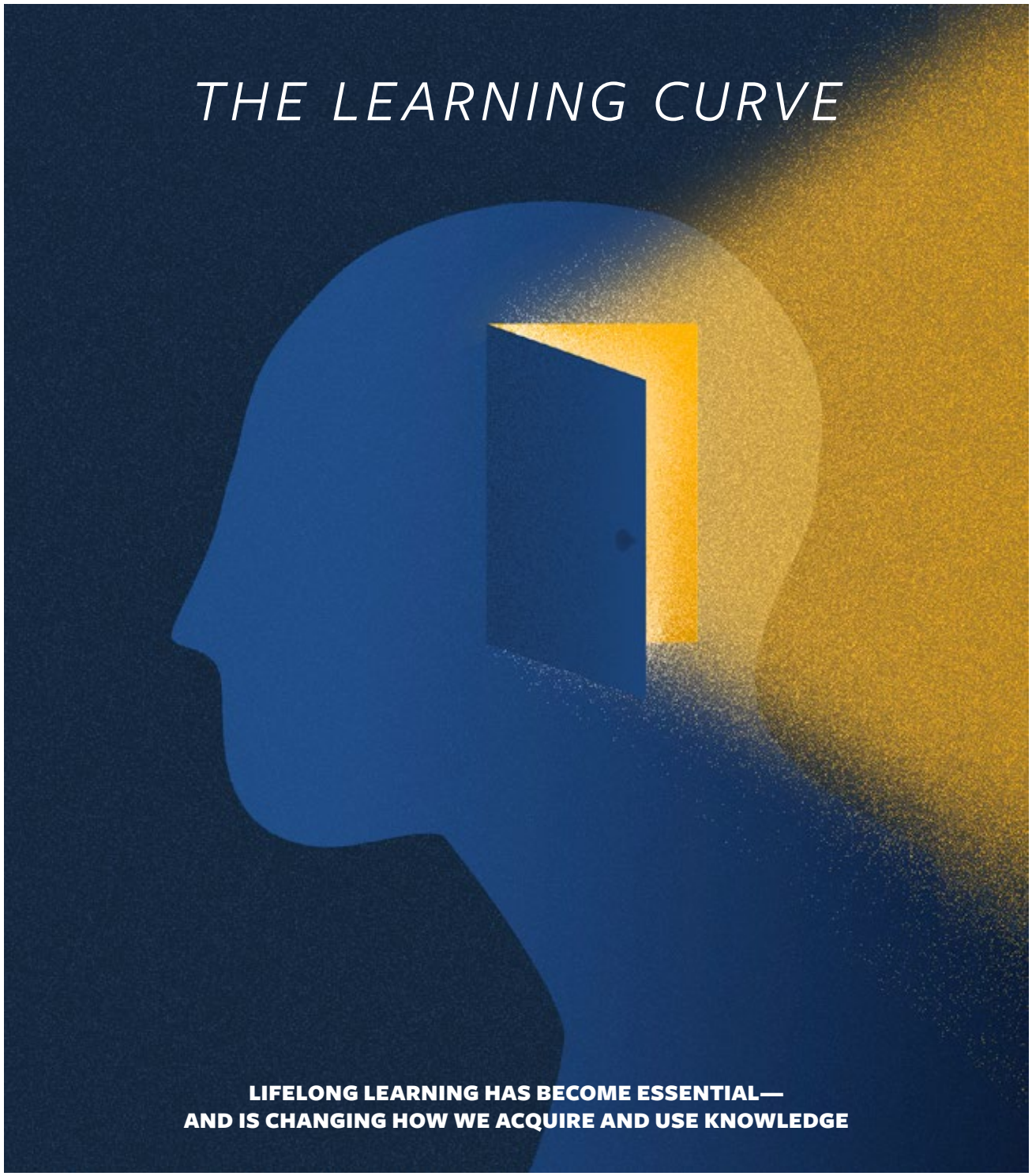
TREND

Analysis of the Facts, Numbers, and Trends Shaping the World
THE PEW CHARITABLE TRUSTS



THE LEARNING CURVE

**LIFELONG LEARNING HAS BECOME ESSENTIAL—
AND IS CHANGING HOW WE ACQUIRE AND USE KNOWLEDGE**

learning

[ˈlər-niŋ]

noun

1. the act or experience of one who learns
2. knowledge or skill acquired by instruction or study
3. modification of a behavioral tendency by experience
4. an essential lifelong activity

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One Commerce Square
2005 Market Street, Suite 2800
Philadelphia, PA 19103-7077

901 E Street NW, 10th Floor
Washington, DC 20004-2037

The Grove
248A Marylebone Road
London, NW1 6JZ

CONTRIBUTORS

POOJA K. AGARWAL is a cognitive scientist, assistant professor at the Berklee College of Music, and author of *Powerful Teaching: Unleash the Science of Learning.* *Voices: Learning Requires Remembering*

LIZ BEIGLE-BRYANT lives in the Seattle region. *Voices: Learning Requires Desire*

BENEDICT CAREY is a science reporter for *The New York Times* and the author of *How We Learn: The Surprising Truth About When, Where, and Why It Happens. Foreword: Learning is a Science*

ALEJANDRO GIBES DE GAC is CEO and founder of Springboard Collaborative. *Voices: Learning Requires Family*

ASHLEY J. LLORENS is chief of the Intelligent Systems Center at the Johns Hopkins University Applied Physics Laboratory. *Machines Are Learning, Too—but Not Like Us*

BRUCE MCCANDLISS heads the Educational Neuroscience Initiative at Stanford University, where he is a professor in the Graduate School of Education. **ELIZABETH TOOMARIAN** directs the Brainwave Learning Center at Synapse School and is a researcher with the Educational Neuroscience Initiative at Stanford University. *Putting Neuroscience in the Classroom*

