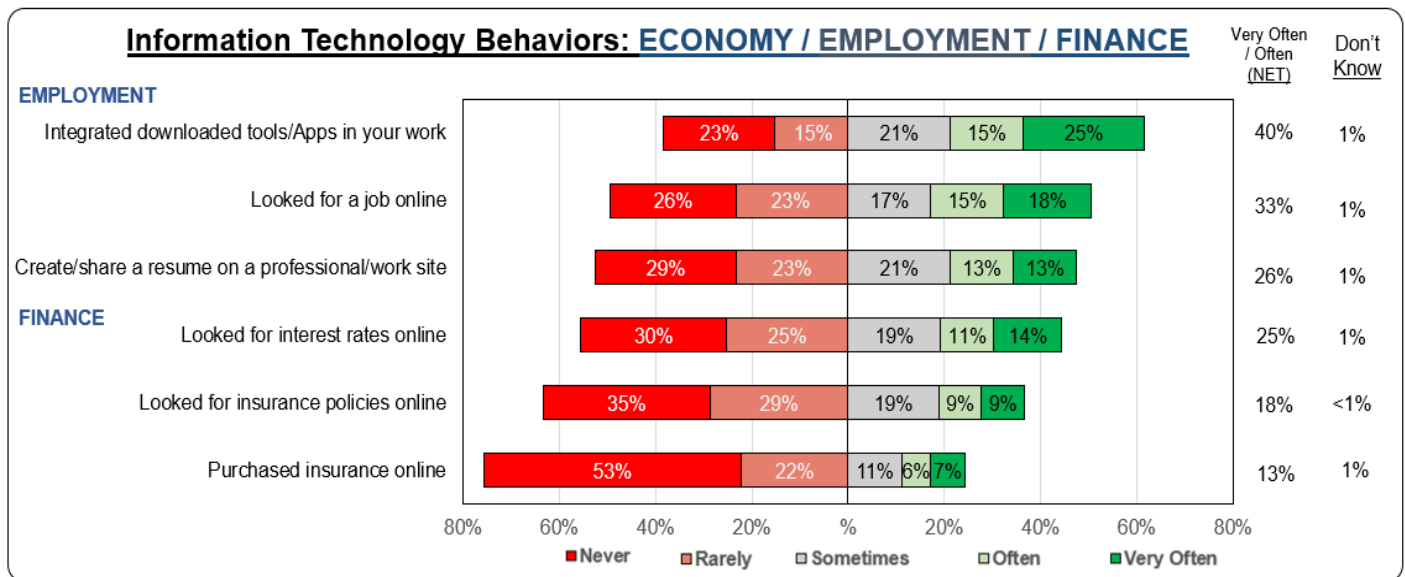
Very Often / Often (NET)	INDUSTRY																	
	Health	Gov	Edu	Building Construction	Tourism	Retailing	Transport	Other Service	Food Service	Legal	Real Estate	Financial Banking	Maintenance	IT Tech	Agriculture	Non-Profit	Manufacture	Other
Basic changes powerpoint/spreadsheet	36%	60%	73%	24%	34%	34%	20%	65%	28%	60%	43%	46%	24%	76%	14%	65%	36%	39%
Online required licenses	33%	31%	25%	19%	18%	36%	30%	49%	19%	19%	41%	36%	8%	75%	25%	58%	4%	39%
Share created video content	13%	28%	38%	37%	20%	17%	15%	46%	27%	29%	47%	9%	7%	32%	9%	50%	34%	31%
Create content from existing online assets	9%	25%	47%	22%	18%	31%	9%	41%	26%	33%	27%	6%	11%	11%	5%	53%	41%	12%
Designed a website	9%	7%	8%	1%	5%		1%	29%	19%	21%				58%	10%	1%	4%	12%
Base	81	72	45	50	21	20	20	19	14	22	17	16	17	14	15	11	8	68

Very Often / Often (NET)	OCCUPATION								
	Professional	Blue Collar	Administrative Clerical	Management	Sales	Technical	Self-employed	Other	Not Employed/ Retired/ Homemaker
Basic changes powerpoint/spreadsheet	50%	21%	55%	48%	64%	56%	13%	31%	25%
Online required licenses	33%	16%	38%	38%	28%	41%	35%	31%	15%
Share created video content	17%	33%	27%	35%	55%	16%	42%	18%	19%
Create content from existing online assets	20%	17%	23%	26%	62%	19%	3%	18%	8%
Designed a website	5%	5%	17%	7%	19%	14%	20%	2%	5%
Base	212	66	54	50	29	37	37	49	105

QX10. Either at work or at home, how frequently have you readily....? Would you say Very Often, Often, Sometimes, Rarely or Never?

ONLINE TOOLS FOR ECONOMIC UNDERTAKING: EMPLOYMENT OR FINANCE

Between 26 – 40 percent regularly utilize online tools in their work or search for employment, these proportions were in line with those who use these tools for creative purposes. Among finance options, few residents use these tools, with a quarter or fewer reporting regular use in this area.



Residents over 54 years old were significantly less likely to use online tools for employment or finance. There were few differences by income or educational backgrounds. Those with Native Hawaiian ancestry were more likely to regularly use these tools in employment compared to other ethnicities. Workers in Tourism, Transportation, and Agriculture were least likely to use online skills for employment/financial reasons. Blue Collar workers, Self-employed, and those Not Employed were also less likely to use these skills online.

Very Often / Often (NET)		GEOGRAPHY				AGE		
	TOTAL	Oahu	Hawaii	Maui	Kauai	18-34	35-54	55-65
Integrated downloaded tools/Apps in your work	40%	43%	36%	24%	34%	51%	43%	18%
Looked for a job online	33%	35%	29%	26%	31%	48%	31%	13%
Create/share a resume on a professional/work site	26%	29%	21%	20%	22%	39%	23%	13%
Looked for interest rates online	25%	27%	18%	20%	23%	34%	24%	15%
Looked for insurance policies online	18%	18%	15%	17%	17%	22%	17%	12%
Purchased insurance online	13%	14%	10%	11%	10%	13%	16%	8%
Base	893	625	122	102	44	333	324	237

Very Often / Often (NET)	EDUCATION			INCOME			ETHNICITY				
	HS or Less	Business/Some College	College / Post	<\$50K	\$50K - \$100K	\$100K+	Caucasian	Japanese	Hawaiian	Filipino	Other
Integrated downloaded tools/Apps in your work	37%	42%	43%	35%	39%	46%	27%	44%	38%	29%	50%
Looked for a job online	27%	40%	33%	33%	36%	29%	21%	47%	35%	29%	31%
Create/share a resume on a professional/work site	24%	30%	27%	27%	21%	32%	15%	39%	25%	22%	29%
Looked for interest rates online	19%	32%	25%	16%	29%	29%	18%	29%	28%	22%	26%
Looked for insurance policies online	17%	20%	16%	11%	21%	19%	15%	18%	19%	13%	19%
Purchased insurance online	17%	10%	13%	7%	15%	15%	16%	8%	9%	11%	17%
Base	281	300	273	277	339	277	166	155	207	93	272

Very Often / Often (NET)	INDUSTRY																	
	Health	Gov	Edu	Building Construction	Tourism	Retailing	Transport	Other Service	Food Service	Legal	Real Estate	Financial Banking	Maintenance	IT Tech	Agriculture	Non-Profit	Manufacture	Other
Integrated Apps at work	42%	50%	60%	46%	24%	28%	29%	66%	33%	48%	38%	32%	42%	73%	35%	62%	55%	44%
Looked for a job online	46%	36%	46%	20%	40%	28%	31%	22%	36%	46%	29%	23%	35%	36%	31%	65%	58%	28%
Create/share a resume on a site	33%	38%	41%	14%	23%	26%	19%	37%	32%	34%	13%	16%	24%	65%	31%	58%	--	20%
Looked for interest rates online	17%	34%	46%	18%	32%	21%	27%	56%	27%	33%	58%	25%	14%	43%	5%	15%	35%	22%
Looked for insurance policies online	9%	27%	38%	18%	10%	5%	18%	33%	5%	33%	6%	23%	11%	31%	8%	3%	57%	28%
Purchased insurance online	6%	20%	28%	11%	6%	4%	4%	39%	14%	33%	3%	18%	11%	31%	8%	8%	40%	15%
Base	81	72	45	50	21	20	20	19	14	22	17	16	17	14	15	11	8	68

Very Often / Often (NET)	OCCUPATION								
	Professional	Blue Collar	Administrative Clerical	Management	Sales	Technical	Self-employed	Other	Not Employed/Retired/Homemaker
Integrated Apps at work	44%	31%	53%	52%	58%	57%	36%	35%	22%
Looked for a job online	36%	18%	60%	35%	42%	47%	11%	35%	23%
Create/share a resume on a site	29%	17%	44%	23%	59%	33%	12%	28%	15%
Looked for interest rates online	30%	21%	24%	34%	56%	30%	4%	32%	10%
Looked for insurance policies online	17%	6%	25%	25%	42%	38%	4%	20%	6%
Purchased insurance online	11%	6%	12%	24%	35%	24%	20%	12%	5%
Base	212	66	54	50	29	37	37	49	105

QX10. Either at work or at home, how frequently have you readily...? Would you say Very Often, Often, Sometimes, Rarely or Never?

