

A photograph of two women in a professional setting, smiling and looking at a laptop. The woman on the left is Black with her hair in a bun, and the woman on the right is white with long dark hair. They are both wearing light-colored blouses. The background shows a modern office with large windows and indoor plants.

Instructional Approaches and Practices

Digital Resilience in the American Workforce (DRAW): Detailed Findings and Discussion

AT A GLANCE

While the DRAW landscape scan showed that the teaching of digital skills has increased since the onset of the pandemic, it also showed that there still is great need for a more strategic approach. This brief presents promising resources and approaches gleaned from the landscape scan in four main sections: 1) Instructional Approaches, Models, and Practices; 2) Integrating Digital Literacy into Skills Instruction, with examples from different contexts; 3) Meeting the Diverse Needs of Learners, with discussion of some different learner audiences and how to best support each of them; and 4) Gaps, Barriers, and Opportunities to Effective Instructional Approaches and Practices. We share observations from research literature, observations about teaching, and learnings drawn from our interviews and questionnaires.



AUGUST 2022

Acknowledgments

The DRAW team would like to recognize everyone who contributed to the instructional brief and landscape scan, especially Jen Vanek, Alison Ascher Webber and Jamie Harris from World Education, who designed and led the scan in partnership with Rachel Pleasants McDonnell and Shakari Fraser from Jobs for the Future. We also want to thank everyone from JFF, World Education, and Safal Partners who led or supported components of the project: Dristi Adhikari, Annalisa Crowe, Meslissa Gordon, Jeff Goumas, Nicole Klues, Fred McIntyre, Ronalis Naveo, Rachel Riggs, Jennie Rivera, Felicia Sullivan, and Alex Swartzel. We are especially grateful for the vision and guidance of Katie Chase and Travis Combs from the Office of Career and Technical Education. Finally, we want to thank the DRAW Technical Working Group members, subject matter experts, practitioners, adult learners, and learner focus group participants who contributed to the scan.

Disclaimer: *This report was created by Jobs for the Future and World Education and as part of the DRAW project funded by the U.S. Department of Education's Office of Career and Technical Education, Division of Adult Education and Literacy, under contract GS10F0094X. The views expressed by the project do not necessarily represent the policy of the Department of Education, and its contents should not be considered an endorsement by the federal government or the funding agency.*

Technical Working Group Members

Paolo Balboa, National Digital Inclusion Alliance
Amanda Bergson-Shilcock, National Skills Coalition
Jill Castek, Portland State University
Jaime S. Fall, formerly with The Aspen Institute (2015-2022)
Anson Green, Tyson Foods
Corina Kasior, Arizona Department of Education
Dylan Siegler, Verizon Foundation
Brandon Olszewski, International Society for Technology in Education
Stephen Reder, Portland State University
Stacey Wedlake, University of Washington

Subject Matter Experts

Ginette Chandler, New Hampshire Adult Education
Jane Egüez, Comprehensive Adult Student Assessment Systems
Kathy Harris, Portland State University
Sherry Lehane, Providence Public Library
Becky Raymond, Chicago Citywide Literacy Coalition
Rachel Riggs, World Education Inc.
Glenda Rose, Community Action Inc.
Susan Wetenkamp-Brandt, Literacy Minnesota
Angela Williams, Goodwill Industries International
Steve Yadzinski, JFF Labs

Sarah Cacicio, Digital Promise

Medha Tare, Digital Promise

Mary Gaston, South Carolina Adult
Education

Organizations, Practitioners, and Learners

Literacy Council of Montgomery County

Pah Kyat, learner

Alvin, learner

Brenda, learner

Pwint, learner

Melvin, learner

Mary, learner

Josue, learner

Elvin, learner

All the learners who completed the survey

All practitioners who completed various
questionnaires

About JFF's Language Choices

JFF is committed to using language that promotes equity and human dignity, rooted in the strengths of the people and communities we serve. We develop our content with the awareness that language can perpetuate privilege but also can educate, empower, and drive positive change to create a more equitable society. We will continually reevaluate our efforts as language usage continues to evolve.

About JFF

Jobs for the Future (JFF) drives transformation of the American workforce and education systems to achieve equitable economic advancement for all. www.jff.org

About World Education

World Education advances equity through education and improving the availability, quality, and capacity of adult education and workforce programs. Its award-winning EdTech Center advances digital equity and supports organizations to leverage technology to accelerate impact. www.worlded.org

About Safal Partners

Safal Partners' mission is to revolutionize public sector programs and services to catalyze positive societal change at scale. www.safalpartners.com

Contents

Introduction	5
About the DRAW Landscape Scan.....	5
Instructional Approaches, Strategies, and Practices	6
Integrating Digital Literacy Into Skills Instruction.....	14
Meeting the Needs of Diverse Learners	20
Gaps, Barriers, and Opportunities to Effective Instructional Approaches and Practices	27
Access to Needed Technologies and Relevant Content.....	27
The Struggle to Address Learner Diversity	28
Practitioner Access to Research	29
Encouraging Innovative Policy, Programming, and Practices	29
Conclusion.....	30
Endnotes.....	31

Introduction

This brief shares findings from the Digital Resilience in the American Workforce (DRAW) initiative landscape scan and responds to questions raised in interviews with learners and practitioners about how educators can best support adult learners in developing the digital skills required to secure a better future for themselves.

While the scan showed that the teaching of digital skills has increased since the onset of the pandemic, it also showed that there still is great need for a more strategic approach. Specifically, practitioners expressed urgency for professional development showing them how to help learners develop digital resilience, defined as having the awareness, skills, agility, and confidence to be empowered users of new technologies and adapt to changing digital skill demands¹. Teachers noted that digital resilience encompasses transferable skills, self-efficacy, and a flexible mindset about technology use. To foster such development, teachers said they need training on how to support social-emotional learning and employ innovative instructional approaches and resources.

“Why did you begin studying technology skills?”

“To forge a better future.”

- Student response

About the DRAW Landscape Scan

There is an urgent need for adult digital skill development in the U.S. With this need as a backdrop, the Digital Resilience in the American Workforce (DRAW) initiative, funded by the U.S. Department of Education’s Office of Career, Technical, and Adult Education (OCTAE), conducted a wide-ranging landscape scan to identify effective approaches and existing resources supporting digital skills development². The scan also identified current efforts to advance digital access and digital equity; useful skill definitions, frameworks, and assessments; and practitioner professional development opportunities. Learnings from the scan are summarized in the report, [*Digital Resilience in the American Workforce: Findings From a National Scan on Adult Digital Literacy Instruction*](#). The findings will inform the design of forthcoming professional development for adult educators by answering this primary research question: *What training resources, strategies, and approaches are most relevant for educators seeking to increase foundational digital literacy and digital resilience for an adult learner population?*

Prior research shows that adequate resources and use of effective instructional strategies can help the adult education field increase learning outcomes and digital resilience while closing inequities in outcomes by race and other socioeconomic factors³.

This brief presents promising resources and approaches gleaned from the landscape scan in four main sections:

- 1) [Instructional Approaches, Models, and Practices](#)
- 2) [Integrating Digital Literacy Into Skills Instruction](#), with examples from different contexts
- 3) [Meeting the Diverse Needs of Learners](#), with discussion of some different learner audiences and how to best support each of them
- 4) [Gaps, Barriers, and Opportunities to Effective Instructional Approaches and Practices](#)

We share observations from research literature, observations about teaching, and learnings drawn from our interviews and questionnaires.

Instructional Approaches, Strategies, and Practices

“It’s not about adding discrete digital skills to regular instruction, but it’s more about seeing how digital resilience can be integrated into an intentional approach to foundational skills instruction that recognizes learners’ assets, in real-world contexts and in ways that meet learners’ needs (both student learners’ and practitioner learners’), recognize their fears, encourage the mindset of being a lifelong learner, and celebrate their strengths.”

— Monica Leong, educator

The landscape scan identified a number of effective instructional approaches, strategies, and practices needed for fostering digital skills and, beyond that, digital resilience.



Contextualization and Integration

Adults learn best when their learning experiences are embedded in a context that is relevant to their lives and goals, a concept called contextualized instruction⁴. Early theories in adult learning suggested that in effective learning environments, adults need to connect their learning to their prior knowledge, real-world problems, and life experiences, all key components of contextualized learning⁵.

Because adults encounter digital tasks in daily life, contextualization is critical for adults building digital literacies. Unfortunately, much early digital literacy instruction used rote, decontextualized materials and strategies. A contextualized approach to instruction, in which learners can immediately see when and how skills can be drawn on in daily life, better supports learning. The contexts drawn on should define digital literacies broadly, meaning not just in the context of careers and education but also in the context of health, finance, civic engagement, family life, and specific areas of interest to learners⁶. (See the [Integrating Digital Skills Into Skills Instruction](#) section for more on contextualizing instruction.)



Choice, Relevance, and Motivation

Building in opportunities for choice on what skills to learn is one way to ensure instruction meets learners' needs and is motivating. Such learner-centered instruction elevates the relevance of instructional tasks and the targeted skills. Tools to support learner choice include:

- [EdTech Center's Digital Literacy Self-Assessment Tool](#), which allows learners to identify the technology they use, how often it is used, and levels of comfortability. (A similar tool exists for teachers: the [Digital Skills Self-Assessment for Instructors](#).)
- [The Digital Literacy Action Plan](#) is a tool teachers can use to help learners identify target skill areas, reflect on progress, and track accomplishments.

“Most adult learners will only learn about digital tools if they feel they need it in their lives. Other than that, interest is minimal.”