KIM PARKER directs social trends research and **LEE RAINIE** directs internet and technology research at the Pew Research Center. They are co-authors of the report "The State of American Jobs," on which this essay is based. *Americans and Lifetime Learning in the Knowledge Age*

ANDREAS SCHLEICHER is the director for education and skills and special adviser on education policy to the secretary-general of the Organization for Economic Cooperation and Development. *How to Prepare the Next Generation for Its Future—Not Our Past*

PETER SMITH was the founding president of California State University Monterey Bay and the Community College of Vermont and currently serves as the Orkand Endowed Chair and senior vice president/chief academic officer at the University of Maryland Global Campus. He is the author of *Free-Range Learning in the Digital Age: The Emerging Revolution in College, Career, and Education. Personal Learning: Its Past, Present, and—Most Importantly, Its Future*

MICHELLE R. WEISE is chief innovation officer at Strada Education Network. *Lifelong Learning Will Be the New Normal—But Are We Ready?*

THE LEARNING CURVE

Albert Einstein said that "education is not the learning of facts, but the training of the mind to think." Today, the growing demand for problem-solving, communication, and leadership skills—combined with the rapid pace of technological change, longer life spans, and an increasingly global economy—gives new urgency to how effectively we train ourselves to learn.

And when circumstances change—to rethink, process new knowledge, and start again.

In this issue of *Trend*, we explore the future of learning. As with previous issues of this annual journal of ideas, we have selected a topic that is both a challenge and an opportunity for today's society, and one that poses major global policy questions. And, as always, we feature a variety of diverse expert perspectives that help break down a complicated subject into its key elements, sharing fresh insight and hopefully fostering new dialogue on one of the key trends shaping the world.

To ground the discussion, Kim Parker and Lee Rainie of the Pew Research Center summarize their findings on how Americans view the changing landscape of work and learning. The authors note that the number of workers in occupations requiring average to above-average education, training, and experience increased 68 percent from 1980 to 2015. This helps explain why, as they write in this issue, "54 percent of adults in the labor force said it will be essential for them to get training and develop new skills throughout their work life."

That work life is getting longer, too. Michelle Weise of Strada Education Network points out that 10,000 Americans will hit age 65 every day until 2030—and many will work well into their 70s. This demographic change greatly increases the need for lifelong learning. Weise explains that employers must therefore invest in "a new learning ecosystem" that addresses the growing demand for training and career counseling—and could also include giving employees time to upgrade their skills; developing age-diverse teams; and relying less on academic credentials and more on knowledge gained outside the classroom.

While Weise focuses on how lifelong learning must be the new normal for workers and their employers, education researcher Andreas Schleicher directs his attention to how we prepare the next generation for the digital jobs of the future. He makes a point that Einstein would almost certainly agree with: that the modern world no longer rewards us for the facts we know, but for "extrapolating from what we know and applying that knowledge in novel ways." In doing so, members of the next generation will often create their own jobs, becoming more imaginative, resilient, entrepreneurial, and technologically savvy. And for all of us, the future will require a greater focus on synthesizing different fields of knowledge; developing social skills such as empathy and collaboration; embracing technology; and working to facilitate innovation, informed risk-taking, and accountability.

The big picture? Globalization, automation, artificial intelligence, and the reality of lifelong learning are changing the way we acquire knowledge. In *Trend*, you'll read differing perspectives on these topics, including fresh insights from accomplished biomedical scientists and dedicated teachers. I hope you will be energized and informed by their research and learn more about the latest policies that are shaping the future of learning.

Rebecca W. Rimel, *President and CEO*

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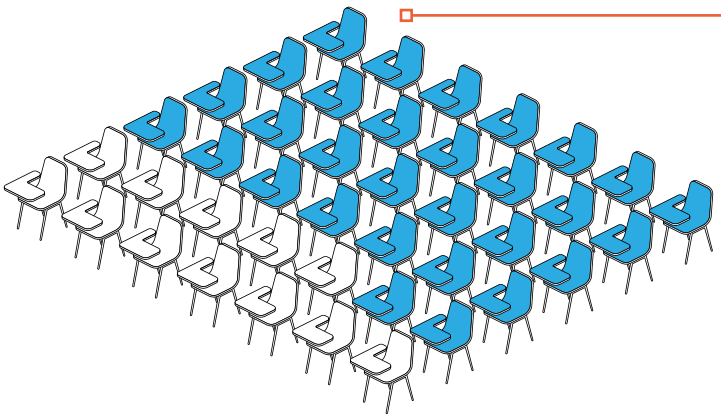
CRUNCH

Source: Pew Research Center

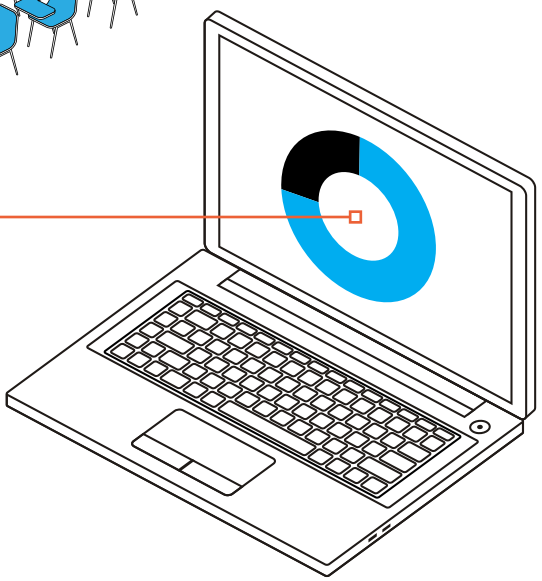
Lifelong Learning

Most Americans consider themselves lifelong learners, whether that means gathering knowledge for "do it yourself" projects, reading up on a personal interest, or improving their job skills. Digital technology plays a role in these pursuits, but place-based learning—at work, conferences, or libraries—remains vital. Differences in education and income are hallmarks of people's learning activities.