APPENDICES

Appendix 1. Ho‘oikaika Framework for Hawaii Digital Literacy and Readiness

Appendix 2. Ho‘oikaika Framework for Hawaii Digital Transformation

Appendix 3. Increasing need of Digital Transformation

Appendix 4. Six building blocks industrials can use for digital transformation

Appendix 5. Disruptive Technologies in Digital Transformation Implementations

Sample Demographics

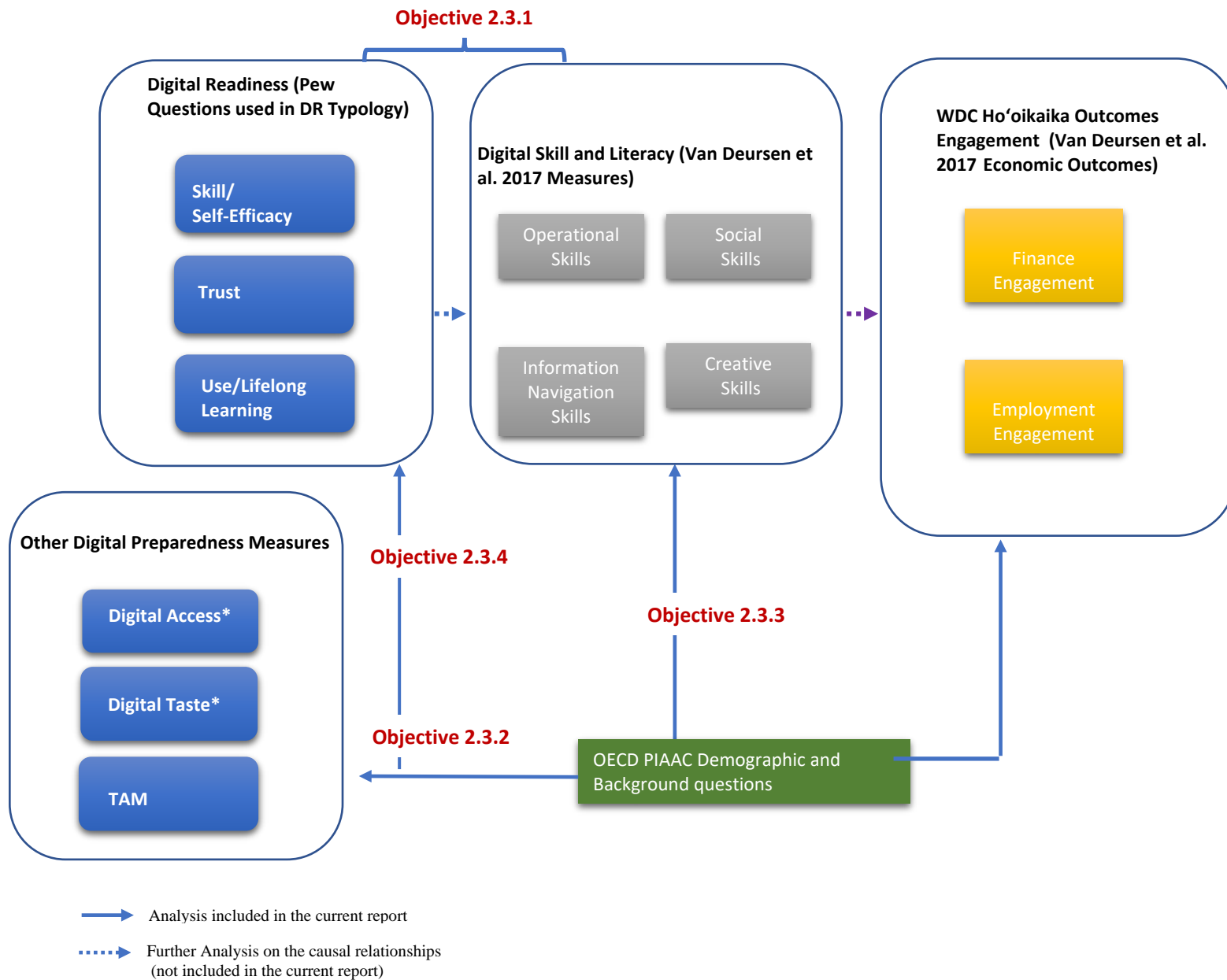
Study Questionnaire

Survey Data

Literature Search Materials

Briefing by Dr. Irwin Kirsch

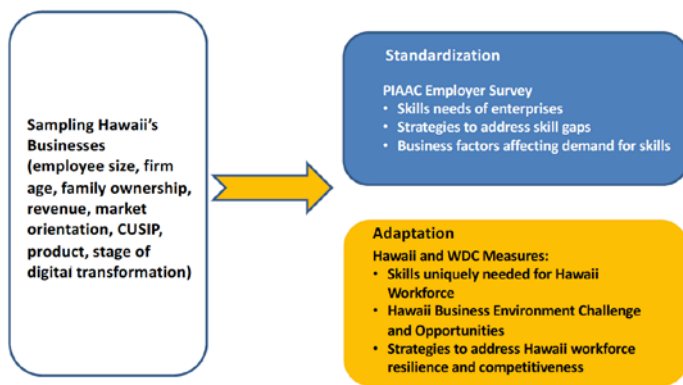
Appendix 1. Ho‘oikaika Framework for Hawaii Digital Literacy and Readiness



Appendix 2. Ho‘oikaika Framework for Hawaii Digital Transformation (Three Stages)

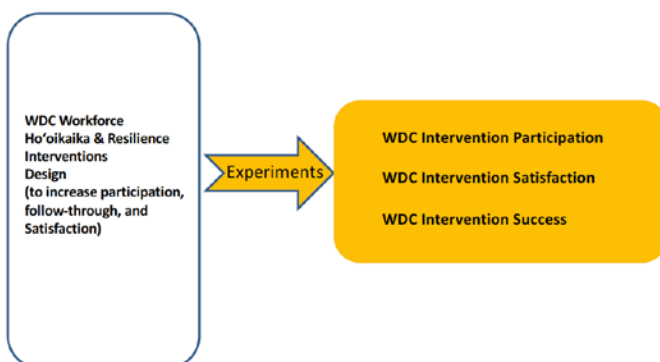
Ho‘oikaika Framework for Hawaii Digital Transformation

—Employer Survey Stage (Future plan)



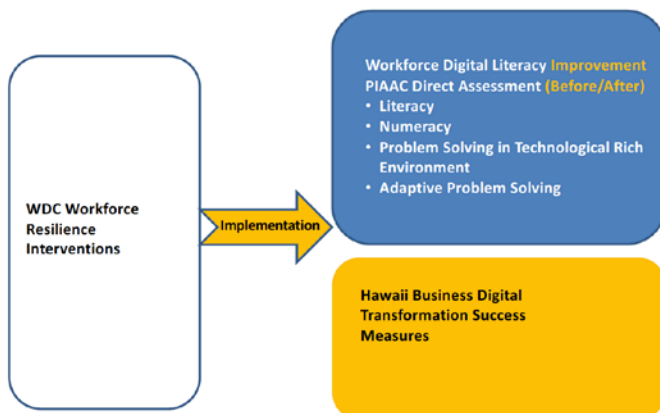
Ho‘oikaika Framework for Hawaii Digital Transformation

—Experimentation Stage (Future plan)



Ho‘oikaika Framework for Hawaii Digital Transformation

—Implementation Stage (Future plan)



Blue: standardized measures that could benchmark with PIAAC or Pew survey
Orange: adapted measures that are uniquely designed for Hawaii workforce

Appendix 3. Increasing need of Digital Transformation

Digital Transformation Remains Top-of-Mind

Earnings calls of U.S. public companies on which “digital transformation” was mentioned.



Figure 2

Source: Bloomberg. Data through 8/15 of each year.

Business Value of AI

No matter the industry, companies will realize more business value from AI than from other analytics techniques. Here's how much more:

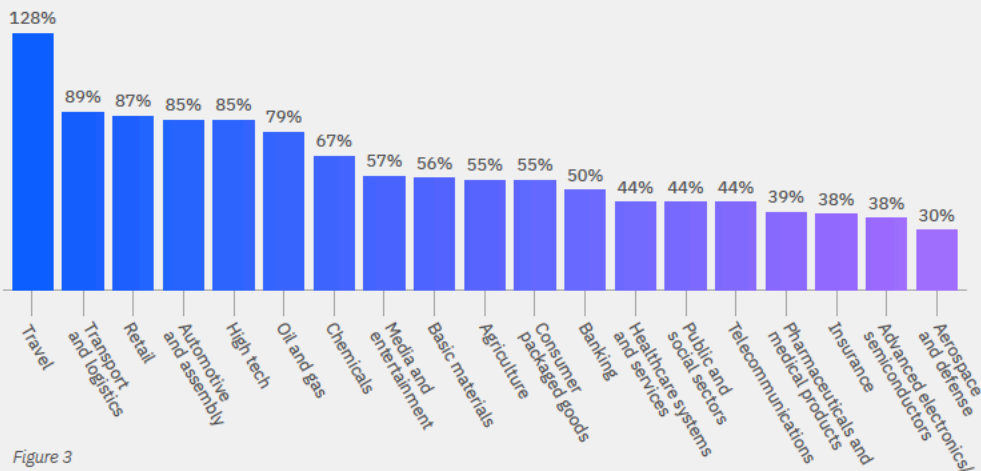


Figure 3

Source: Notes from the AI Frontier, McKinsey Global Institute, April 2018.

Appendix 4. Six building blocks industrials can use for digital transformation (adopted from Angevine, Keomany, Thomsen, and Zemmel 2021).

Six building blocks can help industrials succeed at digitization.

Building blocks of digital transformation



McKinsey
& Company

Appendix 5. Disruptive Technologies in Digital Transformation Implementations (adopted from Ebert and Duarte 2018).

Table 2. Disruptive Technologies Adopted in DX Implementations

Technology type	Inherent nature and attributes	Disruption and significance	Early-adopter experience	Adopted technology	Ease of adoption	No. of alternatives
					URLs	
Collaborative equipment (drones and robots)	Hardware capable of limited interactivity with moving parts and remote or embedded controls having typical sensor or actuator functions in heavy industry, space, or military applications	Adoption of cognitive computing expanded this technology's applicability from routine tasks to those requiring adaptability or autonomy, enabling its commercial use in precision agriculture, logistics, consumable-product industries, and services.	Alibaba manages retail warehouses in China using teams of unmanned shelf-carrying robots, which load and unload at multifunctional workstations.	Quicktron self-charging robots with QR code readers, laser or LIDAR anti-collision sensors, adaptive routing, and Wi-Fi connectivity with back-end software	Hard	Few
					http://translate.google.com/translate?js=n&sl=auto&tl=en&u=http://www.flashhold.com/page/16.htm	
Additive manufacturing and 3D printing	3D object creation from digital models, using printer heads driven by software-controlled stepper motors, for polymerization, jetting, extrusion, fusion, lamination, or deposition	Advances in image processing, precision mechanics, and new materials decreased the price of printers and printed objects, making them accessible to businesses and consumers for rapid prototyping and small-scale or customizable production.	BioArchitects supplies FDA-certified 3D prostheses to customers in Brazil and the US, for training doctors and planning surgery procedures.	GE Arcam machines, which support additive high-power Electron Beam Melting production of titanium prostheses from CAD models generated using diagnostic-imaging exams	Hard	Very few
					http://www.arcam.com/products/arcam-q10	
IoT connected devices	Hardware with embedded digital electronics, software, and network connectivity enabling its unique identification, data collection, and data exchange	Implementation of IPv6 and reduced device costs enabled the massive dissemination of connected devices in machine-to-machine transactions and the IoT.	Volkswagen uses an IoT solution based on RFID tags to manage supply chain traceability in factories worldwide.	A Kathrein IoT distributed antenna system with customized software and standardized UHF RFID tags and transponders to ensure end-to-end order traceability	Hard	Some
					https://www.kathrein-solutions.com/solutions/logistics	
Agile development	Software development based on adaptive planning, evolutionary development, early delivery, and continuous improvement through collaboration of self-organizing cross-functional teams	Rapid-prototyping development evolved to widespread agile development owing to user involvement and rapid compliance with requirements, time-to-market reduction, and early value delivery.	Lloyds Bank adopted design thinking, agile methods, and a cloud-based microservice architecture to break down the transformation of 10 customer journeys, which paid back in three years.	IBM Bluemix, a hybrid cloud platform-as-a-service architecture, used to support Scrum and a minimum-viable-product development methodology	Medium	Very many
					https://www.ibm.com/cloud-computing/bluemix	
Blockchain or Hyperledger	Continuously growing lists of decentralized information blocks, linked and secured through cryptography, used in recording financial transactions between parties efficiently, verifiably, and permanently	This technology has been disseminated to many other application domains that require secure fault-tolerant event record management, such as the arts, law, accounting, commerce, and healthcare.	A blockchain open source platform has been used to manage things ranging from World Food Program vouchers for Syrian refugees to a collaborative decentralized news network.	The Ethereum blockchain app platform, a decentralized framework with programmable virtual-machine and peer-to-peer protocols for defining and running distributed secure transactions	Medium	Some
					https://www.ethereum.org	
Open APIs and microservices	APIs and distributed services allowing system architectures to be structured in modular and open configurations	This technology's use in developing enterprise application ecosystems out of business functionalities, with decoupled deployment and operation, maximizes value for money.	Equinix Cloud Exchange provides cross-cloud application integration and scalable services by using an open-API platform.	Google Apigee, a Java-based service platform to develop, deliver, manage, and analyze APIs via their proxies	Easy	Many
					http://www.apigee.com	
AI	A set of algorithmic tools for data analysis, representation, inference, deduction, and heuristics-based behavior	The coupling of AI to big data, cloud computing, natural-language processing, computer vision and voice recognition enabled scalable resolution of real problems in many application domains.	Telefonica launched its AURA AI service to help customers with any bureaucratic, communication, and interactive-content demand.	The Microsoft Bot Framework and LUIS, the respective IDE for creating and deploying software robots and natural-language-understanding integrated services	Easy	Many
					https://dev.botframework.com https://www.luis.ai/home	

Figure 1. Exploratory Factor Analysis & Reliability Test

Exploratory Factor Analysis: Rotated Component Matrix*

	Component					
(Digital Literacy/Skill and Digital Use Dimensions)	1	2	3	4	5	6
BASIC/ OPERATIONAL SKILLS						
Opened files downloaded from the internet	.74					
Downloaded and saved a photo from the internet	.63					
Used shortcut keys	.68					
Opened a new tab in my browser	.75					
Bookmarked a website	.72					
CREATIVE SKILLS						
Created something from existing online images, music or video				.73		
Made basic changes to powerpoint, spreadsheet or word file someone else created	.59					
Designed a website						
Used online content confidently, knowing what licenses are required to use	.52					
Felt confident sharing video content you created online				.78		
ECONOMY/EMPLOYMENT						
Integrated downloaded tools or applications into the way you work						
Looked for a job online						.85
Created/shared a CV or resume on a professional and work-related site						.80
ECONOMY/FINANCE						
Looked for information on insurance policies online			.84			
Purchased any type of insurance online			.79			
Looked for interest rate information online			.74			
INFORMATION/NAVIGATION SKILLS						
It's hard to decide what are the best keywords to use for online searches		.76				
It's often hard to find a website visited before		.75				
Looking for information online is tiring		.77				
Sometimes it's not clear how you end up at a certain website		.77				
Many website designs are confusing and hard to navigate		.71				
SOCIALSKILLS						
It's clear which information a user should and shouldn't share online					.75	
It's clear when to share or not share information online					.80	
When on the internet, it's important to be careful that comments or behaviors are appropriate to the online situation						
Changing who you share content with online is easy for you to do					.65	
If needed, removing friends from contact lists is easy for you to do						
Reliability Test (Cronbach's Alpha):	.85	.83	.80	.78	.66	.81 (after delete #1)
*Extraction Method: Principal Component Analysis Rotation Method: Varimax with Kaiser Normalization						