— Practitioner
Questionnaire
response

A learner-centered, contextualized approach to instruction allows students to practice the digital skills they need in their daily lives and prepares them to use those skills outside of an instructional setting⁷. This focus on practicing new skills outside of class is critical, as longitudinal studies on adult literacy have proved that the largest long-term gains in adults developing skills correlate to practicing them outside of class rather than hours in a classroom⁸. Practice engagement theory suggests that instruction should focus on giving students the competencies and confidence they need to successfully go out and practice skills in their real lives⁹.

Programs can deploy learner self-assessments to measure changes in confidence in using technology as well as in actual behavior in using technology outside of class. An example of this approach is the [Building Skills Partnership](#), a labor management training program for janitors in California that calls and interviews past participants to assess how their confidence in using technology and actual use of devices in their day-to-day lives have changed since they finished the training¹⁰.

- “[We Learn By Doing! Authentic Practice Outside of Class Through Technology](#),” a Coalition on Adult Basic Education (COABE) presentation by the EdTech Center @ World Education, shares instructional strategies for increasing practice of various adult basic skill areas.



A Strengths-Based Approach Building on Current Skills and Knowledge

Adult learning is fostered when new information connects with past experience or skills¹¹. In the context of digital skills development, that means starting with and then building on the tools and uses of tools that are common among learners. Adult learners often use mobile phones for communication and learning. Indeed, mobile phone technology, including social media functions, is widely used across all socioeconomic demographic groups in the United States, including among immigrants and refugees¹². Teachers can leverage the skills and confidence

learners have with mobile technologies—for example, a teacher might make use of a social media platform for class communication¹³, use texting apps for nudges and reminders¹⁴, or even text complete micro-lessons to learners¹⁵. This supports a strengths-based approach to instruction, which recognizes that adult learners have a wealth of experiences, knowledge, and skills that can enable more learning.

It is important to consider affirming rather than deficit-oriented language when recognizing learners' experience. For example, instead of calling learners “low skilled,” consider describing their current engagement in learning as “developing foundational skills.” Or, instead of viewing learners' home language as getting in the way of learning, shift to looking at it as a means to support their learning¹⁶.

“Language *really* matters in facilitating a shift to an asset-based approach. If we are using deficit-based language *within* our field, we are perpetuating a false perception of how a diverse workforce strengthens society.”

— Practitioner Questionnaire response



Differentiated and Targeted Instruction

While adult learners may have a variety of digital skills and knowledge, it may be fragmented or have gaps¹⁷. Differentiated instruction supports learning by individualizing instruction to learners based on an assessment of their existing knowledge and skills and which skills they need to develop¹⁸. Targeted instruction, or skill boosts, based on an assessment of digital skills is one way to quickly fill in a small gap that could be preventing an adult from accomplishing a goal such as finding a new job, establishing a new career path, or starting a small business¹⁹.

1. [The digital literacy case study and lesson plans in the LINCS Teaching Skills That Matter \(TSTM\) series](#) provide examples of how to support differentiation in learning opportunities that support digital skill development. [The lesson plan on workplace safety](#) is a particularly salient example.



Recycling Skill Instruction to Support the Transfer of Skills

There are many ways to recycle skill instruction, including focusing on the same skills in a variety of contexts. For example, filling out forms online can easily be part of school, health, work, and other digital contexts²⁰. As adults move beyond foundational digital skills, the same skills can be further developed at more advanced levels.

The wider the variety of contexts in which an adult encounters a digital skill, the easier it is to transfer that skill to additional contexts. Not all learners will recognize where a previously learned skill might be useful in a new context. For example, research in a digital literacy drop-in lab showed that learners who understood how to bold text in a word processing platform did not transfer that skill when learning how to use email; they did not realize they could format email text until a volunteer showed them²¹. Helping learners understand how to transfer skills is a key component to fostering digital resilience.

- [The EdTech Integration Strategy Toolkit](#) from World Education is a resource to help educators explore sustainable edtech *routines*, which are general, repeatable activities that can be used regularly regardless of context or content and provide predictable experiences for learners. Using these routines can help learners recycle digital skills learned in previous class meetings.



Fostering a Flexible Mindset and Resilience

One of the keys to digital literacy is understanding that digital tools, technologies, and practices are always changing²². Practitioner Questionnaire respondents noted the importance to provide instruction that includes “the development of learner autonomy and agency” so that learners are “able to adapt to the ever-changing landscape of technology.” Developing the confidence to deal with changes and problems requires a flexible mindset, where learning happens through the struggle encompassed in risk taking and problem solving.

Instructors can model digital resilience—adapting when a tool or practice has changed or a new tool is created, as well as when something goes wrong. Instructors may not be confident in their own skills, but modeling how to identify digital literacy gaps, critically evaluate resources for addressing the gaps, asking

for help, and persevering when facing setbacks can show adult learners methods for their own skills development.

One way instructors can do this, especially since learners may use technologies that are different from the ones they use, is to ask their students to teach them to use different apps or programs. This was a theme that resonated with instructors in a LINCS Coffee Break²³, in which adult education instructors shared examples of when they asked students to teach them how to use their phones in new ways—for example, to use WhatsApp messaging or measure the length of something using the phone camera—or even learn interesting new concepts like the Metaverse.



Self-Efficacy and Self-Directed Learning

Digital literacy self-efficacy is an individual's belief that they can choose technological tools in accordance with their goals, know the features of the tools, and use them effectively²⁴. Developing self-efficacy can impact peer engagement as well as interactions with course technology and online learning behavior²⁵. One way to increase self-efficacy and engagement is to provide opportunities for learners to create media-rich content, which can enrich project-based learning activities²⁶. In such activities, learners drive the learning process, from identifying the digital skills they wish to develop to designing a plan to achieve targeted goals and monitor and reflect on progress. These opportunities for self-directed learning have a positive impact on motivation, growth, retention, and resilience.

- [The Digital Literacy Action Plan](#) uses learner choice to identify steps to improve students' digital literacy and build learner self-efficacy²⁷.



Informal or Incidental Learning

Digital literacy can impact and is impacted by informal learning that occurs outside of a formal instructional setting, often via digital technologies—for example, asking Google or Siri for information or watching videos to gain the knowledge or skills needed. Ideally, informal learning is part of a learning ecosystem where a range of supports, both in person and online, is available to help learners navigate, troubleshoot, and contextualize the use of digital tools²⁸. Such an ecosystem would benefit from partnerships with organizations that interact with learners in work, home, and community life²⁹.

Sites where learning is supported yet informal promote self-directed practice and use of digital tools and support knowledge and skill development³⁰. This informal learning depends on access to technology, including internet connectivity at home, at work, and in non-classroom environments³¹.

Incidental learning is unplanned or unintentional learning that happens during the pursuit of some other task, often when solving a problem, either individually or in collaboration with others³². Informal and incidental learning are nonlinear, co-occur, and are intertwined. The ubiquity of technology has enabled informal and incidental digital skills learning in almost every setting, allowing adult learners to have agency over their own learning journeys, to fill in the gaps in their knowledge and skills that they recognize, as well as expand their capabilities. Informal and incidental learning both employ digital literacies and cultivate them³³ and are highly associated with the development of problem solving in technology-rich environments (PS-TRE)³⁴.

Digital literacy instruction needs to acknowledge and leverage the informal and incidental learning of adults and help them to be confident informal learners when there is no educational program or teacher present.

- One instructional practice that leverages informal learning is when synchronous, teacher-led learning activities are paired with online independent learning in which the teacher provides access to a variety of high-quality self-access digital materials. The learners build digital skills and confidence as they complement the formal learning and meet their own goals.



Peer-to-Peer Collaboration and Mentoring

Adult learners should have opportunities to develop their skills as contributors in learning communities³⁵. One way to do this is to create collaborative learning environments and activities that facilitate peer-to-peer support.

- In digital literacy labs coordinated by Mutual Housing California, learners were supported by peer tutors who were given a laptop as an incentive to complete the program and remain to support other students³⁶. A related model, used in labor management training programs, is use of a learner-advocate, a role described as “part student representative, part community liaison, and part peer tutor or coach,” with learner-advocates sometimes receiving stipends for their participation³⁷.

- Learning circles are peer-supported study groups lightly facilitated by a staff member, teacher, volunteer, or learning circle participant. Learning circles are unique in that the facilitator is a co-learner rather than an expert on the topic of study. The facilitator organizes logistics, communication, and onboarding to digital literacy learning resources. The facilitator helps establish a friendly, supportive learning community, prepares learning activities, and provides technical support when needed³⁸. [Peer 2 Peer University](#) has a [step-by-step facilitator training guide](#) and a selection of open source courses at all levels and topics, including cybersecurity, digital citizenship, and coding languages. [The EdTech Center's guide on how to implement learning circles](#) in adult education programs describes setup and implementation strategies, whether instruction is in person or virtual.



Coaching

To help learners develop digital resilience, educators need to adopt a constructivist³⁹ rather than behaviorist approach, whereby learners actively construct knowledge through their experience as opposed to learning just by rote strategies or repetition. To support such learning, teachers can see their role as shifting from being the conveyer of knowledge toward being a facilitator of knowledge creation and learning—a guide focused on individuals' or groups' needs and nurturing inquiry⁴⁰.

Digital literacy coaching, a one-on-one relationship between a more knowledgeable other and a learner, involves supporting adult learners to develop their own skills. Coaching approaches resist “right answers” and instead prompt learner problem solving through just-in-time questioning and nudging. One model of coaching is the tutor-facilitated digital literacy acquisition project, in which learners work at their own pace on self-selected materials until help is needed, prompting a tutor or coach to provide support through questions to consider while encouraging the learner to try out solutions⁴¹.

Integrating Digital Literacy Into Skills Instruction

Teaching digital literacy in adult education programs tends to happen in two ways: 1) teaching the digital skills independent of other content or 2) integrating the digital skills instruction into the instruction of other content areas. Teaching digital skills directly means following a curriculum that focuses on the technology and required skills to operate it. Integrating digital skills instruction is the preferred approach because it contextualizes the learning and supports development of transferable skills.