73%

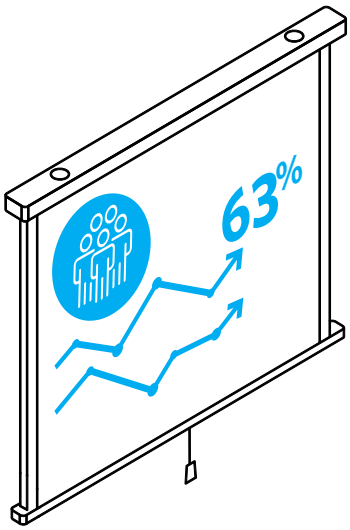
of adults call themselves lifelong learners



74%

of adults are personal learners

They have participated in at least one activity in the past 12 months to advance their knowledge about something that personally interests them.



63%

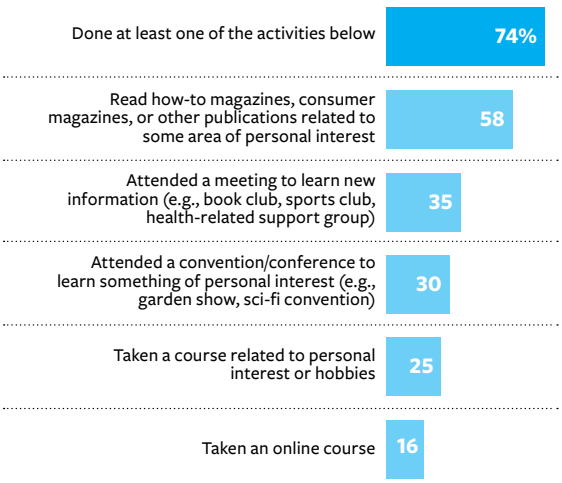
of those who are working (or 36% of all adults) are professional learners.

They have taken a course or gotten additional training in the past 12 months to improve their job skills or expertise connected to career advancement.

Majorities of Americans seek out learning activities in their personal and work lives

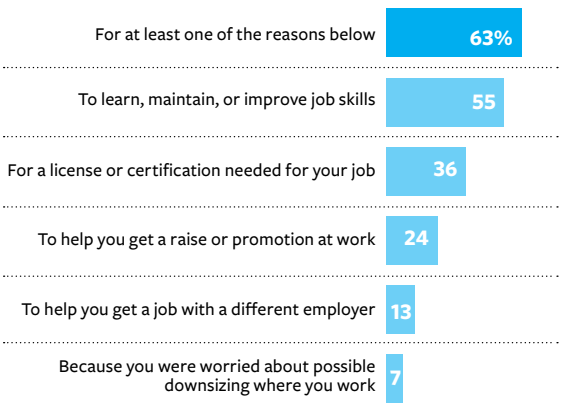
PERSONAL LEARNERS: 74% of adults

Percent of adults who say that in the past 12 months they have ...



PROFESSIONAL LEARNERS: 63% of workers (36% of all adults)

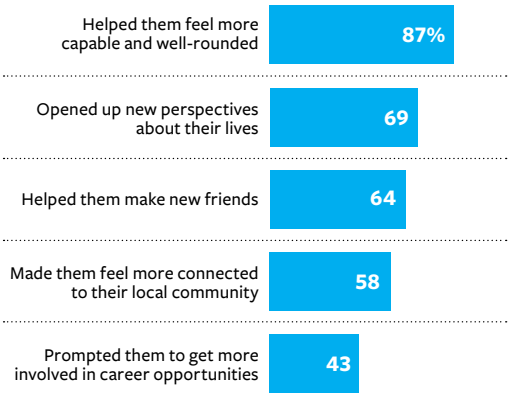
*Percent of those who work full time or part time who say in the past 12 months they have **taken a class or gotten extra training** ...*



Recent educational experiences have paid off in key ways for some learners

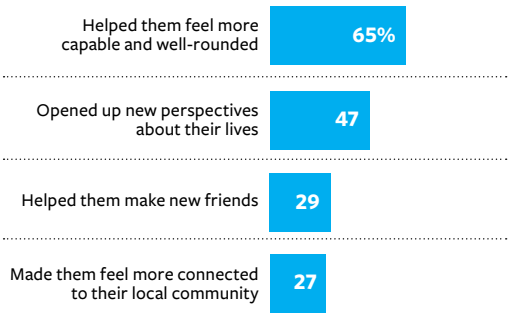
PERSONAL LEARNERS

Among adults who pursued personal learning activities, percent who say their learning ...

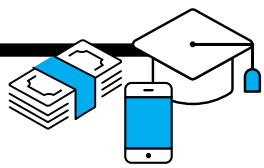


PROFESSIONAL LEARNERS

Among adults who pursued professional learning activities, percent who say their learning ...