Figure 2. Compound Digital Divide

Descriptive Statistics and Correlation Matrix

	1	2	3	4	5	6
1. Basic/Operational Skills	1.000					
2. Creative Skills	.63**	1.000				
3. Social Skills	.10**	.19**	1.000			
4. Information/Navigation Skills	-.35**	-.17*	.05	1.000		
5. Employment Use	.45**	.45**	.10**	-.15**	1.000	
6. Finance Use	.43**	.39**	.07*	-.24*	.39**	1.000
Mean	3.57	2.47	4.33	2.87	2.70	2.26
Standard Deviation	1.14	1.06	.76	1.20	1.33	1.12

**p < .01, *p < .05, two-tailed tests

<u>Digital Literacy/Skills</u>	Dependent Variables			
	Employment Use		Finance Use	
	<i>Model 1</i>	<i>Model 2</i>	<i>Model 1</i>	<i>Model 2</i>
Basic/Operational Skills	.320** (.046)	.257** (.046)	.259** (.040)	.202** (.040)
Creative Skills	.342** (.048)	.288** (.048)	.221** (.041)	.160** (.041)
Social Skills	.046 (.052)	.043 (.051)	.011 (.045)	.003 (.044)
Information Navigation Skills	-.013 (.035)	.013 (.034)	-.106** (.030)	-.104** (.029)
Employment Use				.177** (.028)
Finance Use		.242** (.038)		
Constant	.553* (.299)	.298 (.275)	1.05** (.237)	.954** (.233)
F value	73.81**	69.59**	64.06**	61.45**
R ²	.250**	.282**	.224**	.257**
Adjusted R ²	.246**	.278**	.220**	.253**
R ² Change		.032		.033
F change		39.80**		39.80**

Standard Errors are in parentheses. Two-tailed test results, ** p < .01, * p < .05

Figure 3. Sequential Digital Divide

	Dependent Variables							
<u>Digital Literacy/Skills</u>	Employment Use				Finance Use			
	<i>Model 1</i>	<i>Model 2</i>	<i>Model 3</i>	<i>Model 4</i>	<i>Model 1</i>	<i>Model 2</i>	<i>Model 3</i>	<i>Model 4</i>
Basic/Operational Skills	.360** (.053)	.295** (.053)	.260** (.054)	.232** (.056)	.285** (.046)	.220** (.047)	.194** (.048)	.228** (.049)
Creative Skills	.376** (.052)	.324** (.052)	.300** (.052)	.296** (.052)	.229** (.046)	.162** (.047)	.146** (.047)	.147** (.047)
Social Skills	.054 (.059)	.046 (.058)	.033 (.058)	.021 (.058)	.037 (.052)	.027 (.051)	.018 (.051)	.034 (.051)
Information Navigation Skills	.086* (.038)	.111** (.038)	.121** (.037)	.138** (.039)	-.111** (.034)	-.126** (.033)	-.117** (.033)	-.139** (.034)
Employment Use						.179** (.032)	.166** (.032)	.170** (.032)
Finance Use		.228** (.041)	.212** (.041)	.218** (.041)				
Digital Readiness (Proxy)			.104** (.032)	.096** (.032)			.079** (.029)	.088** (.029)
Digital Confidence				.129 [#] (.072)				-.172** (.064)
Constant	.022 (.319)	-.178 (.315)	-.241 (.314)	-.575 (.365)	.872** (.282)	.868** (.277)	.809** (.276)	1.247** (.320)
F value	63.253**	58.985**	51.517**	44.743**	47.97**	46.26**	40.18**	35.77**
R ²	.254**	.285**	.295**	.298**	.206**	.238**	.246**	.253**
Adjusted R ²	.250**	.280**	.289**	.291**	.201**	.233**	.240**	.246**
R ² Change		.030	.010	.003		.032	.008	.007
F change		31.50**	10.43**	3.18 [#]		31.50**	7.68**	7.27**

Standard Errors are in parentheses. Two-tailed test results, ** p < .01, * p < .05, # p < .10

Figure 3'. Sequential Digital Divide (adding digital readiness proxy in Model 3 and digital confidence in Mode

Sample Demographics

Demographics (1 of 3)

AGE	
18-34	37%
35-44	21%
45-54	15%
55-65	27%
Average (Year Old)	41.6
ETHNICITY	
Native Hawaiian	22%
Caucasian	18%
Japanese	17%
Mixed (NOT Hawaiian)	9%
Filipino	8%
Hispanic	5%
Korean	3%
Chinese	3%
African-American	2%
Other Asian	2%
Portuguese	2%
Other Polynesian	1%
Samoan	0%
Native American	0%
Other	2%
Refused	7%
Base	893

INCOME	
\$21,000 but less than \$35,000	19%
\$35,000 but less than \$50,000	12%
\$50,000 but less than \$75,000	19%
\$75,000 but less than \$100,000	19%
\$100,000 but less than \$150,000	19%
\$150,000 and over	12%
EDUCATION	
Less Than High School	5%
High School Graduate	32%
Business/Trade school	4%
Some College	10%
College Graduate	28%
Post Graduate	11%
Don't Know	4%
Refused	5%
GEOGRAPHY	
Oahu	70%
Hawaii	14%
Maui	11%
Kauai	5%
Base	893

Demographics (2 of 3)

OCCUPATION	
Professional	28%
Blue Collar (laborer/farmer/construction, etc.)	10%
Administrative/Clerical	9%
Management	7%
Technical	6%
Sales	6%
Self-employed	5%
Partner/Owner/Proprietor	2%
Service for hotel/restaurant, etc.	2%
Homemaker/Caregiver	2%
White collar	1%
Students	1%
Chairman/President/CEO/Executive	<1%
Retired	9%
Not Employed	5%
Refused	5%
NUMBER OF JOBS IN 2019	
0	10%
1	63%
2	21%
3+	4%
Refused	3%
Average	1.3
Base	893

INDUSTRY	
Health	15%
Government	11%
Education (Non-government/private)	9%
Construction / Building	8%
Refused	6%
Self-employed	5%
Tourism	5%
Retailing	5%
Transportation	4%
Other Service	4%
Food Service	4%
Legal / Law / Enforcement / Security	3%
Real Estate	3%
Financial services / banks	3%
Maintenance	3%
Computer / Technology	2%
Agriculture	2%
Non-Profit	2%
Manufacturing / Distribution	2%
Other	1%
Telecommunications	1%
Electric / Gas	1%
Student	1%
Marketing	1%
Entertainment/Arts	1%
Military	<1%

Demographics (3 of 3)

YEARS IN HAWAII	
Less than one year	0%
One year but less than 5 years	2%
Five years but less than 10 years	4%
Ten years but less than 20 years	11%
Twenty years or more	19%
Born and raised in Hawai'i	59%
Refused	4%
ORIGIN OF BIRTH	
Born and raised in Hawai'i	59%
U.S. (incl territories)	32%
Another country	9%
FIRST LANGUAGE	
English	89%
Other	11%
GENDER	
Male	52%
Female	48%
LIVE WITH GRANDPARENTS	
Yes	19%
No	81%
Base	893

PARENTS' EDUCATION	
Less Than High School	5%
High School Graduate	32%
Business/Trade school	4%
Some College	10%
College Graduate	28%
Post Graduate	11%
Don't Know	4%
Refused	5%
CHILDREN IN HOUSEHOLD	
1	13%
2	25%
3	21%
4	18%
5+	17%
Refused	6%
Average (# of people)	3.2
MARITAL STATUS	
Single, never married	42%
Married	39%
Divorced, separated, widowed	13%
Domestic Partnership	2%
Refused	4%
Base	893

Study Questionnaire



STATEWIDE DIGITAL SURVEY JUNE 2021

CATI INTRODUCTION

Good afternoon/evening, I'm ____ from OmniTrak Group Inc., a professional research company in Honolulu. We are interested in Hawai'i resident's attitudes toward various issues, and I'd like to ask you a few questions if I may. All of your answers will be kept confidential, of course. First...

[READ IF NECESSARY]

We're not selling anything. We are just interested in your opinions, and your answers will be kept strictly confidential.

May I proceed?

This call may be monitored or recorded for quality control purposes.

SAFETY QUESTIONS

[ASK OF MOBILE SAMPLE ONLY]

QP1. First, have you received this call on your wireless (cellular) phone or landline phone?

1=Landline →[SKIP TO QA]
2=Cellular →[CONTINUE]

QP2. Are you currently driving?

1=Yes →[CONTINUE]
2=No →[SKIP TO QA]

QP3. Are you using a hands-free device for this call?

1=Yes →[SKIP TO QA]
2=No →[CONTINUE]

QP4. I'm sorry but due to safety concerns, we will need to call you while you are not driving. Can we call you back at a later time and at this same number?

1=Yes →[SCHEDULE CALL BACK]
2=No →[DO NOT CALL BACK]

Again, thank you so much for taking the time to talk to us. We truly appreciate your opinions. *To begin.....*

QA What was your age on your last birthday? [IF <18 or >65 YEARS, THANK & TERMINATE]

[IF REFUSED]

Is your current age [READ LIST]

18-34 years of age.....	1 [CONTINUE]
35-44 years of age.....	2 [CONTINUE]
45-54 years of age.....	3 [CONTINUE]
55-65 years of age.....	4 [CONTINUE]
66+ years of age.....	5 [THANK & TERMINATE]
REFUSED	9 [THANK & TERMINATE]

QB Are you a resident of the State of Hawai'i for more than 6 months a year?

Yes..... 1 [CONTINUE]
No 2 [THANK & TERMINATE]

QC. Which island do you reside?

O'ahu1
Maui.....2
Kaua'i.....3

[IF HAWAII ISLAND, PROBE FOR EAST OR WEST]

Big Island (Hawai'i Island) **EAST**4
Big Island (Hawai'i Island) **WEST**5
Other Big Island Areas6
Other Hawaiian Island (Molokai or Lanai)7
Other.....8- [THANK & TERMINATE]

QD. Do you or does anyone in your household work in/for a [INSERT]?
[ASK ALL BEFORE TERMINATING]

Research company.....1 - [THANK & TERMINATE]
Government agency2 - [CONTINUE]
Media/Advertising/PR3 - [THANK & TERMINATE]
Other.....4 - [CONTINUE]

QE. Are you or any member of your immediate household active duty military?

Yes..... 1 [THANK & TERMINATE]
No 2 [CONTINUE]

DF. Which of the following broad categories includes your household's total annual income from all sources before taxes for 2020? Just stop me when I come to the correct category?

Less than \$15,0001- [THANK & TERMINATE]
\$15,000 but less than \$21,0002- [THANK & TERMINATE]
\$21,000 but less than \$35,0003
\$35,000 but less than \$50,0004
\$50,000 but less than \$75,0005
\$75,000 but less than \$100,0006
\$100,000 but less than \$150,0007
\$150,000 and over.....8
[DON'T KNOW].....98- [THANK & TERMINATE]
[REFUSED].....99- [THANK & TERMINATE]

To begin....

QP1. Do you...[INSERT]? [MULTIPLE MENTIONS ALLOWED]

Subscribe to "dial-up" internet service at home.....1
Subscribe to higher-speed broadband internet service at home ...2
Use your cellular phone as a "hotspot" for internet access.....3
Use another means of internet access in my home4
NONE OF THE ABOVE5

[IF DIAL UP “1” IN QP1, ASK]

QP1.a. Just to confirm, you use a dial-up connection to the internet at home and not a higher-speed broadband connection?