Digital literacy is not only knowing how to use an app, digital resource, or particular device but also knowing how and when to use those things in multiple contexts. In an integrated approach, the instructional focus is on the academic content or social practice and the technology used to learn and the subsequent strengthening of digital skills are the means by which it is learned. A multitude of content areas are reflected in adult education programs, including English for speakers of other languages (ESOL) language classes, high school equivalency, and specialized classes such as integrated education and training (IET) programs, in which learners improve their basic skills while simultaneously preparing for job training. Adult education professionals must make the connections between the digital literacy skills students need and the current goals they are pursuing in any academic subject area. Each of the contexts introduced next poses unique challenges and opportunities in terms of integration of digital skills instruction. Regardless, integrating digital technologies into instruction enriches learning and creates opportunities to extend learning activities while building digital skills⁴².

Many Practitioner
Questionnaire
respondents echoed the
importance of an
integrated approach,
noting the need for
**“meaningful contexts
and activities”** and **“life-
wide use and support
for using digital skills.”**

ESOL Classes

English learners (ELs) in the United States represent many different language, cultural, and educational attainment backgrounds. These differences—the diversity of strengths that ELs bring—can make planning for the integration of digital literacy instruction challenging. When ESOL instructors are planning to integrate technology and digital skills instruction, they have to consider cultural background, length of residence, prior education, and digital literacy in the learner’s first language. Many instructors assume that people with low first-language literacy are “too low” to start teaching digital literacy skills⁴³. However, there are various ways to

incorporate digital skills. For example, when teaching the alphabet, keyboards or pictures of keyboards (from computers or phones) can be incorporated into activities. Lessons can be designed to include the vocabulary and concepts required for digital exploration long before a device is used in the lesson. Vocabulary lessons can also be integrated with an introduction to new digital skills⁴⁴.

- One approach is integrating digital literacy skills into academic content, as seen in the [I-DEA curriculum](#), an English language skills program that concurrently teaches college and career skills with language skills.
- LINCS offers [Integrating Digital Literacy Into English Language Instruction](#), which provides educators with an issue brief focused on ways to integrate technology and increase digital literacy in EL environments.
- Integration can happen in workplace education programs, too, such as with the [National Immigration Forum's English At Work Program](#), which integrates digital skills instruction for frontline immigrant workers at grocery stores and in other industries⁴⁵.
- The [TSTM Digital Literacy Toolkit](#)⁴⁶ offers guidance and a promising example of integration of digital literacy instruction and technology use in a workplace English language class, along with three detailed lesson plans showing exactly how that might be accomplished.

Adult High School Equivalency or Basic Academic Skills Classes

Adult learners, at all levels, face the continuing proliferation of technology in various areas of their lives. Digital literacy skills should be integrated into basic academic skill classes as well as adult high school equivalency classes in order to meet the needs of life-wide use and support learners in their use of digital literacy skills. Considering that GED® and TASC™ tests are offered only electronically, it is essential to integrate foundational computer skills, such as the ability to use a mouse and keyboard, into the secondary equivalency classes. Without sufficient opportunities to practice these skills, learners may struggle to achieve their certificate of high school equivalency even if they have acquired the requisite content knowledge.

- An example of integration of digital skills for adult learners seeking high school equivalency is the [National External Diploma Program®](#), which embeds digital skills into content relevant to adult lives.

- “[Digital Literacy Teaching Strategies – Subject Specific](#)” from GetDigitalSkills.org offers specific strategies for integration in different subjects.

Integrated Education and Training (IET) Programs

Part of the mandate for IET programs is to build workforce preparation skills as well as the digital skills required for jobs in the United States today⁴⁷. IET programs often include some digital literacy components, which is important because almost all businesses need workers who can manage the digital tools and equipment required to get the job done. Some IET programs are designed around specific applications such as Microsoft Office and QuickBooks; however, one survey respondent said the field should consider expanding to other skills, such as coding, web design, graphic design, and video editing⁴⁸.

IET programs also teach adult learners how to look for and apply for jobs online. Many companies now use algorithms to screen applications and resumes, which determines if minimum skill requirements are met by looking for keywords or gauging the accuracy of the applicant’s writing to see if it meets specified standards. Therefore, it is critical that participants in a skills training program, such as plumbing or welding, learn how to effectively submit application materials in the online environment⁴⁹. Other programs integrate into instruction the technologies learners might encounter on the job.

- David Hilder from So Others May Eat in Washington, DC, has developed innovative, engaging integrated lessons using Google Classroom to build occupational, math, and digital skills all at once⁵⁰. He describes his process in [this webinar](#).
- [The Career Foundations Technology Integration Toolkit](#) is a sample curriculum with explicit guidance for instructors on fostering and encouraging digital skills development. The lessons suggest technology tools that can be integrated into learning activities.

Adult Learners Participating in Content-Specific Classes

Financial literacy, health literacy, numeracy, and civics education content is sometimes integrated within adult basic skills classes but is sometimes provided as separate courses for adults with specific goals. The content of these classes makes the need to learn digital-age literacy skills more salient for learners.

Civics Education

Civics education aims to help learners become full participants in their communities. Increasingly, this requires both traditional and digital engagement. With digital literacy skills,

adult learners can participate in advocacy that can positively impact their communities. According to the International Society for Technology in Education, digital citizenship instruction should teach learners how to interact through technology and be “active citizens who see possibilities instead of problems and opportunities instead of risks as they curate a positive and effective digital footprint”⁵¹.

- California adult education agencies use [Civic Objectives and Additional Assessment Plans \(COAAPs\)](#), standardized performance-based assessment tasks that measure civic objectives, as a way to set goals and measure outcomes. Many of the COAAPs require the use of digital technology within the instruction and related assessment tasks. Three objectives specifically focus on developing digital literacy skills such as internet safety, online communication, and workforce training in information and communication technologies.
- [I Am ABE](#) is a civics education curriculum created by teachers in Minneapolis and St. Paul, Minnesota. The curriculum is free and accessible in Google Classroom. Its goals are to provide content to create awareness about the role of adult education, provide information about issues that affect learners, and introduce learners to digital tools they can use to advocate for themselves and their communities and stay safe online.

Health Literacy

Health literacy is defined as “the degree to which individuals have the capacity to obtain, process, and understand basic health information needed to make appropriate health decisions”⁵². Low health literacy can result in lower preventive care, slower seeking of care, and lower compliance to treatment plans.

Much health information is conveyed through digital technologies, so building digital literacy skills into health literacy instruction is necessary for addressing health disparities. Digital skills are central to the use of health care portals; access to public health information and digital health records; and use of health-related tools such as fitness trackers, online support communities, and telehealth⁵³. Online patient portals enable patients to schedule appointments, request refills, view test results, and message medical staff with basic questions. Further, registration for vaccinations during the coronavirus pandemic occurred online. Beyond knowing how to apply digital skills to access immunizations, learners need to evaluate the reliability of the health information they are receiving about vaccinations from different sources⁵⁴.

“The lack of critical digital literacy is quite literally leading to illness and death,” one survey respondent said.

- The Network of the National Library of Medicine with Wisconsin Health Literacy has prepared a free [Digital Health Literacy curriculum](#) that can be downloaded from the NNLM website.

Numeracy and Financial Literacy

Numeracy, meaning being able to understand and use numbers in everyday life, includes the ability to interpret statistics and graphs to support wise decision-making. Numeracy and digital literacy intersect in a number of ways—for example, using calculators in a math class or spreadsheets in an IET class.

- IET math teacher David Hilder at So Others Might Eat uses Google Sheets to teach learners about the Pythagorean relationships for a Ladder Safe lesson, as pictured in Figure 1.

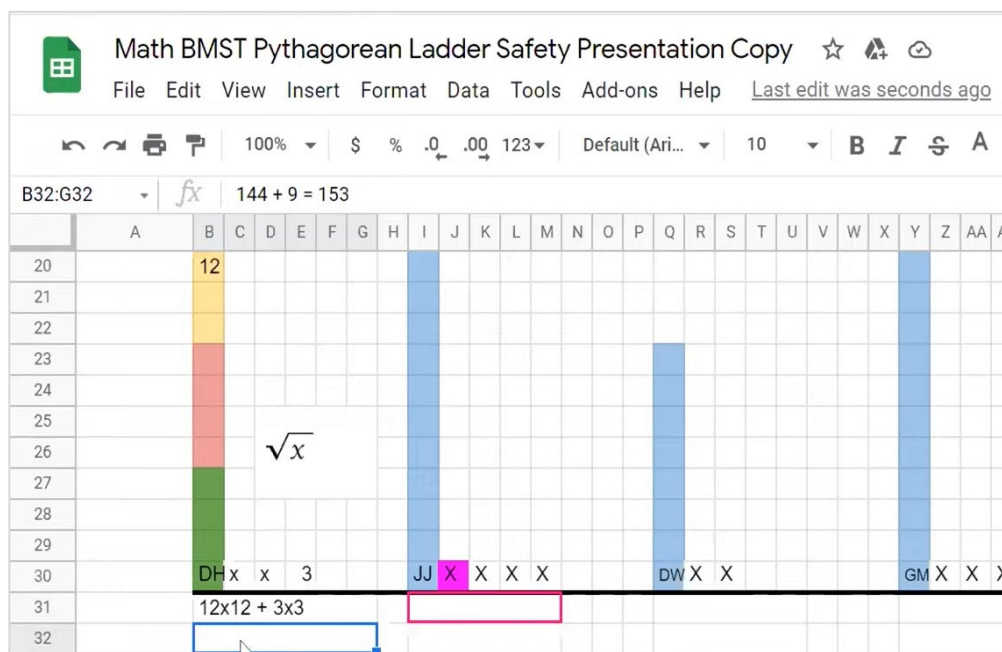


Figure 1: Partial example from a Google Sheet from teacher David Hilder's lesson⁵⁵

Numeracy is an aspect of information literacy, which is one of the three core literacy skills, along with digital and media literacy, important to 21st century employability⁵⁶.