Americans' learning activities are tied to a variety of factors

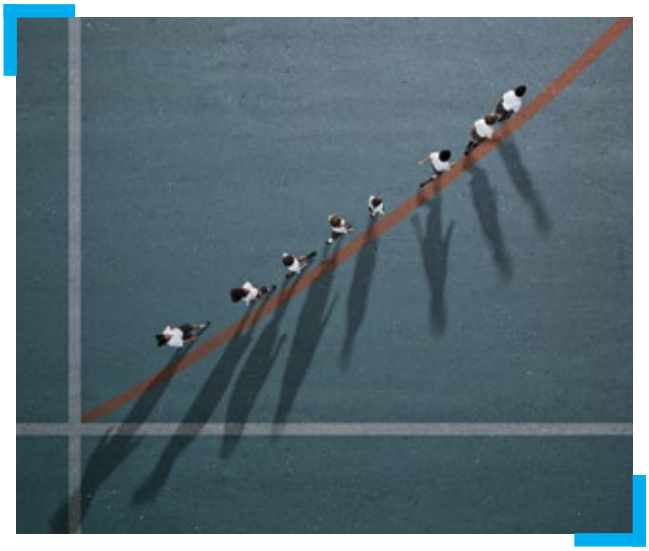


LEVEL OF EDUCATION	Those with more formal education are more likely than others to pursue learning activities.
HOUSEHOLD INCOME	Those who live in households with more income are more likely than others to be both professional and personal learners.
RACE AND ETHNICITY	African Americans and Hispanics are less likely than whites to have pursued personal learning activities in the past year.
TECHNOLOGY ASSETS	Those who have both home broadband and smartphones are more likely than those with no internet connections or only one connection option to take advantage of learning opportunities.
PERSONAL OUTLOOK	Those who consider themselves lifelong learners and are eager to seek information are more likely than others to pursue personal enrichment activities.

FOREWORD

LEARNING IS A SCIENCE

BY BENEDICT CAREY



Human beings learned to learn long before some enlightened soul in a powdered wig pronounced the value of "education."

Formal education was a transformational idea and needs no introduction or defense. It was so good that, down through the generations, its language, culture, and schedules—dividing the day into chunks (classes), insisting on routine, prolonged concentration, monkish devotion—came to define how people presume the brain works most efficiently, or should work.

Only it doesn't, not even close.

School is a recent invention, and so are its customs. The ancient civilizations we learned about in middle school date from a few thousand years ago, no more. Humans have been around for hundreds of thousands of years, and it was during that endless diaspora in the wild that the nervous system grew up. As we foraged for food and water, the brain adapted to pick up cues on the fly, piecemeal, in the dark and cold, under a scorching sun, over changing terrain.

It became a forager, too, for information, for survival strategies, and for skills.

This gap—between how the brain is presumed to learn, and its foraging nature—is large enough that cognitive and memory scientists have had a field day. In the past decade or so, they have produced a string of findings that violate the standard study advice: to work in a dedicated, quiet place, according to a strict ritual (no distractions allowed!). This research has inspired Silicon Valley startups; generated large-scale experiments in public schools and university classrooms; and, for those in the know, provided an off-the-shelf menu

of techniques that can be tailored to deepen learning of specific topics.

Consider foreign languages. When building vocabulary in a new language, it is better to split study time into increments—an hour today, an hour tomorrow, an hour the night before the test—than to put in three hours all at once. This is the kind of advice moms used to dole out regularly, only they never quoted the research: People remember up to two times more French verbs (or English verbs, or state capitals, or bird species) when using incremental, "spaced" study compared with the concentrated kind, scientists have found.

It's worth stopping to savor that simple result: up to twice the recall on a vocabulary test, with no extra time, and no extra effort, required.

Testing is itself perhaps the strongest learning technique available. Think of testing in this context as self-examination: running through a stack of flashcards, or reciting concepts in front of a mirror, or even playing teacher and explaining the material to a friend. For that matter, sparring with a classmate—who can translate simple English sentences into French fastest, after a cocktail? after three?—also counts as a self-examination.

In scores of careful studies, in various fields, cognitive psychologists find that devoting about half of study time to self-examination ramps up a person's score on a delayed test—say, a week later—by about 30 percent. Here again: No extra time or effort required.

And that's only Learning Science 101. As the field deepens, it has begun to turn up many other specific, practical strategies that can be adapted to music, athletics, and technical subjects such as math and engineering.

For example, taking a break during a problem-solving session—allowing yourself a real distraction, such as browsing social media or streaming a favorite TV show—is, in fact, the best way to increase the likelihood you will solve the problem you are stuck on. That means distraction is good, not bad, when engaged at the right time (you do have to come back to the problem, not get lost in the show).

Procrastination can work in one's favor, too. When facing a large, creative project, the temptation is to put off starting it and let the clouds darken with each passing day. That's the bad kind of procrastination. The good kind is only slightly different: Start the project, even if you can work for only 15 minutes. Then put it down. That act in itself activates the brain, both consciously and subconsciously, to begin compiling material that is relevant, both from the outside environment—from news reports, for instance, or even a casual chat—and from the jump-started internal conversation in your own head.

The next time you sit down, you will have far more to say than you expected to have.

These aren't merely "tips" or "techniques." They are small alterations that have outsize effects on performance, rooted in years of rigorous cognitive science. They also provide the basis for what no one ever seems to have: a strategy that guides *how* to learn most efficiently, depending on the topic at hand and the time available.

How to formalize learning science is not as easy as it might seem: Individual learning is one kind of process, and group learning is another, with its own chaos and rhythm. In a recent experiment, psychologists at the University of Texas incorporated a kind of self-examination into their introductory course. Performance improved, as a rule, but the students bristled at the added testing, and some dropped out.

Learning Science could become a course of its own, beginning in middle school, when students first become self-directed learners. There, they'll begin to appreciate both the ancient, foraging brain and the modern, classroom one, and begin coaxing the former to juice the latter.

In a world now swimming in information, ever-advancing technology, and specialized demands, just knowing that primal neural machinery is there—adaptable, congenial, an old soul eager to help—is its own kind of secret sauce: a mental GPS tuned to navigate through any wilderness, even one of our own making.