Yes..... 1 **[SKIP TO**
No 2 **[CONNTINUE]**

[IF HIGHER SPEED BROADBAND “2” IN QP1 OR NO IN QP1a ASK]

QP1.b. And is your subscription **[INSERT]**?

DSL.....1
Cable2
Fiber Optic Service3
DON'T KNOW9

QP2.A. Which, if any of the following do you have at home? Do you have **[INSERT]**?
[MULTIPLE MENTIONS ALLOWED]

A computer of any type1
A digital device with an internet connection, e.g. Ipad, tablet, etc. 2
Smart phone with internet connection, apps, many functions
of a computer3
Cellular/mobile phone but without computer functions.....4

QP3. Now' I'd like read you some questions about how you approach different situations when you want to learn something new. First, **[READ STATEMENT]** How well does the statement **[INSERT]** describe you? Does it describe you Very Well, Somewhat Well, Not too Well or Not Well at All?

Very Well4
Somewhat Well.....3
Not too Well2
Not Well at All1
DK/REFUSED9

ROTATE ATTRIBUTES	Rating
I find myself looking for new opportunities to grow as a person.	<input type="checkbox"/>
I am not the type of person who feels the need to probe deeply into new situations or things.	<input type="checkbox"/>
I like to gather as much information as I can when I come across something that I am not familiar with.	<input type="checkbox"/>
I am easily distracted when I try to concentrate.	<input type="checkbox"/>
I am really glad I am no longer in school and don't have to go to classes anymore.	<input type="checkbox"/>
I think of myself as a lifelong learner	<input type="checkbox"/>

QP4.A Next, I have a few questions related to your personal interests, outside of a job. work. This might include interests related to a hobby, your home, health, religion, your community or other areas of personal interest to you. In the year **2019, before the pandemic**, did you **[INSERT]**? **[MULTIPLE MENTIONS ALLOWED]**

ROTATE ATTRIBUTES	Yes
Take a course related to your personal interest or hobbies	1
Read "how-to" magazines, consumer magazines, or other publications related to some area of personal interest	2
Attend a meeting where you learned new information such as a book club, a sports club, arts club or a health-related support group	3
Attend a convention or conference where you learned about something of personal interest, like a garden show, a car show, a science fiction convention, or a music conference	4
Take an online course	5
Engage in online learning, other than a formal course (e.g. Youtube, free online presentation/webinar or DIY website)	6

[IF YES TO ANY IN QP4.A, ASK]

QP4.B Thinking about all of the activities you said you did in **2019, before the pandemic**, about how much time in total did you spend on these personal interest activities. **[PROBE AS NEEDED AND RECORD]**

Hours

Days

Weeks

QP5. Thinking about the learning activities or courses you have taken for **personal interest**, where did these learning activities take place? Did you do this **[INSERT]**

ROTATE ATTRIBUTES	Yes
At a library	1
At a high school, community college, or university	2
At a community center	3
At a church, temple, synagogue or other religious center	4
On the internet	5
At some other place I have not mentioned	6

[IF "OTHER PLACE" MENTIONED, ASK]

QP5.A Where was that specifically? **[PROBE AND RECORD]** _____

QP6. Again, thinking about all of these learning activities or courses you took for your personal interests in **2019, before the pandemic**, about how much of this took place online on the internet using a computer, a tablet, or a smartphone? Please include any material you got from instructional or "how-to" videos.

[IF NEEDED] About what percentage of your personal interest learning was done online in **2019, before the pandemic?**

%

QP7. Now' I'd like to ask you a few questions about how you deal with information and communications technology? How well does the statement **[INSERT]** describe you? Does it describe you Very Well, Somewhat Well, Not too Well or Not Well at All?

Very Well4
 Somewhat Well.....3
 Not too Well2
 Not Well at All1
DK/REFUSED9

ROTATE ATTRIBUTES	Rating
When I get a new electronic device, I usually need someone else to set it up or show me how to use it	<input type="checkbox"/>
I am more productive because of all of my electronic information devices	<input type="checkbox"/>
I find it difficult to know whether the information I find is trustworthy	<input type="checkbox"/>
Between phone calls, texts, emails, social media, or other messages, I deal with too much information in my daily life	<input type="checkbox"/>

[IF INTERNET USER OR OWNER OF SMARTPHONE IN QP2.A, ASK]

QP8. Overall, how confident do you feel using computers, smartphones, or other electronic devices to do things you need to do online? Do you feel...**[INSERT]**?

Very Confident4
 Somewhat Confident3
 Only a Little Confident2
 Not At All Confident1
DK/REFUSED9

QP9. I'm going to read you a list of educational resources and ask you to tell me how familiar, if at all, you are with each. Are you Very Familiar, Somewhat Familiar, Not Too Familiar or Not At All Familiar with **[INSERT]**?

Very Familiar4
 Somewhat Familiar3
 Not Too Familiar2
 Not At All Familiar1
DK/REFUSED9

ROTATE ATTRIBUTES	Rating
Distance Learning	<input type="checkbox"/>
Digital Badges	<input type="checkbox"/>
Khan Academy	<input type="checkbox"/>
Podcasts	<input type="checkbox"/>
Open Online courses on platforms such as Coursera, edX, Udacity or UDEMY	<input type="checkbox"/>
Other learning applications	<input type="checkbox"/>

QX10. Either at work or at home, how frequently have you readily **[INSERT]**? Would you say Very Often, Often, Sometimes, Rarely or Never?

Very Often5
Often.....4
Sometimes.....3
Rarely2
Never1
DK/REFUSED9

ROTATE ATTRIBUTES	Rating
BASIC SKILLS [PN:RANDOMIZE WITHIN SET]	
Opened files downloaded from the internet	<input type="checkbox"/>
Downloaded and saved a photo from the internet	<input type="checkbox"/>
Used shortcut keys	<input type="checkbox"/>
Opened a new tab in my browser	<input type="checkbox"/>
Bookmarked a website	<input type="checkbox"/>
CREATIVE SKILLS [PN:RANDOMIZE WITHIN SET]	
Created something from existing online images, music or video	<input type="checkbox"/>
Made basic changes to powerpoint, spreadsheet or word file someone else created	<input type="checkbox"/>
Designed a website	<input type="checkbox"/>
Used online content confidently, knowing what licenses are required to use	<input type="checkbox"/>
Felt confident sharing video content you created online	<input type="checkbox"/>
ECONOMY/EMPLOYMENT [PN:RANDOMIZE WITHIN SET]	
Integrated downloaded tools or applications into the way you work	<input type="checkbox"/>
Looked for a job online	<input type="checkbox"/>
Created/shared a CV or resume on a professional and work-related site	<input type="checkbox"/>
ECONOMY/FINANCE [PN:RANDOMIZE WITHIN SET]	
Looked for information on insurance policies online	<input type="checkbox"/>
Purchased any type of insurance online	<input type="checkbox"/>
Looked for interest rate information online	<input type="checkbox"/>

QX12. Next, Do you Strongly Agree, Somewhat Agree, Neither Agree or Disagree, Somewhat Disagree or Strongly Disagree that **[INSERT STATEMENT]**?

Strongly Agree5
 Somewhat Agree4
 Neither Agree or Disagree.....3
 Somewhat Disagree2
 Strongly Disagree1
DK/REFUSED9

ROTATE ATTRIBUTES	Rating
NAVIGATION SKILLS [PN:RANDOMIZE WITHIN SET]	
It's hard to decide what are the best keywords to use for online searches	<input type="checkbox"/>
It's often hard to find a website visited before	<input type="checkbox"/>
Looking for information online is tiring	<input type="checkbox"/>
Sometimes it's not clear how you end up at a certain website	<input type="checkbox"/>
Many website designs are confusing and hard to navigate	<input type="checkbox"/>
SOCIALSKILLS [PN:RANDOMIZE WITHIN SET]	
It's clear which information a user should and shouldn't share online	<input type="checkbox"/>
It's clear when to share or not share information online	<input type="checkbox"/>
When on the internet, it's important to be careful that comments or behaviors are appropriate to the online situation	<input type="checkbox"/>
Changing who you share content with online is easy for you to do	<input type="checkbox"/>
If needed, removing friends from contact lists is easy for you to do	<input type="checkbox"/>

Now, I have a few last questions for classification purposes only. .

D1. What is your ethnic background? **[IF MORE THAN ONE:]** With which do you identify the most?

Caucasian.....	1
Chinese	2
Filipino	3
Native Hawaiian.....	4
Japanese	5
African American	6
Mixed (not Hawaiian).....	7
Other Asian.....	8
Hispanic.....	9
Other Polynesian	10
Samoan	11
Korean	12
Portuguese	13
Native American (American Indian / Alaska Native)	14
Other (<i>Specify</i>).....	50
[REFUSED]	99

D2. Including yourself and any children, how many people, live in your household? ☐ ☐

D3. Do you live with grandparents or any relatives from an older generation?

Yes.....	1
No	2

D4. What is your marital status?

Single, never married	1
Married	2
Divorced, separated, widowed	3
Domestic Partnership	4
Other (<i>specify</i>).....	5
[REFUSED]	9

D5. What is the last grade in school you completed?

Less Than High School	1
High School Graduate	2
Business/Trade school	3
Some College	4
College Graduate	5
Post Graduate	6
[DON'T KNOW]	8
[REFUSED]	9

QD5a What is the highest level of education achieved by either parent or your legal guardian?

Less Than High School	1
High School Graduate	2
Business/Trade school	3
Some College	4
College Graduate	5
Post Graduate	6
[DON'T KNOW]	8
[REFUSED]	9

QD6. What is your occupation? What kind of main job do you do?

Chairman/President/CEO/Executive	1
Management.....	2
Partner/Owner/Proprietor	3
Professional.....	4
Technical	5
Sales.....	6
Service for hotel/restaurant, etc.	7
Administrative/Clerical.....	8
Not Employed	9
Retired	10
Blue Collar (laborer/farmer/construction, etc.)	11
White collar.....	12
Self-employed.....	13
Homemaker/Caregiver	14
Military	15
Other (<i>Specify</i>).....	50
[DON'T KNOW]	98
[REFUSED]	99

NEED TO ADD INDUSTRY QUESTION

D7 In what industry do you work?

D8. In **2019, before the pandemic**, how many jobs did you simultaneously hold? ☐ ☐

D9. How many years have you lived in Hawai'i?

Less than one year	1
One year but less than 5 years	2
Five years but less than 10 years.....	3
Ten years but less than 20 years	4
Twenty years or more.....	5
Born and raised in Hawai'i.....	6
[DON'T KNOW]	8
[REFUSED]	9

D10. Were you born in the US or another country?

U.S. (incl territories).....	1
Another country	2

D11. What was the first language you spoke?

English.....	1
Other.....	2

D12. **[RECORD, DO NOT ASK]** Gender of respondent?

Male.....	1
Female.....	2

These are all the questions I have for you. May I have your first name only, please, in case my supervisor needs to verify that I conducted this interview or if there is any clarification needed?

We will be conducting a follow-up survey online and would be interested in your opinions on this same subject matter. Your participation and responses will be completely confidential. For your time and participation in this online survey, you will receive a \$10 Amazon egiftcard. Would you be interested in participating? *Great!*

We will send a survey link and unique password to you via email. To do this, may I have:

Your Name

Your email address **[REPEAT TO CONFIRM ACCURACY]**

Thank you for taking the time to answer my questions. Your opinions are very important to us. Have a nice day.