- Though pitched at a higher level than that of most adult foundational education learners, Economic Lowdown, a series of podcasts, videos, and interactive lessons, illustrate an instructional approach that supports “developing both quantitative and information literacy skills through a social justice lens”⁵⁷. Teachers with free accounts can create

“classrooms” on the [Econ Lowdown site](#) into which they can add interactive lessons and videos pulled from a library of free digital learning resources. They can also pull the lessons into their Canvas courses.

Digital literacy is also key to financial literacy because traditional banking is becoming less and less available⁵⁸. Today, consumers must acquire the skills and knowledge to use the digital banking tools required to carry out new, complex digital transactions and protect the security of their accounts. This reality has added a digital layer to financial literacy, combining it with digital literacy and digital rights. Digital financial literacy is “acquiring the knowledge, skills, confidence, and competencies to safely use digitally delivered financial products and services, to make informed financial decisions, and to act in one’s best financial interest per the individual’s economic and social circumstance⁵⁹.

- The CASH Campaign of Maryland, a member of the Maryland Skilled Immigrant Task Force, provides [CASH Academy](#) as well as financial navigators to assist individuals.

Adult Learners Participating in Workforce Services

Many survey respondents identified digital-age literacy skills as increasingly important in the workforce⁶⁰. Jobs that require minimal skills are being automated and digitized in the workplace, resulting in more employment opportunities for middle- and high-skilled individuals, especially in industries that are heavily machine based⁶¹.

In adult education services, integration of digital literacy skills is important in three main areas: career readiness; IET courses, including workplace instruction; and apprenticeships. Survey respondents noted that adult learners need to have digital literacy skills to both access the jobs that are available and upskill to improve their employment situation.

- One approach to upskilling is pre-apprenticeship programs that equip adult learners with the digital and other skills needed to enter apprenticeships, including the growing number of registered apprenticeships in IT and cybersecurity, software development, and computer support and technology services⁶². One example of this is [Road to Hire](#), which designs programs to meet marginalized learners’ needs and prepare them for career pathways and apprenticeships in high-growth STEM careers.
- An example of formalized digital literacy training in the workplace is the [Upward Academy at Tyson Foods](#). The academy offers workers classes online or in the plant, as well as digital literacy labs at factories and a device loaning program that enables employees to take tablets home. To support English learners accessing online courses, all of the tutorials are offered in the company’s top 10 languages⁶³.

Meeting the Needs of Diverse Learners

“When you're teaching adults, you're teaching individual whole people. You're not just teaching, you know, those five subject areas.”

–Practitioner Questionnaire response

In adult education, learners are a diverse group of people, with differing backgrounds, experiences, goals, knowledge, and abilities. As a result, levels of digital literacy can vary greatly in the same class. Family background, education level, age, gender, differences in cognitive or physical abilities, country of origin, and ability to use technology skills at home or work are all factors influencing the starting point of digital literacy and needed learning and supports⁶⁴. The DRAW landscape scan found some promising practices for meeting the needs of specific learner groups and some notable gaps, such as resources to support neurodiverse learners.

One promising trend that emerged during the pandemic was [a more concerted effort by adult education providers such as the YWCA to screen learners upon intake](#) to identify factors that might impact their ability to persist. Many of these strategies are flexible in that they can be implemented asynchronously or synchronously, in person or remotely, and with or without technology.

- [Digital Promise's Adult Learner Variability Navigator](#) helps educators take these factors—spanning cognition, learner background, social and emotional learning, and adult literacies—and identify learner-centered instructional strategies that will be most effective.
- [Chapter 3 of the IDEAL Distance and Blended Learning Handbook](#) and [Module 2 Topic 3 of the EdTech Center Course Transforming Distance Education course](#) offer suggestions on screening learners to determine supports they will need to persist in technology-rich instruction.
- The EdTech Center has created self-assessment tools that teachers can ask learners to use to gauge digital literacy skills and knowledge and access to technology. [This skills inventory](#) gives learners a chance to report on the apps and devices they use, the frequency of that use, and how comfortable they are with them. [A Pre-Course Access](#),

[Skills, & Comfort Survey](#) also helps teachers understand learner access to and comfort using digital technologies.

Learners With Limited Access to Technology

Access to devices and the internet was a frequently cited challenge throughout the DRAW landscape scan. Around 71 percent of people who have less than a high school diploma access the internet, compared with 84 percent for high school graduates and 98 percent of those who have some college. People with lower incomes and educational levels are significantly less likely to have broadband access at home and much more likely to be “smartphone dependent” for the internet⁶⁵. [The DRAW blog](#) on digital access and equity provides more details on this issue.

The use of phones vs. workplace computers was mentioned by several educators in the Practitioner Questionnaire. One program director noted “a great need to bridge the gap in digital literacy for adults and marginalized groups.” Most adult learners have access to the web via their cell phone and very little experience on a laptop, much less a desktop. These skills are essential to work readiness⁶⁶, but students are sometimes resistant to direct digital-age literacy instruction. Because they are embarrassed by their skill level, they do not always disclose gaps or ask for help when needed.

“Adults with low digital skills tend to become more frustrated with technology challenges and turn it into a very negative experience, confirming their beliefs that they cannot and should not learn to use technology,” suggested one survey respondent.

With these facts in mind, adult education practitioners must consider how they develop and present instructional content to their students:

- Pay attention to accessibility features when creating instructional content
- Consider font size and the medium through which instructional content is presented
- Recognize and make considerations for the devices and broadband speed students may be using to access class content

Additionally, practitioners' implementation of edtech routines can support adult learners as they build their digital literacy skills and provide a safe environment for learning.

English Learners

As noted above, when integrating technology, English language instructors have to consider all factors, including cultural background, length of residence, prior education, first language

literacy, digital literacy in learners' first language, and English language proficiency. Even tech-savvy ELs may struggle with technology couched in the English language, and assessments conducted in English may not present an accurate picture of learners' digital literacy. One respondent noted, "Materials in English may not be accessible for learners who are still developing their proficiency⁶⁷." The field is awaiting the launch of features within Northstar Digital Literacy's assessments that will create opportunities for multilingual learners.

Another consideration in English language classrooms is that ELs who have recently come to the United States prioritize tasks that support immediate needs, like finding work and spending their limited income on stable housing and transportation. As such, there may be a cultural disconnect between what teachers expect in terms of technology at home and what immigrants can or are willing to do⁶⁸. Because ELs may not immediately see the connection between digital literacy and being fully functioning in their communities, instructors may need to help make the connections for them.

"Materials in English may not be accessible for learners who are still developing their proficiency."

— Practitioner Questionnaire response

As noted earlier, there are a variety of ways to incorporate digital skills into instruction for emerging literacy. For English learners with limited first language literacy, when teaching about the community and prepositions of direction, a digital map or GPS can be used to integrate use of digital literacy skills into relevant instructional content for learners. Adults with higher levels of English language proficiency who lack digital skills often want to learn "anything" or specific things, like how to use their children's school's parent portal or ensure that they and their children are safe in cyberspace.

Regardless of their level, ELs benefit from digital literacy instruction that is integrated with language acquisition⁶⁹. Additionally, individuals with emerging literacy or those working to acquire English language skills benefit from the integration of vocabulary instruction with hands-on use of technology⁷⁰. Scaffolding these lessons to make sure proper support is provided is key to students increasing their competence in digital literacy, which in turn boosts their confidence⁷¹.

People With Records

In the United States, individuals who are incarcerated typically do not have much digital access⁷², which creates a serious disadvantage when they are released and need to use technology to find employment, housing, and health care. Some people with records participate

in reentry programming specifically designed to address these interconnected challenges, but many simply enroll in local adult education programs. Some individuals reentering society do not have access to devices, and others fear not being able to adapt. An interview study with 45 women reentering society showed that lack of internet access and digital devices during the pandemic impacted parole compliance, job acquisition, access to support services such as housing, online safety, educational opportunities, ability to support their children, and more⁷³. This problem is even greater for people who serve long sentences. They can struggle with using the basic and necessary functions on their phones and other digital devices. These structural barriers to reentry are difficult to overcome because many do not have a frame of reference to even know what to ask about when they need help⁷⁴.

Ideally, digital skill development can begin while learners are engaged in correctional education. The ability to access education and develop new skills is linked to reduced recidivism⁷⁵. Indeed, a meta-analysis of research literature spanning 30 years showed that correctional education lowered recidivism by 43 percent⁷⁶, making the work of adult educators serving these learners critical. They need to be equipped to prioritize basic digital skills instruction that is relevant, timely, and based on students' proficiency levels. Additional tools for improving learners' digital citizenship should also be integrated into content-area studies and provided as resources for out-of-class practice. Whenever possible, adult education programs in correctional settings should look for ways to provide digital skills and technology training, even if that requires tightly locked-down devices and servers or offline access to content.

Older Adults

Older adults are often excluded from full participation in digital tasks and activities because they lack digital literacy skills to make full use of smartphones, tablets, and other devices with touchscreen technology⁷⁷. Further, elderly women have been found to have lower levels of problem-solving skills in technology-rich environments than other age groups⁷⁸, and older adults are more likely to be socially isolated than other age groups⁷⁹, preventing them from making connections in today's digital society. "Digital skills, in addition to socializing, are increasingly required for performing instrumental tasks, such as searching for contacts [or] medical help, measuring medical indicators in e-health services, paying bills, and taking part in democratic processes"⁸⁰.