Putting Neuroscience in the Classroom

The more we know about how the developing brain changes as we learn, the better we can support young learners.

BY BRUCE MCCANDLISS AND ELIZABETH TOOMARIAN

As we learn, our brains continually change. From toddlerhood to early childhood, all of life's natural learning experiences—from a playdate with a friend to hearing that bedtime story one more time—are acting to refine the function and structure of circuits in the brain that are central to how we see, hear, feel, and act in the world. When children go off to school, they need to adapt these circuits of their brains in new and profound ways as they learn how to translate letters into words, words into ideas, and numbers into mathematical concepts. Now, scientists and educators are teaming up to study how schooling changes brain development—and to take lessons from what they learn to improve the learning process.

On a typical day at the Synapse School in Menlo Park, California, where our team of Stanford University neuroscientists works hand in hand with teachers, students might drop by the Brainwave Learning Center, an on-site research lab where they can wear stretchy caps with more than a hundred small, spongy sensors on their heads. These sensors measure the naturally occurring brain waves that fluctuate as they play educational games or engage in guided meditation. The students can also watch live computer displays to witness how their own brain waves change as they concentrate on a task or engage in mindfulness. This interactive experience provides each child the chance to see and think about their own brain activity, how it changes with learning, and even how it changes with moment-to-moment shifts in mindset, which helps instill in students a sense of ownership of their learning process. Meanwhile, the brain activity evoked by the educational games provides important data to ongoing studies of brain and skill development.

This nascent research is bringing together two different worlds: the rapidly progressing field of developmental cognitive neuroscience, which studies how brains change during learning, and the complex domain of schools, teachers, and curricula, which shape and support the learning. This emerging field of educational neuroscience goes beyond what either of these worlds could attempt to tackle on their own and will help answer important questions: How does classroom learning place pressure on specific brain circuits to change? Are there differences in these circuits that could help us understand why some children struggle with learning? Are there ways we can improve education to help children with those challenges?

Our understanding of how brain development changes during the early school years is expanding rapidly. Today's generation of children is the first to grow up in a time when tools such as magnetic resonance imaging (MRI) and wearable brain-wave sensors are widely available. At the same time, collaborative, open-science practices such as data sharing are becoming the norm. This has expanded our basic knowledge about the developing brain circuits of reading, math, and attention, as well as allowing sampling of large populations of schoolchildren that covers the true range of neurodiversity in them.

Just last year, for example, over 11,000 third grade children completed an extensive brain scanning protocol in multiple cities across the country. Each has pledged to repeat the scans every two years as they progress through elementary, middle, and high school, providing the largest brain development study ever carried out and enabling researchers to follow changes

in the structure and functions of specific neural circuits and fully explore the diversity of paths that children's brain development takes. Importantly, we will be able to explore the question of how all this rich diversity in brain development is linked to each child's ongoing education through richly detailed assessments of their educational achievement, home and school environment, social media use, and involvement in arts and sports.

But how can the role of educational experiences be directly linked to changes in brain structure and function? Remarkably, many brain imaging technologies are now sensitive to changes in brain circuits that accrue from one week to the next, allowing researchers to better understand how specific learning experiences drive changes in brain function and structure. In one study, researchers used MRI imaging to take pictures of the brains of struggling readers who tested in the dyslexic range and were undergoing several weeks of intensive tutoring. Brain scans collected every two weeks revealed remarkable changes in both reading skills and in the structural brain scan measures of white matter tracts (the long fiber bundles that connect one part of the brain to another). A control group scanned across weeks of "business as usual" education allowed researchers to make powerful claims about the extent to which this tutoring actually caused changes in the brain circuits. Such results are challenging and even changing our understanding of the term "learning disability." These findings place increasing focus on how the right educational supports can lead to positive changes in both the mind and brain.

CIRCUITS THAT ADAPTED AT VERY EARLY AGES TO RECOGNIZE FACES AND OBJECTS RECONFIGURE TO RECOGNIZE THOUSANDS OF VISUAL WORDS.

We also can study how week-to-week change accumulates over a school year by observing natural experiments that are occurring in educational systems all the time. For example, schools need to decide when a student enters kindergarten and when a student must wait. Consider a group of 5-year-olds born in September of the same year in a school district that requires incoming kindergartners to have a birthday before the 15th of the month. After a year, students of virtually the same maturity who attended school can be compared with those who had to wait. This provides a rare glimpse into the impact that formal learning in kindergarten—versus alternatives such as preschool or day care—has on developing brains. Such studies are already beginning to show how kindergarten experiences can enhance development in brain networks related to skills such as sustained attention.

Teachers, of course, play a central role in guiding a child's learning experiences. The way a teacher focuses a student's attention can affect the nature of learning-induced changes in specific brain circuits. One recent brain-imaging study asked students to learn to read words made up from a set of artificial symbols, not traditional letters, that the students had never seen before. Two different sets of learning instructions either biased them toward a "whole-word" strategy or a "letter-sound" strategy. Words learned under whole-word instructions produced a