Survey Data (Transferred To DLIR)

Literature Search Materials

DIGITAL READINESS & LITERACY SURVEY

**Literature Search Focused
On Definitions & Assessments Per WDC**

April 9, 2021



I. DEFINITIONS

	DIGITAL LITERACY	DIGITAL READINESS
US Department of Education¹	<p>Defined as 1) prior computer use; 2) Willingness to take OECD PIAAC Assessment; 3) Passed 4 of 6</p> <p>Premise: Master foundation computer skills inc:</p> <ul style="list-style-type: none"> -Manipulating input/ output on devices e.g., mouse, keyboard, displays -Aware of structure of digital environment e.g., files, folders, scrollbars, hyperlinks, menus, buttons -Ability to interact effectively with digital information e.g., save, close, delete, send -<i>Interaction with texts, numerical data, graphs & ability to locate, evaluate & critically judge validity, accuracy & appropriateness of information</i> 	<p>2015 Every Student Succeeds Act New Provisions</p> <ul style="list-style-type: none"> -Use of technology to improve academic achievement & digital literacy -Professional development -Library programs to provide students opportunity to develop digital literacy skills
U.S. Department of Commerce²	<p>Portal: www.DigitalLiteracy.gov to augment DOC Natl Telecommunications & Information Administration's Broadband Technology Opportunities Program</p>	<p>Does Not Address; Previously defined as internet access</p>
Natl Conference of State Legislators³	<p>-Fluency in use and security of interactive digital tools and searchable networks inc: Ability to use digital tools safely & effectively for learning, collaborating, producing</p>	<p>Digital Citizenship: Norms of appropriate, responsible behavior when using technology. Concept includes:</p> <ul style="list-style-type: none"> -Digital access -Digital commerce -Digital communications -Digital literacy -Digital etiquette -Digital law -Digital rights & responsibilities -Digital health & wellness -Digital security

¹ "A Description of U.S. Adults Who are Not Digitally Literate," Saida Mamedova, Emily Pawlowski, Lisa Hudson, Stats in Brief, U.S. Department of Education, May 2018

² "Fact Sheet: Digital Literacy," US Department of Commerce, May 13, 2011

³ "Promoting Digital Literacy & Citizenship in School," Sunny Deye, NCSL Vol 25, No. 07, February 2017

	DIGITAL LITERACY	DIGITAL READINESS
UNESCO	Built EU digital Competence Framework for Citizens: -Ability to access, manage, understand, integrate, communicate, evaluate and create information safely and appropriately through digital technologies for employment, decent jobs, entrepreneurship. Includes competences variously referred to as computer literacy, ICT literacy, information literacy and media literacy ⁴	
Urban Institute⁵	-Foundational” digital skills are in contrast to “specialized” digital skills required for jobs that are all or mostly digital, such as a computer programmer, developer, software engineer, or IT support person. Digital Literacy is end of Continuum --Basic: Use of digital tools --Use of tools for specific tasks inc software/ platform application --Accomplish digital task and apply to new circumstance, e.g., retrieving digital scheduling --Use knowledge for more complex applications Movement requires confidence, familiarity, interest	Does not address/ Basic level focus is on behavior, e.g., use of digital tools
National Education Association/ American Library Association⁶	Ability to use information and communications technologies to find, evaluate, create and communicate information, requiring both cognitive and technical skills	Does not address directly though implies internet access, classroom technology, student equipment are funding prerequisites

⁴ “A Global Framework of Reference on digital Literacy Skills for Indicator 4.4.2,” UNESCO Information Paper #51, Centre for Information Technology in Education, University of Hong Kong, Nancy Law, David Woo, Jimmy de la Torre, Gary Wong, June 2018

⁵ “Foundational Digital Skills for Career Progress,” Ian Hecker & Pamela Loprest, Urban Institute, August 2019

⁶ “How to Assess digital Literacy for Students & Educators,” Jacqui Murray, NEA Today, August 16, 2020

	DIGITAL LITERACY	DIGITAL READINESS
DQ Institute Global Standards⁷ / Coalition for Digital Intelligence / IEEE (Institute of Electrical & Electronics Engineers)⁸	<p>Digital Literacy: Data & AI Literacy/ Content Creation and Computational Literacy/ Media & Information Literacy</p> <p>Digital Intelligence (DQ): “Comprehensive set of technical, cognitive, meta-cognitive, socio-emotional competencies grounded in universal moral values that enable individuals to face challenges and harness opportunities of digital life.”</p> <ul style="list-style-type: none"> -Digital Literacy -Digital Communications -Digital Emotional Intelligence -Digital Security -Digital Safety -Digital Use -Digital Identity -Digital Rights 	Does not address
CISCO⁹		<p>7 Component Analysis using secondary data to index 141 countries; Takes macro view similar to comparisons of different countries as a place to do business</p> <ul style="list-style-type: none"> -Basic Needs -Human Capital -Ease of Doing Business -Business & Governmental Investment -Start-up Environment -Technology Instructure -Technology Adoption <p><u>Outcome:</u> Singapore #1 / Highest of all countries for Business & Govt Investment, 4th Ease of Doing Business, 5th Technology Infrastructure</p>

⁷ “World’s First Global Standard on Digital Literacy, digital Skills, and Digital Readiness,” DQ Institute,

⁹ “Cisco Global Digital Readiness Index 2019,” Tae Yoo, Cisco White Paper, 2020

	DIGITAL LITERACY	DIGITAL READINESS
INDIVIDUAL STATES	Louisiana Department of Education: Definitions focused on students as aid to teachers. ¹⁰ -Ability to use technology to find, evaluate, create and communicate information. -Working knowledge of computer hardware -Working knowledge of computer software e.g., word processing, spreadsheets, mathematical, presentation -Understanding a wide range of apps	N/A
	North Carolina State University College of Education defines as 3 categories: 1) Locating and consuming digital content; 2) Creating digital content; 3) Communicating digital content ¹¹	N/A
	Maryland Department of Labor Adult Education: Same as American Library Assn above with 7 interconnected elements: Technical, Civic, Communicative, Collaborative, Computational Thinking, Investigative, Productive ¹²	N/A
	Many other states use the American Library Association's definition	

¹⁰ "Building Digital Literacy," Department of Education, Louisiana, Louisiana Believes, _____

¹¹ "Digital Literacies and Learning: Designing a Path Forward," Hiller Spires and Melissa Bartlett, Friday Institute White Paper Series, June 2012

¹² "Digital Literacy Framework for Adult Learners," Maryland Department of Labor, Adult Education,

II. ASSESSMENTS

	VIRTUAL LEARNING	READINESS	DIGITAL LITERACY	
ACCESS	X	X	X	X
	Learning.com	PEW	North Star	OECD/ PIACC
Used by	K-12 / Intl Society for Technology in Ed.	Public overall	Libraries Adult Ed Classes	US Dept of Education US Dept of Labor
OBJECTIVES	-Preparedness for virtual learning	Perceptions/ behavior -Help people prepare using digital tools -Navigate environment -Solve Problems -Make Decisions		-Assess literacy, numeracy, problem-solving in tech environment -Benchmark against natl intl results -Provide training baseline
			Skill Use: Specific computer related	Skill Use: Workplace skills by simulating tasks to solve problem using computer technologies e.g., emailing, website, spreadsheets, buying, finding information
Methodology & Scope of Work	On-Line	Telephone	On-Line	On-Line with backgrounder telephone/ in-person
Self-Efficacy		Confidence		Approach focuses more on self-reported behavior than perceptions -Prior computer use -Cognitive -Interaction/Social -Physical Skills -Learning Skills
Skills		-Facility in getting tech to work - Use of digital tools for learning	<u>Computer Essentials</u> -Computer basics -Internet basics -Email -Windows -MAC OS	- <u>Functional Literacy</u> : Under-stand, evaluate, use/texts to identify/ evaluate tasks - <u>Functional Numeracy</u> : Access, use, interpret, communicate mathematical info in life situations to solve problem/understand situation

	HARDWARE & BASIC KNOW	READINESS	DIGITAL LITERACY	
			<u>Software Skills</u> -Word -EXCEL -PowerPoint -Google Docs	
			<u>Daily Life Tech</u> -Social Media -Information Literacy -Career Search skills	
			-Digital Footprint	
Trust		Discernment of trustworthiness		Evaluate/ interpret information
Communications		Aware – ed tech terminology		Workplace communications, training skills (See self-efficacy)
Categories of Literacy	-Empowered learner -Digital Citizen -Knowledge Constructor -Innovative Designer -Computational thinker -Creative communicator -Global collaborator	Readiness Spectrum 1) <u>Relatively Hesitant</u> (52%) -The Unprepared (14%) -Traditional Learners (5%) -The Reluctant (33%) 2) <u>Relatively more Prepared</u> (48%) -Cautious Clickers (31%) -Digitally Ready (17%)		5 Levels - <u>No</u> digital skills - <u>Below Level 1</u> : Perform well defined tasks requiring only 1 function w/generic interface e.g., navigating across multiple pgs. w/ web browser using application in tandem - <u>Level 1</u> : Use statis technology for single-step tasks, e.g., basic navigation on browser/email processes - <u>Level 2</u> : Use more advanced tech and tools to facilitate operations, multi-step, surmounting barriers, inferential reasoning, e.g., sort function to identify entries in spreadsheet that match criteria from different app - <u>Level 3</u> : Can complete tasks demanding higher cognition, inc. high inferential reasoning, evaluation of data reliability, e.g., using scheduling app with multiple variables like participants schedules, rooms bookings

Briefing By Dr. Irwin Kirsch

Using PIAAC in Hawaii: Large Scale Assessments as Policy Research

Irwin S. Kirsch

May 7, 2021

AGENDA

- Setting a context
- What are large scale assessments (LSA)
- Understanding large scale assessments as policy research
- Design criteria for LSA – *Comparability, Interpretability & Relevance*
- What is PIAAC and how it can be adapted for use in Hawaii
- Questions and Discussion

SETTING A CONTEXT FOR LARGE SCALE ASSESSMENTS

- Since their introduction some 60 years ago, they have grown in both scope and salience – both national and international
- Increasing interest reflects not only the importance of skills & skill development for both economic growth and societal well-being, but also the value of benchmarking performance against peers and across periods of time
- Interest in these types of assessments have contributed to advances in new methodologies, measurement science and the incorporation of new digital technologies

WHAT ARE LARGE SCALE ASSESSMENTS

- They are survey-based studies that assess the knowledge, skills and dispositions of both student and adult populations in a comparative context
- They provide estimates of the distributions of skills in key domains for various populations and subgroups of interest along with estimating the strength of the relationships between these skill distributions and social, educational and, in the case of adults, labor market outcomes
- In addition they can encompass a broad range of ages which, in the case of PIAAC, enable comparisons across age cohorts and can be used to study trends over time

LARGE SCALE ASSESSMENTS AS POLICY RESEARCH

- Results from LSAs are released into educational policy landscapes that are often characterized by complex dynamics among a range of stakeholders
- As a result, it is not a simple matter to evaluate whether the results are moving a country or a jurisdiction in a productive direction as a source of policy information. That is, we need to consider how to judge the utility of these surveys.
- For years, I have emphasized the idea that a deeper understanding of the utility of these surveys can be obtained through a framework that was introduced back in 1987. At that time Sam Messick argued that LSA were a form of policy research and should be judged by their contributions to policy analysis.

DESIGN CRITERIA FOR LARGE SCALE ASSESSMENTS

Messick's framework contains a set of design criteria that offer guidance for the design, development and implementation of these LSAs and for evaluating their overall utility. They include: *comparability, interpretability, and relevance*.

- **Comparability** refers to the degree to which results obtained among different subgroups or jurisdictions have the same meaning in relations to the underlying constructs being assessed. In the context of LSA, this is absolutely essential to having any utility. Achieving this goal covers issues involving instrumentation, sampling, and linking over time and across groups.
- **Interpretability** depends on the process that was used to develop the instruments that have been used in the survey. The term implies strong, evidence-based support for the desired interpretations or what is commonly referred to as construct validity.
- **Relevance** indicates the extent to which the evidence obtained through the instruments (cognitive and background) are germane to the current policy questions and yield results that can be analyzed to address current priorities.

WHAT IS PIAAC & HOW CAN IT BE ADAPTED FOR HAWAII

- PIAAC is an international comparative survey of adults 16-65 years of age. It was designed to provide policy level information about the distributions of skills and background characteristics of nationally representative samples of adults.
- The first cycle of PIAAC was administered in 3 rounds between 2012-2017 to representative samples of adults in some 38 countries. Cycle 2 is currently underway in 33 countries.
- PIAAC was the first computer-based, large-scale assessment of adult skills that was designed for and delivered on computers.
- It consisted of a 30-35 minute background questionnaire and a set of cognitive modules that assessed *literacy*, *numeracy* and *problem solving skills in technology environments* (PSTRE).