Older adults may be resistant to learning technology, especially if they lack confidence in basic literacy or language skills⁸¹. But they may be more accepting of new technology given well-trained teachers who can provide the appropriate kinds of support at the appropriate times⁸². Adult educators working with older adults need to consider physical disabilities that may make using technology difficult and include solutions such as increasing the zoom level when using a web browser. Asking older adults to use tablets instead of smartphones can facilitate learning,

mitigating the challenges of using smaller devices that require more dexterity and have limits to text enlargement. Older adults also benefit from tools and technologies that have been designed with their population in mind, including alternative text, multimedia content, and navigation guides.

Because they were taught and learned from a different educational paradigm, older adults may struggle with the shift to digital devices⁸³. Therefore, the curriculum should be structured but flexible so that it can be adapted to the needs of these learners⁸⁴. Digital skills instruction also needs to be relevant to older adults' personal goals, include human interaction and support, and facilitate touchpoints outside of classes as well as mechanisms to enlist family supports⁸⁵. Integrating digital literacy skills in contexts that are important to them will decrease resistance and frustration.

“Senior citizens often seem overlooked.”

— Practitioner
Questionnaire response

According to several respondents, the focus on workforce development in adult education has impacted services to older adults.

Individuals With Disabilities and Neurodiversity

Some adult learners have disabilities or are neurodiverse. *Neurodiversity*, a term coined by Judy Singer, a sociologist on the autism spectrum who did not want to be defined by her “intellectual disability,”⁸⁶ refers to individuals who have trouble processing written text (as with people with dyslexia), focusing for long periods of time (as with those with attention-deficit disorder), or managing social expectations (as with some on the autism spectrum). However, they may or may not have intellectual disabilities. In fact, people with neurodiverse brains may be exceptionally intelligent or have other strengths that demonstrate that they are not “disabled.” These adult learners may have unique challenges in developing digital literacy.

In industry, there has been a push for neurodiversity management practices in which managers and human resource and development personnel highlight and then draw upon particular differences of employees, making it possible for them to succeed at work by changing the work environment and changing their jobs⁸⁷. However, our landscape scan found few examples of best practices for neurodiversity management practices in the adult education classroom.

Many people with disabilities are impacted by the digital divide. For example, many websites do not fully comply with the Web Content Accessibility Guidelines 2.1⁸⁸. When websites are not accessible, people with physical or intellectual disabilities may not be able to benefit from the

content. In general, survey respondents indicated that there is not enough disability inclusion and compliance with the Americans With Disabilities Act in adult education⁸⁹. Adult educators need to work at making digital literacy lessons, including materials and tools, accessible to all learners. In the digital world, ensuring that individuals with disabilities are included often means providing alternative ways to access the content other students can access—for example, by providing closed captioning for videos for the hearing impaired or alternative text descriptions of images for the visually impaired.

- Using the [Universal Design for Learning Guidelines](#) when designing digital literacy skills lessons could help instructors and materials designers create lessons that are as inclusive as possible.

With so much information and communication occurring online and through digital technologies, people with intellectual disabilities have much to gain from digital literacy, using such skills to overcome barriers to participating more actively in work, schooling, and daily life. However, increased reliance on digital content and information could make them vulnerable to exploitation and receiving misinformation⁹⁰. As such, adult educators need to help all learners critically interpret information from the digital world.

Learners With Emerging Literacy

The development of digital skills is an important need for all adult learners, including those who are still developing foundational literacy skills. According to a [UNESCO report](#), technology designed for users with emerging literacy should include the use of:



1. Voice-based
computing interfaces



2. Graphics



3. Nonlinear user
interfaces



4. Local and learner-generated
content



5. Social elements⁹¹

However, given a lack of technologies and resources that reflect these goals, practitioners need to incorporate various strategies for building digital skills and resilience.

For students to be successful with independent online learning activities, instructors must model tech tools and build learners' self-efficacy. Beneficial strategies for learners with emerging literacy include scaffolding digital skills within relevant contexts for learners⁹² and providing opportunities for learners to transfer prior knowledge and skills to new contexts and content areas. Another strategy is integration of vocabulary instruction with hands-on use of technology⁹³.

- The [Canadian Language Benchmarks for Adult Literacy Learners](#) provides six guiding strategies when introducing technology to literacy education and second language learning for adults: build on learners' strengths, model use of digital technologies, recycle and practice extensively, increase technology skills through thematic instruction, encourage experimentation and celebrate success, and expect learners' technology use to vary within literacy levels⁹⁴. The framework also describes different levels of familiarity with digital technologies, which can help instructors understand where their learners are and where they can aim to go.

Parents

Parents have specific needs in terms of digital literacy. For example, school districts often communicate with parents primarily through digital means, and parents need to know how to keep their children and their devices safe in the digital world. One way adult educators can do this is to invite students to investigate and report on the tools their children are using, citing their challenges and concerns. Additionally, initiatives that proactively educate parents on how to use digital technologies to stay connected and support their children's learning have proved useful.

- [The Padres Comprometidos Ed-Tech curriculum](#), implemented at 10 affiliates of UnidosUS, provides instruction to parents so they can support their children. The model not only leverages expertise in the community and increases access but also includes a focus on the social-emotional well-being of the adult learners throughout instruction.
- The U.S. Department of Education, Office of Educational Technology, with contributions from Digital Promise and Learning Heroes, developed the [Parent and Family Digital Learning Guide](#) to help all parents and caregivers, including those who have limited experience with digital tools, monitor their children's progress and use technology for learning.

Another possible strategy is for K-12 schools to show parents how to use readability features in Adobe Acrobat Reader to make PDF forms and documents easier to read on smartphones. The feature, [Liquid Mode](#), makes digital text on PDFs formattable, giving readers control over content sections, letter size and spacing, and line spacing. The feature has been field tested in multiple adult literacy programs in the United States and found to support reading for adult learners⁹⁵.

Gaps, Barriers, and Opportunities to Effective Instructional Approaches and Practices

As our research surfaced the approaches, strategies, and resources described above, we also noted barriers to their implementation and gaps in innovative responses to important issues yet addressed. These gaps indicate the need for further work on access to appropriate instructional content; addressing the limitations of relying on learners' use of smartphone technologies; addressing the complexities of serving wildly diverse populations of students, the extent to which we are stuck in old ways of teaching; and the need for additional research.

Access to Needed Technologies and Relevant Content

- The field needs more digital literacy skills content, designed according to Universal Design for Learning guidelines. To make this possible, more instructors and materials designers need professional learning opportunities to help them create lessons that are as inclusive as possible for all students.
- Teachers would benefit from organized efforts to share and adapt open educational resources through the use of free tools like [SkillBlox](#), which helps instructors easily find free, quality instruction content to create customized playlists for learners or groups of learners to meet their learning needs and interests and help educators integrate digital skills into instruction of other skills.
- Programs need access to more resources to help specific populations access devices, the internet, and technologies relevant to them to build necessary digital literacy skills.
- Programs need to make use of smartphone technology because those are the devices learners typically have access to. However, that proficiency and access does not necessarily transfer to the digital skills needed for education and workforce. One respondent noted, “A major percentage of young adults who drop out of high school and

those who complete high school are not equipped with the technology skills, knowledge, and mindset necessary to engage in postsecondary education and training, a career, or to advance from an entry-level position into higher management levels. They are proficient with their cell phones, but these are limited skills compared to what they need to succeed in school and at work”⁹⁶.

The Struggle to Address Learner Diversity

As noted previously, adult learners are a diverse group of people possessing differing backgrounds, experiences, goals, knowledge, and abilities. Supporting richly diverse learner groups can be a challenge. Given the variation that exists in the adult learner population, specific interventions or strategies are likely to be more effective for some groups over others⁹⁷. Meeting the diverse needs of learners must be intentional and have a direct correlation to student outcomes. However, our landscape scan highlighted how resources for meeting the digital literacy needs of diverse learners are limited:

- Few digital literacy resources are available in other languages. Questionnaire respondents frequently expressed a need for digital skill instructional resources for ELs with emerging language proficiency. Further, tools used to evaluate digital literacy are typically in English, which confounds results, though assessments such as Northstar are starting to offer versions in various native languages..
- There are few examples of best practices for neurodiversity management in the adult education classroom or ways to adapt instruction to adult learners with differing physical and cognitive abilities.
- Programs need good data on who needs support in developing digital skills. The study described in *Empowering Adults Through Upskilling and Reskilling Pathways, Volume 1: Adult Population With Potential for Upskilling and Reskilling* illustrates an approach for drawing on diverse data sets for this purpose. Based on European demographic data, it offers a thorough illustration of how to draw on demographic data to better describe characteristics of and then recognize which adults need the most support. Such research should be replicated in the United States⁹⁸.

Practitioner Access to Research

A fundamental issue in the areas of teaching and learning is a dearth of research. Though teachers may have clarity on what is working well for their students, it is challenging to gain momentum for policy shifts and funding if there is little empirical evidence on effectiveness on adult learning and outcomes. While it is important to recognize valued instructional practices in digital literacy and honor the practitioner knowledge that underlies them, it is also important to conduct empirical studies to evaluate practices and best determine for whom and under what conditions different strategies and resources work best⁹⁹.

The [CREATE Adult Skills Network](#) is to date the largest investment made by the Institute for Educational Sciences to support research in adult education. The initiative is led by the American Institutes of Research, World Education, Jobs for the Future, and Abt Associates, with the aim of developing a research base about effective ways to use technology in adult learning. It develops, adopts, and evaluates interventions that use technology to build adult learners' skills and improve their academic outcomes. The network's activities and resources guide practitioners, educators, researchers, and policy and funding stakeholders in their work using technology to support adult skills programming. Such coordinated funding and research collaboration will benefit the field.