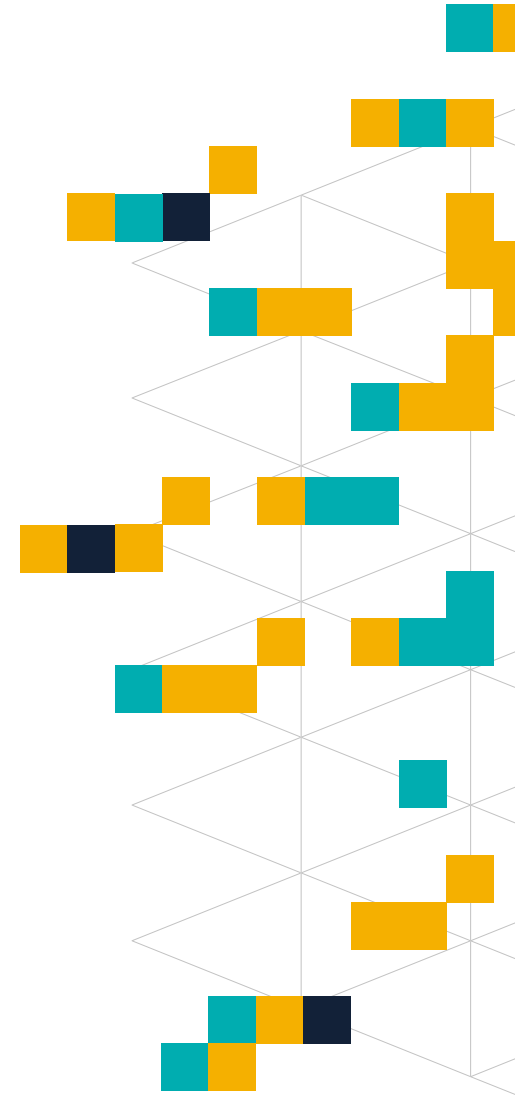
pattern of brain activity associated with novice learners or unfamiliar words. In contrast, words learned under letter-sound instructions produced a left hemisphere response in regions associated with adult-level word recognition. This adds to a growing body of work suggesting that with their instructional choices, teachers can play a significant role in helping to direct learning, which may have an impact on which brain circuits are changing as a result.

Combining the science of reading and math development with brain imaging has led to new insights into how brain circuits change as children master these foundational educational skills. We know that emerging readers' brains change in two fundamental ways: Circuits that adapted at very early ages to recognize faces and objects reconfigure to recognize thousands of visual words. And circuits for language that developed early to hear and pronounce words adapt to recognize sounds associated with syllables and letters. As children learn to read, these circuits increasingly take on the job of taking a jumble of tiny lines, curves, and spaces and turning them into recognized patterns of letters, letter combinations, and familiar words such as "rabbit," which happens to be one of the few six-letter words first graders at Synapse know by sight. By middle school, students' circuits further mature to allow them to recognize any of several thousand words they've been exposed to in their days at Synapse in less time than it takes to blink.

Meanwhile, we know that math is marked by changes in several other areas of the brain, including a region where visual systems recognize number symbols. Mastering math requires children to learn to automatically associate numerical meaning with these symbols—for example, that the quantity "seven" is written as 7. This specific form of math learning changes circuits of the brain that are located within systems more specialized for spatial relationships than language. As children move into middle school, their brain circuits begin to consolidate and retrieve facts to make relationships between numbers with effortless thought.

Every class of kindergartners at Synapse is actively going through those processes during the school year. Each student brings with them a diversity of developing skills in language, vision, attention, and other cognitive factors that can be measured safely and conveniently in our on-site Brainwave Recording Studio. When students place those nets of sensors on their heads, we can capture a thousand "pictures" of activity per second by measuring the natural electrical fields produced by the child's brain activity.

After six months of learning, students come in again to allow us to trace how their brain circuits have developed. Repeated visits over the subsequent elementary school years will enable our research team and the school staff to watch as students' brain circuits change as they



WHEN CHILDREN UNDERSTAND HOW THEIR BRAINS CHANGE AS THEY LEARN NEW THINGS, THE WHOLE OF IDEA OF LEARNING IN SCHOOL COULD CHANGE PROFOUNDLY FOR THEM.

grow from novice kindergartners to confident middle schoolers who spend hours a day learning through reading. Importantly, we combine these brain measures with leading behavioral reading assessments. The aim is to leverage the overlapping and complementary insights of these approaches to better understand the interaction between educational experiences and an individual student's strengths and vulnerabilities, and to predict and rapidly respond to emerging challenges.

This knowledge can guide extra instructional support for a young learner, for instance, to focus additional training on phonological processing or visual attention needs. Similarly, we know that children's early difficulties with ordering or combining sets of objects, recognizing spatial patterns, and understanding quantities—that general sense of how much of something there is—correlate with later math achievement. So this knowledge, too, can help focus extra support for a young learner to strengthen the brain network that underlies math skills. Clearly, we need to move beyond just describing traditional levels of students' performance—grading whether they meet or fall below expected standards—and to provide insights that might lead to investigating specific instructional approaches and why they work for the students who respond to them.

Around the world, there is a growing number of collaborations between cognitive neuroscientists and schools that are beginning to tackle a large set of issues beyond just reading and mathematics. This work will help us understand how critical factors such as empathy, creativity, self-control, and problem solving develop in school experiences and how schools can influence the brain circuits involved in much of what makes us human.