WHAT IS PIAAC & HOW CAN IT BE ADAPTED FOR HAWAII (2)

- Education and skills online (ESO) is a derivative product that can be used to assess individuals as well as selected groups of adults 16-65 years of age
- Designed to provide individual-level results that are linked to PIAAC and, therefore, share the same validity evidence
- Receive individual *literacy, numeracy, and problem-solving in technology-rich environments* scores that are directly comparable to those on the PIAAC scales
- Delivered over the internet and can be taken anytime on an individual's personal computer or in a computer lab
- Available in English (Australia, Canada, Ireland, US) and a number of other languages

WHAT IS PIAAC & HOW CAN IT BE ADAPTED FOR HAWAII (3)

Sections of the PIAAC background questionnaire that can be adapted

A: General Information

B: Education and Training

C: Current Status and Work History

D: Current Work

E: Last job

F: Skills used at work (current job or in last 12 months)

G: Literacy, Numeracy and ICT skill use at work

H: Literacy, Numeracy and ICT skill use in everyday life

I: Questions about yourself

J: Background information

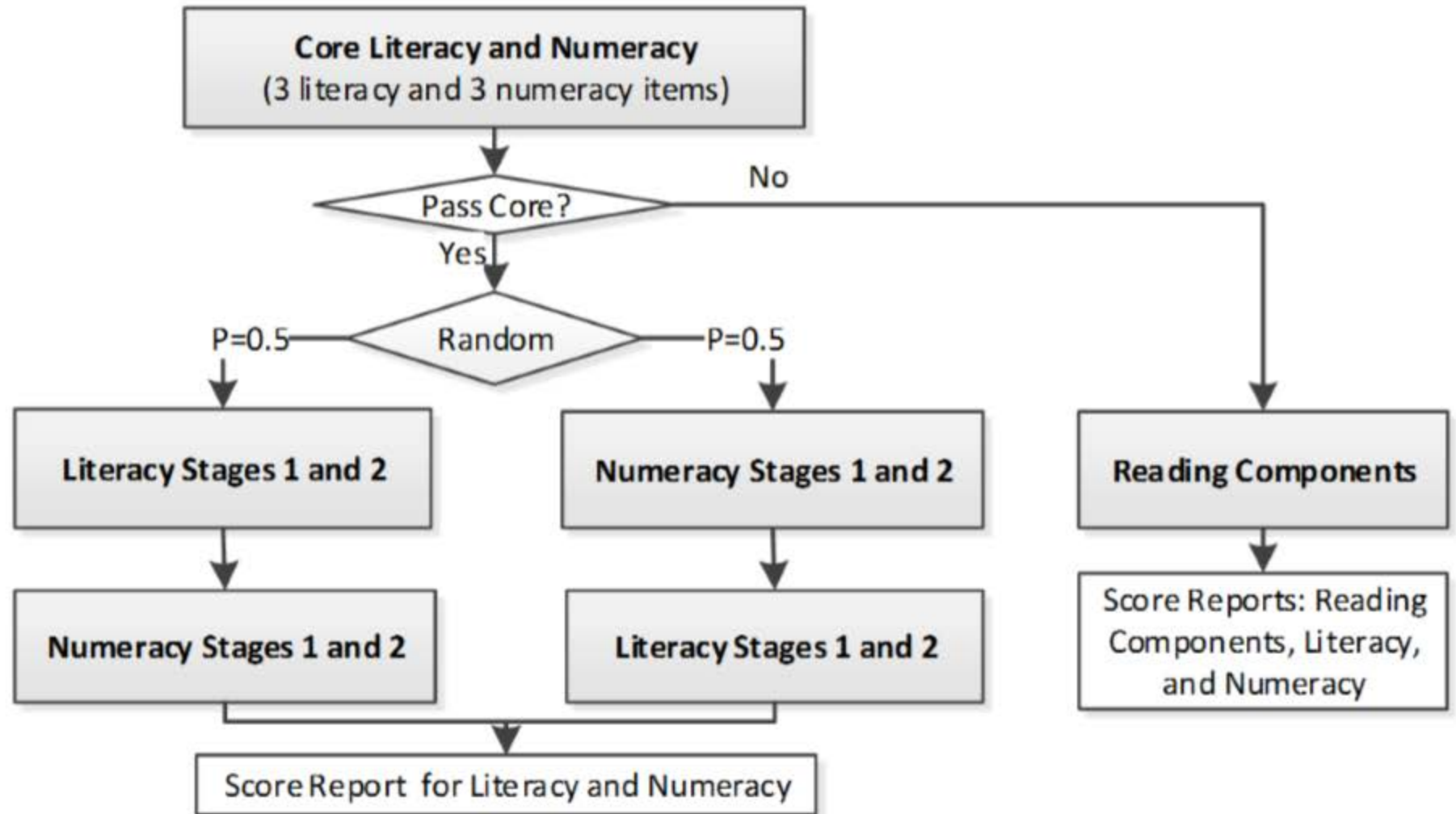
QUESTIONS AND DISCUSSION



LSA IMPACT: A FEW EXAMPLES

- DIRECT IMPACT that resulted in changes to curriculum and assessment
 - Less noticed but perhaps equally important there are examples where results have been used to support existing policies.
- INDIRECT IMPACT provides another type of evidence of impact from LSA
 - Shift in the discourse marking a move away from attainment to a focus on skills
 - Importance of skills highlights issues around growing inequalities
 - Increase in media attention also draws in more researchers, funding and debates around policies and practices
 - Increased participation of donor organizations such as World Bank UNESCO, & the Inter-American Development Bank among others
- CAUTION: Impact depends on the readiness of the relevant national or local actors to take account of the information provided, to articulate plans and policies and to commit to funding and political capital needed to motivate and drive change.

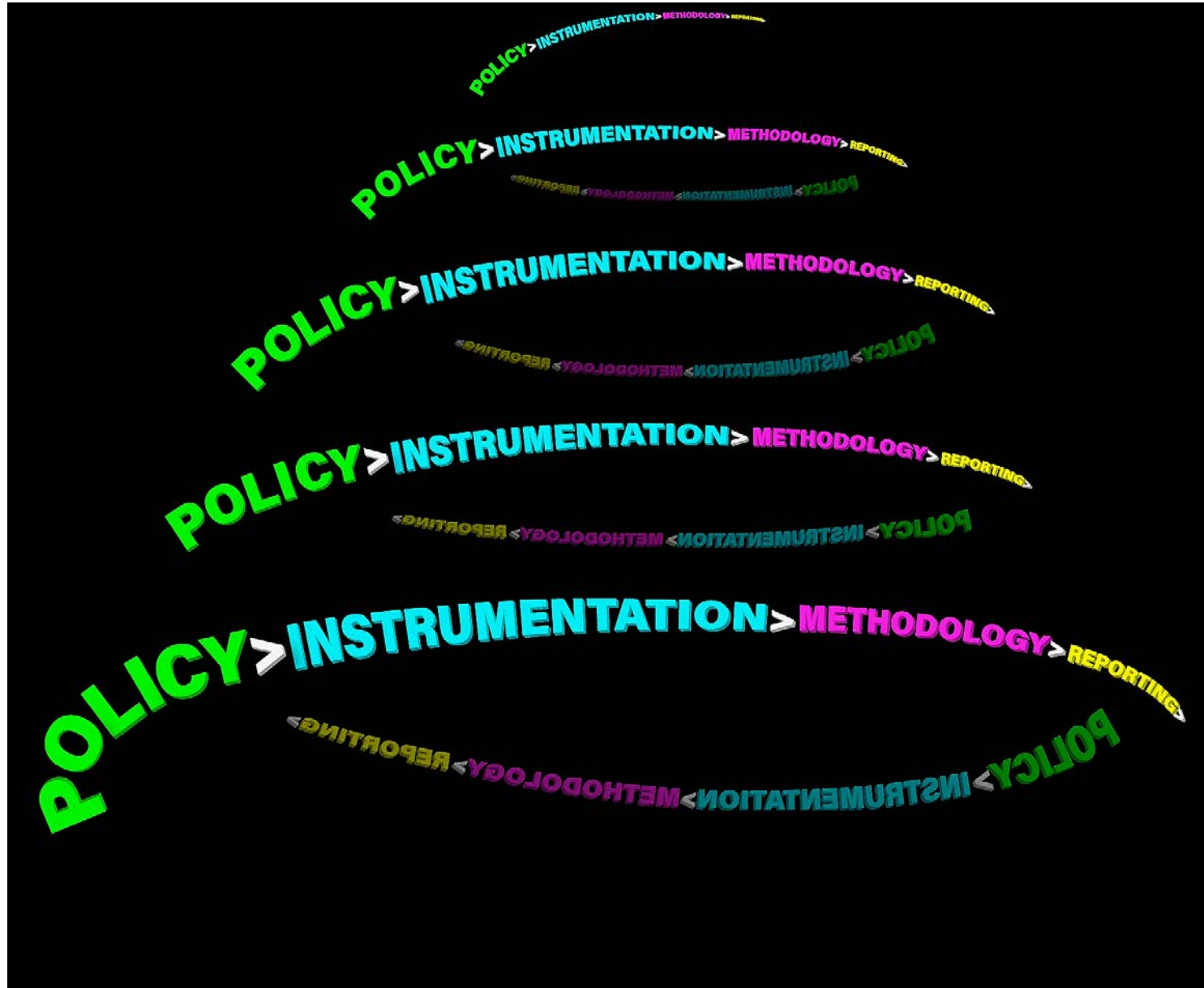
Core Exam



LARGE SCALE ASSESSMENTS AS POLICY RESEARCH (2)

- The goal is to provide deeper understandings of how these skills are developed and how they relate to a variety of key outcomes.
- These policy driven questions lead to the formulation of new frameworks that drive the development of new instruments as well as to the expansion of legacy domains (such as literacy and numeracy) which drive new advancements that facilitate richer analyses and deeper interpretations of the data. These, in turn, elicit increased interest among more stakeholders, leading to further questions
- The result has been that LSAs have evolved along what we refer to as a virtuous spiral of increased relevance and utility.

Large Scale Assessments as Policy Research



LARGE SCALE ASSESSMENTS AS POLICY RESEARCH

- Since their inception some 60 plus years ago they have experienced substantial growth in participation and greater salience reflecting what we believe results from increased utility of comparative information among policy makers and key stakeholders.
- Perceived utility of these surveys is likely fueled by mounting concerns about the levels and distributions of human capital and how they have become associated with important outcomes for individuals and societies.
- Today, policy makers and other key stakeholders including researchers are calling for these assessments to measure new and important cognitive domains along with providing more and richer background and contextual information

Policy Report



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

Irwin Kirsch, Anita Sands,
Steve Robbins, Madeline Goodman
and Rick Tannenbaum

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 US 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 identifies 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.

Irwin Kirsch and Anita Sands

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 By 2030, The Council on Foreign Relations estimates as many as a third of American workers will either need to change occupations or acquire new skills.⁵

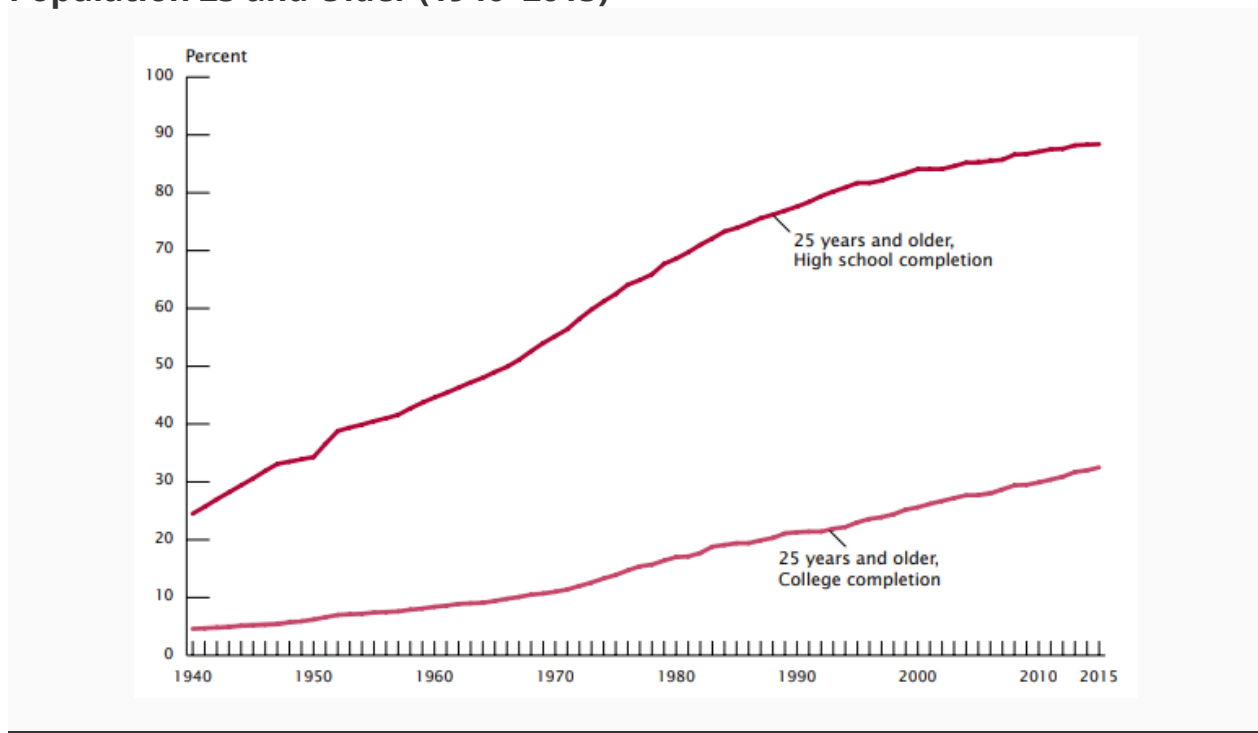
Our goal with this report is to present a case for why we must develop strategic interventions to buttress America's middle-skill workers not only with higher levels of education but also, critically, with the skills they need so they are better equipped for the jobs of today—and those that will most 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.