Encouraging Innovative Policy, Programming, and Practices

The following strategies can support the innovative programming and instruction needed to develop adult learners' digital resilience:

- State and local program leaders should prioritize digital literacy initiatives that support the inclusion of digital components in lesson plans and curriculum development, not just direct skill instruction in a computer lab. Policy at all levels must focus on increasing access to contextualized and integrated models of training and education.
- Programs should emphasize digital skills instruction for the most nascent English language learners, to ensure that they maximize their time in English language instruction by making use of digital skills to enhance their learning. To do so, the field

needs ample English and multilingual resources at accessible reading levels and with adequate supports, such as visualization, culturally relevant connections, and explicit vocabulary and skills instruction.

- Programs should explore using technologies that are used for training in the workplace, to better prepare learners to succeed in employer-sponsored upskilling and talent development programs. Jaime Fall, previously of the Aspen Institute noted, “Training at work is often done showing a two-minute video on an iPad, but ABE programs still want to put learners in a computer lab. We need to create opportunities for students to learn how to learn in a way that mirrors the training they will receive in the workplace”¹⁰⁰.
- Programs need guidance on how to make good technology choices. These decisions should not be made solely based on the influence of a vendor that sells a product that is convenient. Ultimately, technology decisions should be made based on whether a product meets the needs and goals of learners. If strategies and resources are to be driven by the technology tool or platform choice, then the program needs to make such choices based on who is a trusted partner. For example, Literacy Minnesota, developer of the Northstar Digital Literacy assessment, is viewed differently than for-profit comprehensive curriculum developers because Literacy Minnesota runs its own instructional services.

Conclusion

Though there is still a deep need for research into what works in teaching and learning digital skills as well as a more strategic approach to fostering digital resilience, the landscape scan uncovered many effective approaches, strategies, and practices that educators can adopt now. Learners and teachers alike are aware of the urgency to develop technology skills and digital resilience. The next step already underway in the Digital Resilience in the American Workforce (DRAW) initiative is to take all the learnings from the landscape scan and develop professional development resources and training to help adult educators learn how to better support their learners in developing foundational digital skills. Follow the [DRAW project page](#) for further updates, information, and professional development support, as well as opportunities to join discussions on advancing digital resilience and equity.

Endnotes

¹ Digital US Coalition, *Building a Digitally Resilient Workforce: Creating On-Ramps to Opportunity* (Boston: Digital US, World Education, May 2020), <https://digitalus.org/wp-content/uploads/2020/06/DigitalUS-Report-pages-20200602.pdf>.

² DRAW is funded by the U.S. Department of Education's Office of Career, Technical, and Adult Education under contract GS10FO094X.

³ Digital US Coalition, *Building a Digitally Resilient Workforce*, <https://digitalus.org/wp-content/uploads/2020/06/DigitalUS-Report-pages-20200602.pdf>.

⁴ Debra Bragg et al., *What Works for Adult Learners: Lessons From Career Pathway Evaluations* (Boston: Jobs for the Future, July 10, 2019), www.jff.org/resources/what-works-adult-learners-lessons-career-pathway-evaluations/.

⁵ Elaine Cox, "Coaching and Adult Learning: Theory and Practice," *New Directions for Adult and Continuing Education* 148 (December 3, 2015): 27-38, <https://onlinelibrary.wiley.com/doi/10.1002/ace.20149>.

⁶ Jen Vanek and Kathy Harris, *Digital Literacy and Technology Integration in Adult Basic Skills Education: A Review of the Research* (Syracuse, New York: ProLiteracy, 2020), www.proliteracy.org/Portals/0/pdf/Research/Briefs/ProLiteracy-Research-Brief-02_Technology-2020-06.pdf.

⁷ Amanda Bergson-Shilcock, *Digital Equity for an Inclusive Economic Recovery: Retail and Hospitality* (Washington, DC: National Skills Coalition, July 21, 2021), <https://nationalskillscoalition.org/resource/publications/digital-equity-for-an-inclusive-economic-recovery/>; Tatiana Iñiguez-Berrozpe and Ellen Boeren, "Twenty-First Century Skills for All: Adults and Problem Solving in Technology Rich Environments," *Technology, Knowledge and Learning* 25, no. 4 (March 27, 2019): 929-951, <https://link.springer.com/article/10.1007/s10758-019-09403-y>; Organisation for Economic Co-operation and Development, *Skilled for Life? Key Findings From the Survey of Adult Skills*, 2013, www.oecd.org/skills/piaac/SkillsOutlook_2013_ebook.pdf; and Stephen Reder, Britta Gauly, and Clemens Lechner, "Practice Makes Perfect: Practice Engagement Theory and the

Development of Adult Literacy and Numeracy Proficiency,” *International Review of Education* 66, no. 2-3 (2020): 267-288, <https://link.springer.com/article/10.1007/s11159-020-09830-5>.

⁸ Stephen Reder, *The Longitudinal Study of Adult Learning: Challenging Assumptions* (Montreal: The Centre for Literacy, 2012), https://tcal.org.au/wp-content/uploads/2021/01/Longitudinal-Study-CFLRsrchBrief_Chllngng_Assmptns.pdf.

⁹ Reder, *The Longitudinal Study of Adult Learning*, https://tcal.org.au/wp-content/uploads/2021/01/Longitudinal-Study-CFLRsrchBrief_Chllngng_Assmptns.pdf.

¹⁰ Beatriz Vera, personal communication, July 28, 2022.

¹¹ Elaine Cox, “Coaching and Adult Learning: Theory and Practice,” *New Directions for Adult and Continuing Education* 148 (December 3, 2015): 27-38, <https://onlinelibrary.wiley.com/doi/10.1002/ace.20149>.

¹² *Digital Diaspora: How Immigrants Are Capitalizing on Today’s Technology* (Philadelphia: Welcoming Center for New Pennsylvanians, 2012), <https://welcomingcenter.org/wp-content/uploads/2016/08/Digital-Diaspora-FINAL-report-Nov-2012-1.pdf>; Pew Research Center, “Mobile Fact Sheet,” November 23, 2021, www.pewresearch.org/internet/fact-sheet/mobile/; and Aaron Smith and Dana Page, *U.S. Smartphone Use in 2015*. (Washington, DC: Pew Research Center, 2015), www.pewresearch.org/wp-content/uploads/sites/9/2015/03/PI_Smartphones_0401151.pdf.

¹³ Jen Vanek, “Teaching Skills That Matter: Digital Literacy,” LINCS, 2018, <https://lincs.ed.gov/state-resources/federal-initiatives/teaching-skills-matter-adult-education/digital-literacy>.

¹⁴ Priyanka Sharma, Jen Vanek, and Alison Ascher Webber, *Leveraging Technology to Increase Economic Opportunity for Adults: Field Testing Tools That Break Barriers to Learning and Employment* (Boston: World Education, March 2019), <https://edtech.worlded.org/wp-content/uploads/2019/10/ttale-report.pdf>.

¹⁵ Jen Vanek and Alison Ascher Webber, *Field Testing Cell-Ed: Mobile Learning for All* (Boston: EdTech Center @ World Education, 2019), <https://edtech.worlded.org/wp-content/uploads/2018/12/Cell-Ed-Reportfinal-012319-2-1.pdf>.

¹⁶ Ofelia Garcia, “What is Translanguaging?” National Association for Language Development in the Curriculum, *EAL Journal* blog, July 26, 2016, <https://ealjournal.org/2016/07/26/what-is-translanguaging/>.

¹⁷ Digital US Coalition, *Building a Digitally Resilient Workforce*, <https://digitalus.org/wp-content/uploads/2020/06/DigitalUS-Report-pages-20200602.pdf>.

¹⁸ Carol Ann Tomlinson, *The Differentiated Classroom: Responding to the Needs of All Learners* (Alexandria, Virginia: Association for Supervision and Curriculum Development, 2014), www.ascd.org/books/the-differentiated-classroom-responding-to-the-needs-of-all-learners-2nd-edition?variant=108029.

¹⁹ Digital US Coalition, *Building a Digitally Resilient Workforce*, <https://digitalus.org/wp-content/uploads/2020/06/DigitalUS-Report-pages-20200602.pdf>.

²⁰ American Institutes for Research, *Integrating Digital Literacy Into Adult English Language Instruction*, LINCES ESL Pro PD Module (Washington, DC: U.S. Department of Education Office of Career, Technical, and Adult Education, 2015), <https://courses.lincs.ed.gov/>.

²¹ Jen Vanek, *Migrant Adult Learners and Digital Literacy: Using DBR to Support Teaching and Learning* (Minneapolis: University of Minnesota, 2017), <https://conservancy.umn.edu/handle/11299/190483>.

²² Amanda Bergson-Shilcock, *The New Landscape of Digital Literacy* (Washington, DC: National Skills Coalition, 2020), <https://nationalskillscoalition.org/resource/publications/the-new-landscape-of-digital-literacy/>.

²³ 2022 COABE conference session facilitated by the EdTech Center and Digital Literacy Strand.

²⁴ Serkan Aslan, “Analysis of Digital Literacy Self-Efficacy Levels of Pre-service Teachers,” *International Journal of Technology in Education* 4, no. 1 (2021): 57-67, www.ijte.net/index.php/ijte/article/view/47.

²⁵ Daniel Prior et al., “Attitude, Digital Literacy and Self-Efficacy: Flow-On Effects for Online Learning Behavior,” *The Internet and Higher Education* 29 (April 2016): 91-97, www.sciencedirect.com/science/article/abs/pii/S109675161630001X?via%3Dihub.

²⁶ Linda Darling-Hammond, Molly B. Zielezinski, and Shelley Goldman, *Using Technology to Support At-Risk Students' Learning* (Stanford, California: Stanford University Center for Opportunity Policy in Education, 2014), <https://edpolicy.stanford.edu/sites/default/files/scope-pub-using-technology-report.pdf>.