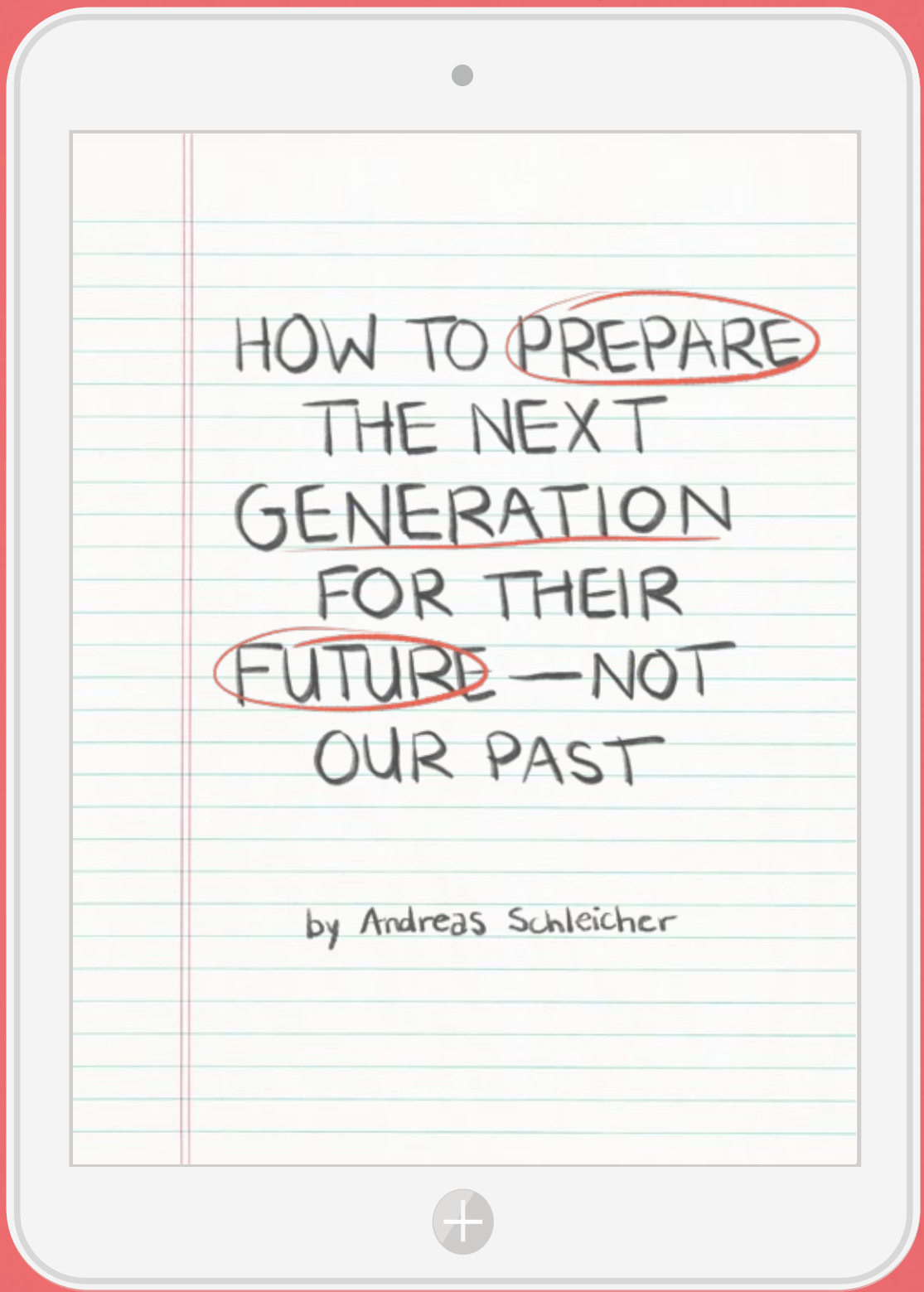
This is central to our partnership with Synapse School, where social-emotional learning is a foundational principle. Synapse students are trained in mindfulness practices right from kindergarten, including focused breathing during a "mindful minute." Because key members of our research team are also full-time staff at the school, we have a deep understanding of these school-specific practices and values. When children complete a mindful minute while wearing the net of sensors on their heads, they can actually see their brain waves change as they do something that is common practice in their classrooms.

This insight is possible only because of the continuity that exists between lab and school. The children are also interacting with adults who are familiar to them and with whom they already share a history and deep trust. The neuroscientist who is putting the funny-looking net of sensors on their heads is the same adult who was out at recess the previous week when they lost their baby tooth, or who was in their class that day helping with a project. When the boundaries between the neuroscience lab and the school environments begin to overlap, we are able to push past traditional obstacles and forward into a new understanding of how going to school changes our brains.

By working directly in schools, educational neuroscientists are learning a great deal about the notion of learning itself. The students in these schools, of course, get to see scientists in action. They also get a chance to learn as the researchers go about their work and to see their own brains as the complex entities that they are, that change and adapt to their experiences. And that is a great lesson for all of us: For when children understand how their brains change as they learn new things, the whole of idea of learning in school could change profoundly for them.

THE TAKEAWAY

We need to move beyond traditional descriptions of educational performance and gain insights that lead to effective teaching approaches and an understanding of why they work for students.


HOW TO PREPARE THE NEXT GENERATION FOR THEIR FUTURE—NOT OUR PAST
by Andreas Schleicher

Moving forward, young citizens will create jobs, not seek them, and collaborate to advance an increasingly complex world. That will require imagination, empathy, resilience, and entrepreneurship.

Almost 12 million students who took the global test known as PISA (the Programme for International Student Assessment) were not able to complete even the most basic reading, mathematics, or science tasks—and these were 15-year-olds living in the 72 high- and middle-income countries that participated in the last test in 2015. Over the past decade, there has been virtually no improvement in the learning outcomes of students in the Western world, even though spending on schooling rose by almost 20 percent during this period. And in countries like the United States, the quality of learning outcomes can still best be predicted by a school's ZIP code.

So it might be tempting to toss this journal aside and drop any thought about improving education. Is it impossible to change anything as big, complex, and entrenched in vested interests as education? Well, keep on reading and consider this: The learning outcomes among the most disadvantaged 10 percent of Vietnamese and Estonian 15-year-old students now compare favorably with those among the wealthiest 10 percent of families in most of Latin America and are on a par with those of the average student in the United States and Europe. Consider that in most countries, we can find excellence in education in some of the most disadvantaged schools—and that many of today's leading education systems have only recently attained these top positions. So it can be done.