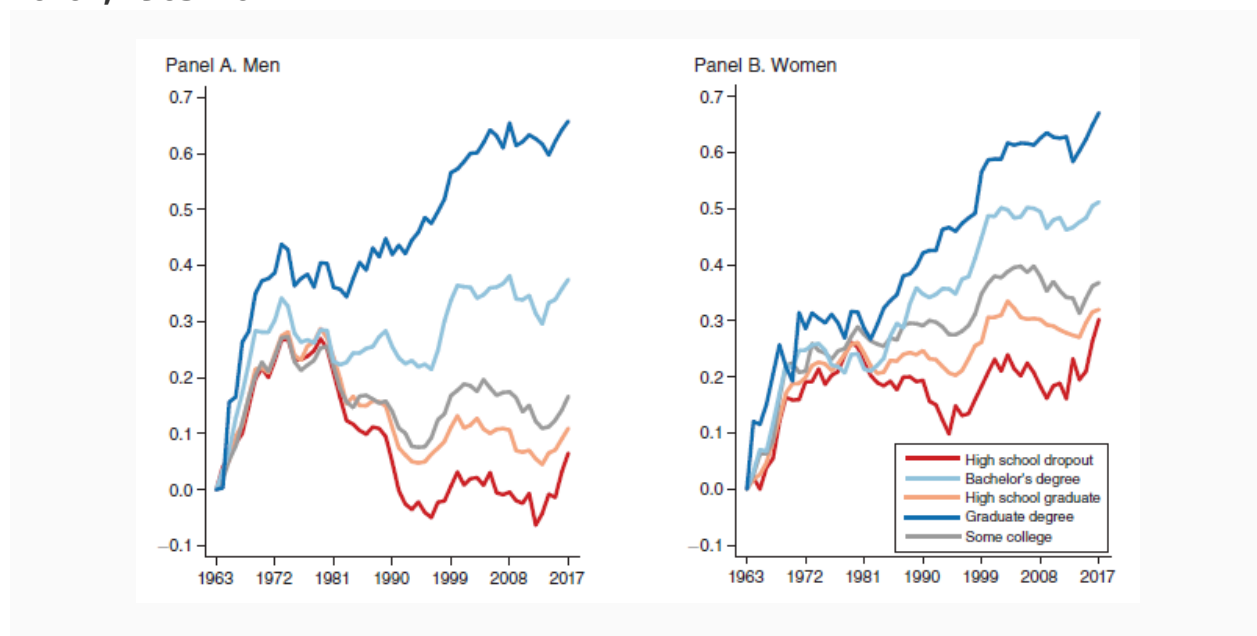
Source: U.S. Census Bureau, 1947–2015, Current Population Survey and 1940 Decennial Census⁹

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 blue-prints, 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, 1963–2017¹³



Source: Author (2019), based on Current Population Survey (CPS) Annual Social and Economic Supplement.

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 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 post-secondary 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-skilled 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 education programs 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 Experts³⁴

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
<u>Written Comprehension</u>	The ability to read and understand information and ideas presented in writing.	50.7	90.2	100	39.5	49.3	9.8
<u>Written Expression</u>	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
<u>Fluency of Ideas</u>	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
<u>Originality</u>	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
<u>Inductive Reasoning</u>	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
<u>Category Flexibility</u>	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 Experts³⁸

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.

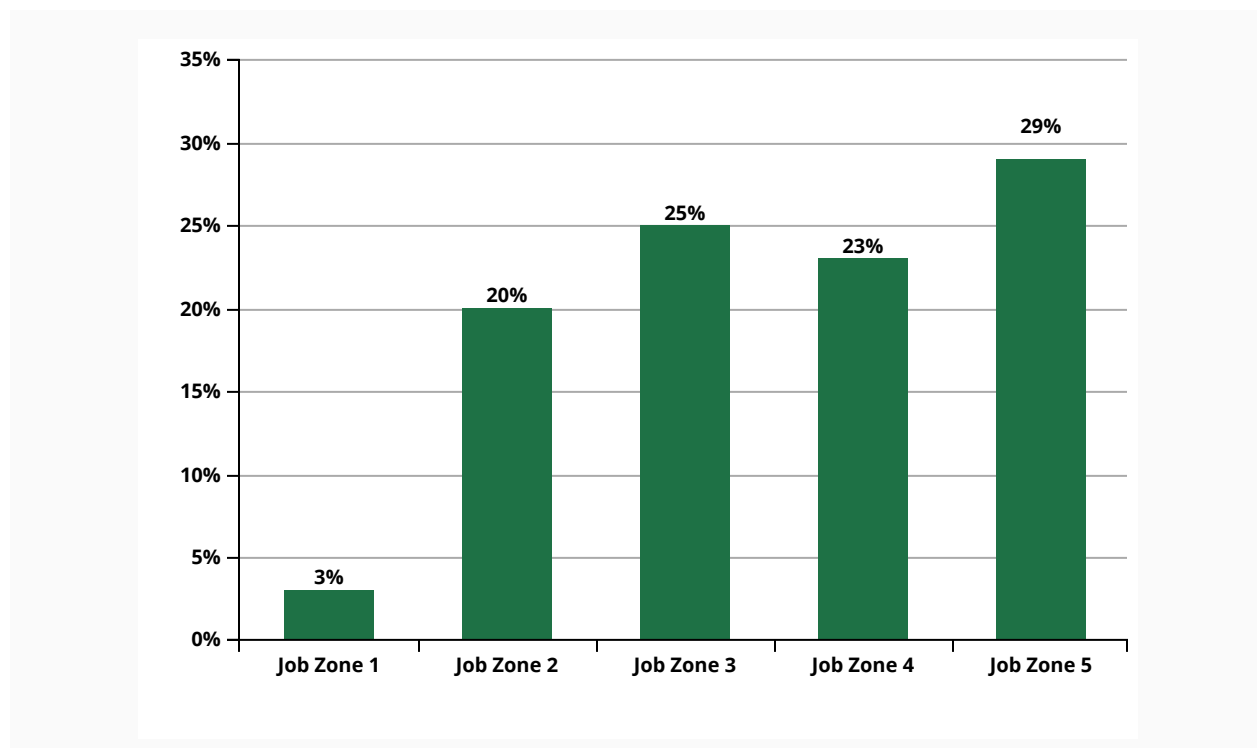
A key takeaway from the analysis of attributes and skills by job zone classification is the substantial degree of similarity in the cognitive abilities and skills deemed integral for jobs in Zone 3 and Zone 4, despite the differences in training typically associated with these zones. This finding suggests 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

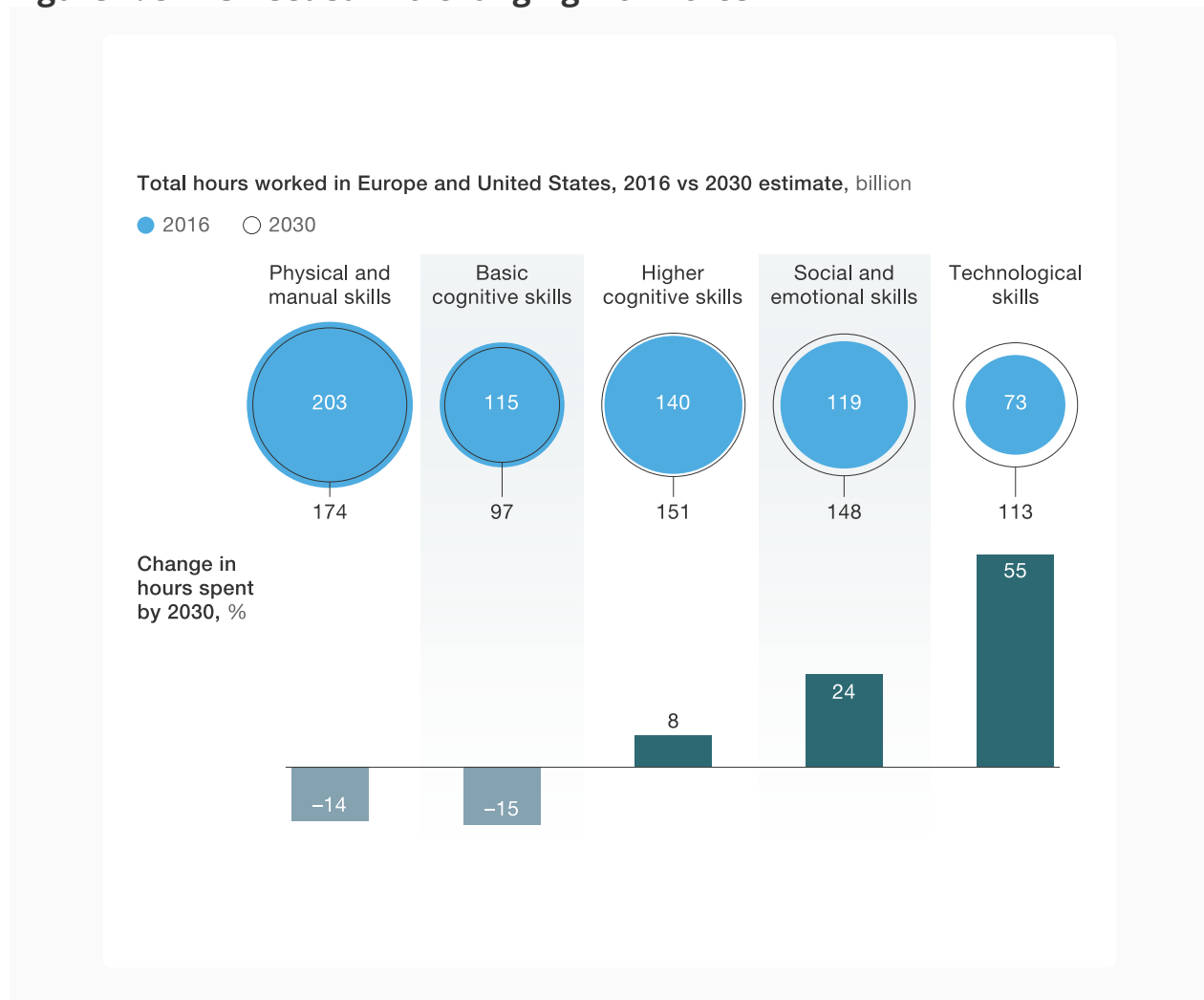


Source: O*NET Bright Outlook occupations cross-walked to O*NET job zones by authors using O*NET crosswalk information. See Appendix A for crosswalk results.

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: McKinseyGlobalInstitute, 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.