²⁷ Jen Vanek, Destiny Simpson, and Jeffrey Goumas, *IDEAL Distance Education and Blended Learning Handbook, 7th Edition* (Boston: EdTech Center @ World Education, EdTech Books, 2020), https://edtechbooks.org/ideal_dl_handbook.

²⁸ Suzanne Smythe, Anke Grotlüschen, and Klaus Buddeberg, "The Automated Literacies of E-Recruitment and Online Services," *Studies in the Education of Adults* 53, no. 1 (2021): 4-22, <https://www.tandfonline.com/doi/full/10.1080/02660830.2020.1855870>.

²⁹ Vanek and Webber, *Field Testing Cell-Ed*, <https://edtech.worlded.org/wp-content/uploads/2018/12/Cell-Ed-Reportfinal-012319-2-1.pdf>; and OECD, *Skilled for Life?* www.oecd.org/skills/piaac/SkillsOutlook_2013_ebook.pdf.

³⁰ Alexandra Wicht, Stephen Reder, and Clemens Lechner, "Sources of Individual Differences in Adults' ICT Skills: A Large-Scale Empirical Test of a New Guiding Framework," *PLOS One* 16, no. 4 (2021), <https://doi.org/10.1371/journal.pone.0249574>.

³¹ Suzanne Smythe and Sherry Breshears, "Complicating Access: Digital Inequality and Adult Learning in a Public Access Computing Space," *Canadian Journal for the Study of Adult Education* 29, no. 1 (2017): 67-81, <https://cjsae.library.dal.ca/index.php/cjsae/article/view/5362>.

³² Karen Watkins et al., "The Evolving Marsick and Watkins (1990) Theory of Informal and Incidental Learning," *New Directions for Adult and Continuing Education* 159 (2018): 21-36, <https://eric.ed.gov/?id=EJ1191238>.

³³ Eric M. Meyers, Ingrid Erickson, and Ruth V. Small, "Digital Literacy and Informal Learning Environments: An Introduction," *Learning, Media and Technology* 38, no. 4 (2013): 355-367, www.tandfonline.com/doi/full/10.1080/17439884.2013.783597.

³⁴ H. Nygren et al., "Lifelong Learning: Formal, Non-formal and Informal Learning in the Context of the Use of Problem-Solving Skills in Technology-Rich Environments," *British*

Journal of Educational Technology 50, no. 4 (2019): 1759-1770, <https://bera-journals.onlinelibrary.wiley.com/doi/10.1111/bjet.12807>.

³⁵ Lavern Byfield et al., “Digital Literacy and Identity Formation in 21st Century Classrooms: Implications for Second Language Development,” *International Journal of Applied Linguistics & English Literature* 5, no. 1 (2016): 39-45, www.journals.aiac.org.au/index.php/IJALEL/article/view/1959/1770.

³⁶ Kathy Harris et al., “Unexpected Breakthroughs in Adult Digital Literacy: Mutual Housing California, Stride Center, and Learner Web,” paper presented at the Coalition for Adult Basic Education (COABE) Conference, Phoenix, 2018.

³⁷ Ellen Licht, Beth Maher, and Alison Ascher Webber, “Teaching Workers: Learner-Centered Instruction for English Acquisition and Social Change,” *The CATESOL Journal* (San Francisco State University, 2004), www.catesoljournal.org/wp-content/uploads/2014/07/CJ16_licht.pdf; and Alison Ascher Webber, personal communication, August 23, 2021.

³⁸ Maryann Peterson and EdTech Center staff, “8 Tips for Implementing Learning Circles in Any Program,” EdTech Center @ World Education, September 5, 2019, <https://edtech.worlded.org/8-tips-for-implementing-learning-circles-in-any-program/>.

³⁹ Steve Harlow, Rhoda Cummings, and Suzanne M. Aberasturi, “Karl Popper and Jean Piaget: A Rationale for Constructivism,” *The Educational Forum* 71, no. 1 (January 20, 2008): 41-48, www.tandfonline.com/doi/abs/10.1080/00131720608984566.

⁴⁰ Deirdre Butler et al., “Different Strokes for Different Folks: Scaling a Blended Model of Teacher Professional Learning,” *Interactive Technology and Smart Education* 14, no. 3, (September 18, 2017): 230-245, www.emerald.com/insight/content/doi/10.1108/ITSE-01-2017-0011/full/html.

⁴¹ Gloria Jacobs et al., *Executive Summary: Tutor-Facilitated Digital Literacy Acquisition in Hard-to-Serve Populations, a Research Project* (Portland, Oregon: Portland State University, 2015), https://pdxscholar.library.pdx.edu/cgi/viewcontent.cgi?article=1008&context=digital_literacy_acquisition_findings.

-
- ⁴² Vanek and Harris, *Digital Literacy and Technology Integration*, www.proliteracy.org/Portals/o/pdf/Research/Briefs/ProLiteracy-Research-Brief-02_Technology-2020-06.pdf.
- ⁴³ Ekaterina Tour, Edwin Creely, and Peter Waterhouse, “It’s a Black Hole...”: Exploring Teachers’ Narratives and Practices for Digital Literacies in the Adult EAL Context,” *Adult Education Quarterly* 71, no. 3 (2021): 290-307, <https://journals.sagepub.com/doi/10.1177/0741713621991516>.
- ⁴⁴ Jen Vanek, *Using the PIAAC Framework for Problem Solving in Technology-Rich Environments to Guide Instruction: An Introduction for Adult Educators*, commissioned paper (Washington, DC: Program for the International Assessment of Adult Competencies, 2017), https://static1.squarespace.com/static/51bb74b8e4b0139570ddfo20/t/589a3d3c1e5b6cd7b42cddcb/1486503229769/PSTRE_Guide_Vanek_2017.pdf.
- ⁴⁵ Victoria Neff, Ana Negoescu, and Jen Vanek, “Workplace ESOL Goes Digital: Expanding Opportunities for English Language Learning,” *COABE Journal* 10, no. 1, Part 2, <https://behindeveryemployer.org/wp-content/uploads/2022/01/WORKPLACE-ESOL-GOES-DIGITAL.pdf>.
- ⁴⁶ Vanek, “Teaching Skills That Matter,” <https://lincs.ed.gov/state-resources/federal-initiatives/teaching-skills-matter-adult-education/digital-literacy>.
- ⁴⁷ Bergson-Shilcock, *The New Landscape of Digital Literacy*, <https://nationalskillscoalition.org/resource/publications/the-new-landscape-of-digital-literacy/>.
- ⁴⁸ DRAW Practitioner Questionnaire.
- ⁴⁹ Suzanne Smythe, “Adult Learning in the Control Society: Digital Era Governance, Literacies of Control, and the Work of Adult Educators,” *Adult Education Quarterly* 68, no. 3 (April 2018): 197-214, <https://journals.sagepub.com/doi/abs/10.1177/0741713618766645>.
- ⁵⁰ David Hilder, “Contextualized Instruction Using Google Classroom,” YouTube video, 22:04, EdTech Center Distance Education Strategy Session Resources, March 12, 2021, www.youtube.com/watch?v=WPLg9pHCKOo.
- ⁵¹ International Society for Technology in Education, “Digital Citizenship in Education,” www.iste.org/areas-of-focus/digital-citizenship.

-
- ⁵² Health Resources and Services Administration, “Health Literacy,” updated August 2019, www.hrsa.gov/about/organization/bureaus/ohe/health-literacy/index.html#:~:text=Health%20literacy%20is%20the%20degree,Minority%20population ns.
- ⁵³ K. Harris, “Unexpected Breakthroughs.”
- ⁵⁴ DRAW Practitioner Questionnaire.
- ⁵⁵ Hilder, “Contextualized Instruction,” www.youtube.com/watch?v=WPLg9pHCKOo.
- ⁵⁶ Bri Stauffer, “What Are 21st Century Skills?” Applied Educational Systems, January 10, 2022, www.aeseducation.com/blog/what-are-21st-century-skills.
- ⁵⁷ Diego Mendez-Carbajo, Charissa O. Jefferson, and Katrina L. Stierholz, “Keeping It Real: Information Literacy, Numeracy, and Economic Data,” *Numeracy* 12, no. 2, Article 5 (2019), <https://digitalcommons.usf.edu/cgi/viewcontent.cgi?article=1295&context=numeracy>.
- ⁵⁸ Jorg Erlebach et al., “The Sun Is Setting on Traditional Banking,” BCG, November 24, 2020, www.bcg.com/publications/2020/bionic-banking-may-be-the-future-of-banking.
- ⁵⁹ Alliance for Financial Inclusion, “Digital Financial Literacy Toolkit,” 2021, www.afi-global.org/wp-content/uploads/2021/07/AFI_DFS_Literacy_Toolkit_V5_29July.pdf.
- ⁶⁰ DRAW Practitioner and Learner Questionnaires.
- ⁶¹ Benjamin Balsmeier and Martin Woerter, “Is This Time Different? How Digitalization Influences Job Creation and Destruction,” *Research Policy* 48, no. 8 (October 2019), www.sciencedirect.com/science/article/abs/pii/S0048733319300733?via%3Dihub.
- ⁶² The Office of Governor Larry Hogan, Maryland, “Governor Hogan Announces Approval of 27 New Apprenticeship Programs During COVID-19 Pandemic,” <https://governor.maryland.gov/2021/04/20/governor-hogan-announces-approval-of-27-new-apprenticeship-programs-during-covid-19-pandemic/>.
- ⁶³ Della Adams et al., “The Digital Upside to the Pandemic Lockdown: Creating Digital Equity Through Native Language Support at Tyson Foods,” *COABE Journal* 10, no. 2, Article 12 (2021), <https://coabe-connects.myshopify.com/products/article-12-the-digital-upside-to-the-pandemic-lockdown-creating-digital-equity-through-native-language-support-at-tyson-foods>.

-
- ⁶⁴ Iñiguez-Berrozpe and Boeren, “Twenty-First Century Skills for All,” <https://link.springer.com/article/10.1007/s10758-019-09403-y>; and OECD, *Skilled for Life?* https://www.oecd.org/skills/piaac/SkillsOutlook_2013_ebook.pdf.
- ⁶⁵ Pew, “Mobile Fact Sheet,” www.pewresearch.org/internet/fact-sheet/mobile/.
- ⁶⁶ DRAW Learner Questionnaire.
- ⁶⁷ DRAW Practitioner Questionnaire.
- ⁶⁸ Tiffany L. Gallagher, Dane Di Cesare, and Jennifer Rowsell, “Stories of Digital Lives and Digital Divides: Newcomer Families and Their Thoughts on Digital Literacy,” *Reading Teacher* 72, no. 6 (2019): 774-778, <https://ila.onlinelibrary.wiley.com/doi/10.1002/trtr.1794>.
- ⁶⁹ Margie McHugh and Catrina Doxsee, “English Plus Integration: Shifting the Instructional Paradigm for Immigrant Adult Learners to Support Integration Success,” Migration Policy Institute policy brief, October 2018, www.migrationpolicy.org/research/english-plus-integration-instructional-paradigm-immigrant-adult-learners.
- ⁷⁰ Jen Vanek, *Second Language Proficiency, Academic Language, and Digital Literacy for LESLLA*, J. Sacklin and D. McParland (eds.), Literacy Education and Second Language Learning for Adults, p. 136, Portland, <https://drive.google.com/drive/folders/13TKI99J6Urlq73IvmQTKz50QLxjEEM9t>.
- ⁷¹ Esther Prins, “Digital Storytelling in Adult Basic Education and Literacy Programming,” *New Directions for Adult and Continuing Education* 154 (Summer 2017): 29-38, <https://onlinelibrary.wiley.com/doi/abs/10.1002/ace.20228>.
- ⁷² Michelle Tolbert, Jordan Hudson, and Heather Claussen Erwin, *Educational Technology in Corrections* (Washington, DC: LINC, U.S. Department of Education Office of Career, Technical, and Adult Education, 2015), <https://lincs.ed.gov/professional-development/resource-collections/profile-821>.
- ⁷³ Matt Blomberg et al., “Digital Divide and Marginalized Women During COVID-19: A Study of Women Recently Released From Prison,” *Information, Communication & Society* 24, no. 14, (July 29, 2021): 2113-2132, www.tandfonline.com/doi/full/10.1080/1369118X.2021.1963462.

⁷⁴ Bianca Reisdorf et al., “Digital Reentry: Uses of and Barriers to ICTs in the Prisoner Reentry Process,” *Information, Communication & Society* 1, no. 18, <https://www.tandfonline.com/doi/full/10.1080/1369118X.2021.1924826>.

⁷⁵ *Digital Technology in Prisons: Unlocking Relationships, Learning and Skills in UK Prisons* (London: The Centre for Social Justice, January 2021), www.centreforsocialjustice.org.uk/wp-content/uploads/2021/01/CSJJ8671-Digital-In-Prisons-210604.pdf; Hillary Schaub and Daniel M. West, “Digital Literacy Will Reduce Recidivism in the Long Term,” Brookings, *TechTank* blog, October 6, 2015, www.brookings.edu/blog/techtank/2015/10/06/digital-literacy-will-reduce-recidivism-in-the-long-term/; and United Nations, *Introductory Handbook on the Prevention of Recidivism and the Social Reintegration of Offenders* (Vienna: United Nations Office on Drugs and Crime, 2018), www.unodc.org/documents/justice-and-prison-reform/18-02303_ebook.pdf.

⁷⁶ Lois M. Davis et al., *Evaluating the Effectiveness of Correctional Education: A Meta-Analysis of Programs That Provide Education to Incarcerated Adults* (Santa Monica, California: RAND Corporation, 2021), www.rand.org/content/dam/rand/pubs/research_reports/RR200/RR266/RAND_RR266.sum.pdf.

⁷⁷ Borka Jerman Blažič and Andrej Jerman Blažič, “Overcoming the Digital Divide With a Modern Approach to Learning Digital Skills for the Elderly Adults,” *Education and Information Technologies* 25, no. 1 (July 19, 2019): 259-279, <https://link.springer.com/article/10.1007/s10639-019-09961-9>.

⁷⁸ Iñiguez-Berrozpe and Boeren, “Twenty-First Century Skills for All,” <https://link.springer.com/article/10.1007/s10758-019-09403-y>.

⁷⁹ National Academies of Sciences, Engineering, and Medicine, *Social Isolation and Loneliness in Older Adults: Opportunities for the Health Care System* (Washington, DC: The National Academies Press, 2020), <https://nap.nationalacademies.org/catalog/25663/social-isolation-and-loneliness-in-older-adults-opportunities-for-the>.

⁸⁰ Blažič and Blažič, “Overcoming the Digital Divide,” <https://link.springer.com/article/10.1007/s10639-019-09961-9>.

⁸¹ Ching-Ju Chiu et al., “How to Help Older Adults Learn New Technology? Results From a Multiple Case Research Interviewing the Internet technology Instructors at the Senior Learning Center,” *Computers & Education* 129, no. 1 (2019): 61-70, www.learntechlib.org/p/201512/.

⁸² Blažič and Blažič, “Overcoming the Digital Divide,”
<https://link.springer.com/article/10.1007/s10639-019-09961-9>.

⁸³ Blažič and Blažič, “Overcoming the Digital Divide,”
<https://link.springer.com/article/10.1007/s10639-019-09961-9>.

⁸⁴ Ching-Ju Chiu et al., “How to Help Older Adults Learn New Technology?”
www.learntechlib.org/p/201512/.

⁸⁵ Kerolyn Ramos Garcia et al., “Improving the Digital Skills of Older Adults in a COVID-19 Pandemic Environment,” *Educational Gerontology* 47, no. 5 (2021): 196-206,
www.tandfonline.com/doi/full/10.1080/03601277.2021.1905216.

⁸⁶ Thomas Armstrong, “The Myth of the Normal Brain: Embracing Neurodiversity,” *AMA Journal of Ethics* 17, no. 4, (2015): 348-352, <https://journalofethics.ama-assn.org/article/myth-normal-brain-embracing-neurodiversity/2015-04>.

⁸⁷ Robert Austin and Thorkil Sonne, “The Dandelion Principle: Redesigning Work for the Innovation Economy,” *MIT Sloan Management Review*, May 19, 2014,
<https://sloanreview.mit.edu/article/the-dandelion-principle-redesigning-work-for-the-innovation-economy/>.

⁸⁸ Courtney Mullin, Robert Gould, and Sarah Parker Harris, “ADA Research Brief: Digital Access and Title III of the ADA,” (Chicago: ADA National Network Knowledge Translation Center, 2020), https://adata.org/research_brief/digital-access-and-title-iii-ada.

⁸⁹ DRAW Practitioner Questionnaire.

⁹⁰ Pablo Delgado et al., “Training Young Adults With Intellectual Disability to Read Critically on the Internet,” *Journal of Applied Research in Intellectual Disabilities* 32, no. 3 (2019): 666-677,
<https://onlinelibrary.wiley.com/doi/10.1111/jar.12562>.

⁹¹ R. Zelezny-Green et al., *A Landscape Review: Digital Inclusion for Low-Skilled and Low-Literate People*, Chapter 7, 28-42 (Paris: UNESCO, 2018), <https://en.unesco.org/icted/content/digital-inclusion-low-skilled-and-low-literate-people>.

⁹² DRAW Practitioner Questionnaire.

⁹³ Jen Vanek, *Second Language Proficiency, Academic Language, and Digital Literacy for LESLLA*, J. Sacklin and D. McParland (eds.), *Literacy Education and Second Language Learning for Adults*, p. 136, Portland, <https://drive.google.com/drive/folders/13TKI99J6Urlq73IvmQTKz5oQLxjEEM9t>.

⁹⁴ *Canadian Language Benchmarks: ESL for Adult Literacy Learners* (Ottawa, Ontario: Centre for Canadian Language Benchmarks, 2016), http://andersoncollege.online/wp-content/uploads/2021/02/CLB_ESL_for_ALL_2016_web-1.pdf.

⁹⁵ Jen Vanek, Victoria Neff, and Haylee Niemann, *Literacy and Digital text: Field Testing a Readability Technology in Adult Education Program* (Boston: World Education, *In press*)

⁹⁶ DRAW Practitioner Questionnaire.

⁹⁷ Iñiguez-Berrozpe and Boeren, “Twenty-First Century Skills for All,” <https://link.springer.com/article/10.1007/s10758-019-09403-y>.

⁹⁸ Cedefop, *Empowering Adults Through Upskilling and Reskilling Pathways. Volume 1: Adult Population With Potential for Upskilling and Reskilling*, no. 112 (Luxembourg: Publications Office of the European Union, 2020), <http://data.europa.eu/doi/10.2801/475393>.

⁹⁹ Judith Alamprese, *Building Knowledge and Evidence About Using Digital Technologies in Adult Foundational Skills Programs*, Center for the Study of Adult Literacy, [link forthcoming]; and Jen Vanek and Jeffrey Goumas, *Highlighting Innovative Practitioner Uses of Digital Technologies in Adult Foundational Skills Instruction*, Center for the Study of Adult Literacy, 2021, <https://s3.us-west-2.amazonaws.com/us-west-2.files.campus.edublogs.org/sites.gsu.edu/dist/c/18792/files/2021/12/CSAL-Session-1-Vanek-and-Goumas-2021-508c.pdf>.

¹⁰⁰ Jaime S. Fall, personal communication, September 23, 2021.