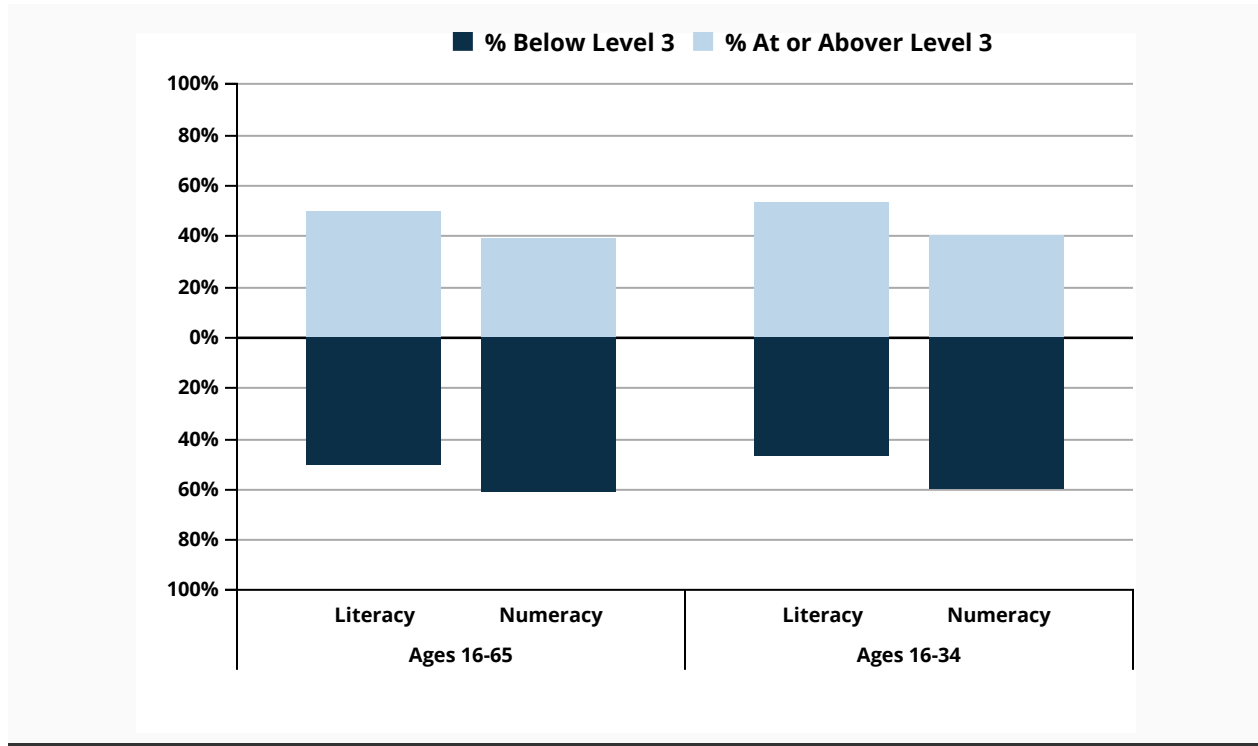
Extensive research on adult literacy conveys a similar message. As Kirsch et al. (2002) noted at the turn of this century, "[L]iteracy can be thought of as a currency in this society. Just as adults with little money have difficulty meeting their basic needs, those with limited literacy skills are likely 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 Performing Below and At or Above Level 3, 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

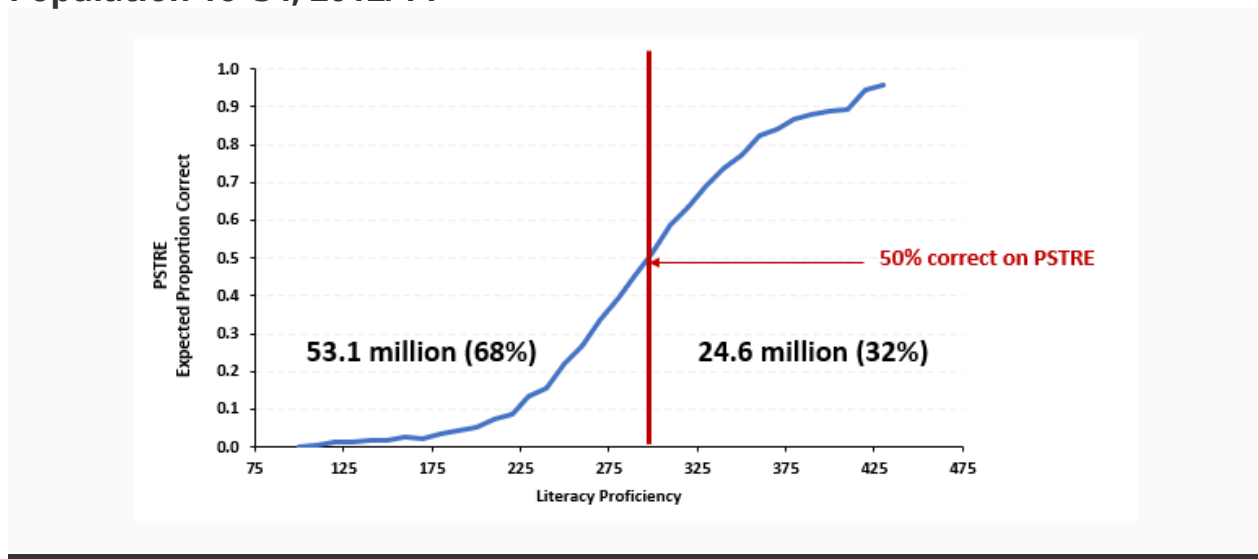
In general, a key difference between the kinds of tasks that those who perform at or above Level 3 can do compared to those below this standard hinges on the complexity of what an individual is being asked to do with a text or display of information. For example, in numeracy, those who perform at Level 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 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



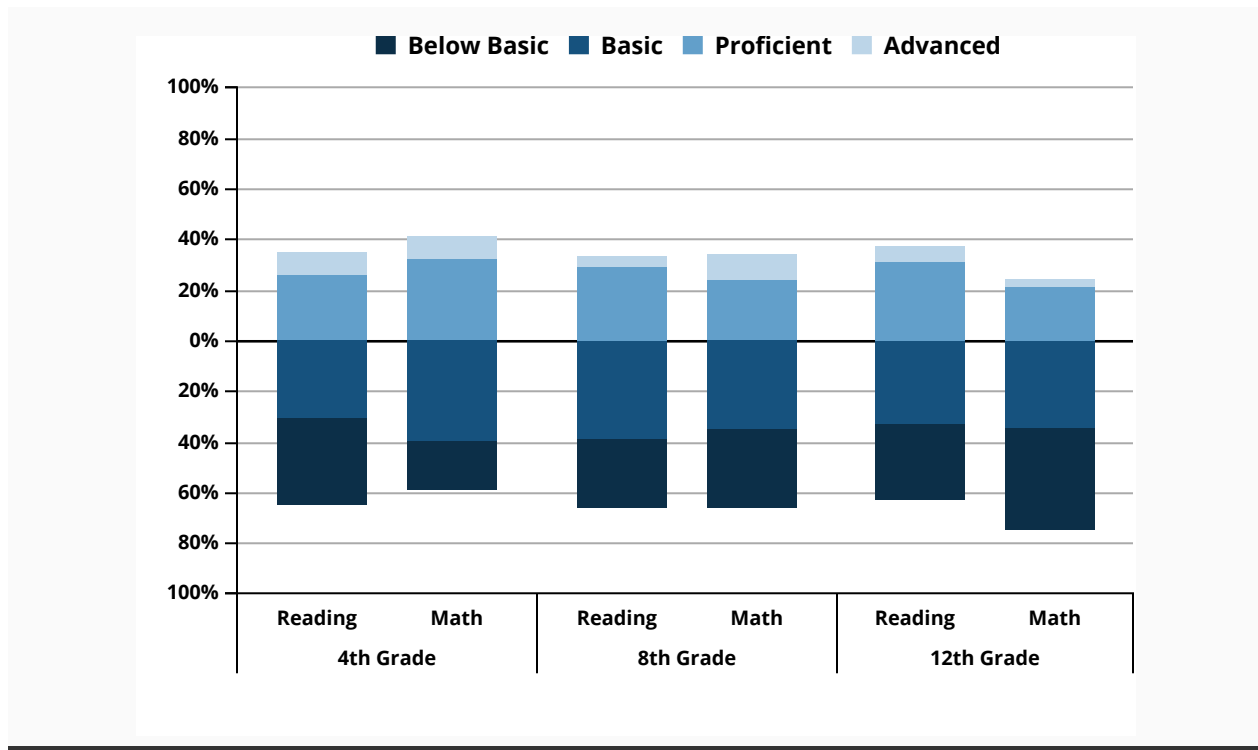
Source: Graphic prepared by authors using data from the Organisation for Economic Co-operation and Development (OECD), Programme for the International Assessment of Adult Competencies (PIAAC), 2012/2014.

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 *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 *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 Proficiency by Select Domain 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
<ul style="list-style-type: none"> 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 <ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> Promote efficient and effective use of the learning system for trainers Asynchronous and synchronous instruction supporting varied learning options Motivational strategies that support learners Immediate feedback to support learning Actionable data to evaluate program effectiveness 	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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 construct-based, or ECD,⁶⁰ and offers a critical roadmap for the development of coherent and quality interventions.

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 on-going 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
19-4021.00	Biological Technicians	4
15-2041.01	Biostatisticians	5
47-2021.00	Brickmasons and Blockmasons	2

Notes: *Unable to determine Job Zone Category

Source: Data for Crosswalk from [O*NET OnLine](https://www.onetonline.org/) by the U.S. Department of Labor, Employment and Training Administration (USDOL/ETA). Used under the [CC BY 4.0](https://creativecommons.org/licenses/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
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
15-1199.07	Data Warehousing Specialists	4
15-1141.00	Database Administrators	4
15-1199.06	Database Architects	4

Notes: *Unable to determine Job Zone Category

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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
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
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

Notes: *Unable to determine Job Zone Category

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

CODE	OCCUPATION	JOB ZONE RECODE
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
19-2041.03	Industrial Ecologists	5
17-2112.00	Industrial Engineers	4
19-3032.00	Industrial-Organizational Psychologists	5

Notes: *Unable to determine Job Zone Category

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

CODE	OCCUPATION	JOB ZONE RECODE
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
25-4013.00	Museum Technicians and Conservators	4
29-1125.02	Music Therapists	4
29-1199.04	Naturopathic Physicians	5

Notes: *Unable to determine Job Zone Category

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

CODE	OCCUPATION	JOB ZONE RECODE
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
47-2151.00	Pipelayers	2
47-2152.02	Plumbers	3
47-2152.01	Plumbers, Pipefitters, and Steamfitters	3

Notes: *Unable to determine Job Zone Category

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

CODE	OCCUPATION	JOB ZONE RECODE
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
39-1012.00	Slot Supervisors	2
11-9151.00	Social and Community Service Managers	4
21-1093.00	Social and Human Service Assistants	4

Notes: *Unable to determine Job Zone Category

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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
19-4061.00	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

Notes: *Unable to determine Job Zone Category

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Appendix B: PIAAC Literacy Skills by Level of Educational Attainment, Population 16–34, 2012/14

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, 2012/14

EDUCATION - HIGHEST QUALIFICATION - LEVEL	AGE	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)	16-34	6	(1.3)	24	(2.4)	42	(2.8)	24	(2.5)	4	(1.4)	‡	†
Upper secondary (ISCED 3A-B, C long)	16-34	3	(0.6)	12	(1.3)	38	(2.0)	37	(2.0)	10	(1.3)	1	(0.3)
Post-secondary, non-tertiary (ISCED 4A-B-C)	16-34	‡	†	9	(2.6)	46	(4.9)	38	(4.4)	7	(2.3)	‡	†
Tertiary - professional degree (ISCED 5B)	16-34	‡	†	3	(1.3)	29	(4.2)	51	(4.9)	17	(3.6)	‡	†
Tertiary - bachelor degree (ISCED 5A)	16-34	‡	†	2	(0.8)	16	(1.9)	50	(2.9)	30	(3.0)	2	(0.9)
Tertiary - master/research degree (ISCED 5A/6)	16-34	‡	†	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 Organization for Economic Cooperation and Development, Program for the International Assessment of Adult Competencies (PIAAC), PIAAC 2012/2014 Literacy, Numeracy, and Problem Solving TRE Assessment.

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