But change can be a struggle. Young people are less likely to invest their time and energy in better education if it seems irrelevant to the demands of the "real" world. Businesses are less likely to invest in their employees' lifelong learning if those workers might move away for a better job. And policymakers are often more likely to prioritize immediate concerns over long-range issues.

But this long-range view is necessary. For those with the right knowledge and skills, digitalization and globalization have been liberating and exciting, while for those who are insufficiently prepared, they can mean vulnerable and insecure work, and a life with few prospects. Our economies are shifting toward regional hubs of production, linked by global chains of information and goods but concentrated where comparative advantage can be built and renewed. This makes the distribution of knowledge and wealth crucial, and that is intimately tied to the distribution of educational opportunities.

In this digitalized global age, the next generation of young citizens will create jobs, not seek them, and collaborate to advance an increasingly complex world. That will require imagination, empathy, resilience, and entrepreneurship, the ability to fail forward. The most obvious implication of a world that requires learners to constantly adapt and grow is the need to build the capacity and motivation for lifelong learning. People used to learn to do the work; now learning is the work, and the post-industrial era will require coaching, mentoring, teaching, and evaluating that can build passion for learning.

There must be an appreciation for the value of learning well beyond high school, beyond college graduation. People need to take ownership over what they learn, how they learn, where they learn, and when they learn. And lifelong learning requires people not only to constantly learn new things but also to unlearn and relearn as the world changes.

Governments can help. The easiest way is telling young people more of the truth about the social

and labor-market relevance of their learning. Education systems can be incentivized to help learners choose a field of study that resonates with their passions, in which they can excel, and that allows them to contribute to society, putting people on the path to success. Unfortunately, many educational institutions still focus on marketing fields of study that are easy to provide, which leaves some university graduates struggling to find good jobs even as employers say they cannot find the people with needed skills. In many countries, such skill mismatches keep rising.

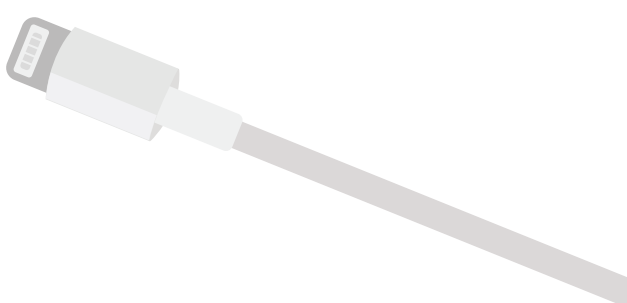
Also needed moving forward is a shift from qualifications-based certification systems to more knowledge- and skills-based certification systems. That means moving from documenting education pathways and degrees to highlighting what individuals can actually do, regardless of how and where they acquired their knowledge, skills, and character qualities. As the digital transformation diversifies training and learning opportunities, this certification of knowledge and skills becomes increasingly important, and businesses are increasingly testing knowledge and skills on their own while relying less on diplomas.

The dilemma for education is that the kinds of things that are easy to teach have become easy to digitize and automate. There is no question that state-of-the-art knowledge and skills in a discipline will always remain important. But the modern world no longer rewards us just for what we know—Google knows everything—but for extrapolating from what we know and applying that knowledge creatively in novel situations. The industrial age taught us how to educate students so they could remember what we told them; in the age of artificial intelligence, we will need to think harder about how we can pair the artificial intelligence of computers with the cognitive, social, and emotional skills and values of people. Whether artificial intelligence will destroy or create more jobs will very much depend on our success with this and whether our imagination, our awareness, and our sense of responsibility will help us harness technology to shape the world for the better. It is telling that employment in Europe's creative industries—those that specialize in the use of talent for commercial purposes—grew at 3.6 percent during the crucial period between 2011 and 2013, a time when many European sectors were shedding jobs or showing stagnant employment rates.

Moreover, technology and artificial intelligence are not magic powers; they are just extraordinary amplifiers and accelerators that add speed and accuracy. Artificial intelligence will amplify good ideas and good practice in the same way that it amplifies bad ideas and bad practice; i.e., artificial intelligence is ethically neutral. However, it is always in the hands of people who are not neutral. That is why education in the future is not just about teaching people something, but about helping them develop a reliable compass to navigate an increasingly complex, ambiguous, and volatile world. Ethics will be at the heart of 21st-century learning.

There are other important dimensions too. The conventional approach in school is often to break problems down into manageable bits and pieces and then to teach students how to solve these bits and pieces. But modern societies create value by synthesizing different fields of knowledge, making connections between ideas that previously seemed unrelated. That requires being familiar with and receptive to knowledge in other fields.

Not least, social skills are rising in labor-market relevance, so tomorrow's citizens will need to think for themselves and join others, with empathy, in work and citizenship. Innovation is now rarely the product of individuals working in isolation but rather an outcome of how we share and integrate knowledge. Employers increasingly seek to attract learners who easily adapt and can share, apply, and transfer their skills and knowledge. At work, at home, and in the community, people will need a deep understanding of how others live in different cultures and traditions and how others think, whether as scientists or artists. Digitalization can enrich this capacity but also put it at risk.



The challenge is that developing such cognitive, social, and emotional capabilities requires a very different approach to teaching and learning, well beyond imparting and absorbing prefabricated knowledge. In the most advanced education systems, teaching has become a profession of advanced knowledge workers who own their professional practice and who work with a high level of professional autonomy and within a collaborative culture. In Finland, there tend to be nine applicants for every teaching post, not because teaching is financially more attractive than in other countries but because teaching in Finland is intellectually attractive.

The past was divided, with teachers and content divided by subjects, and students separated by expectations of their future career prospects. Nowadays, education is becoming more integrated, with an emphasis on the interrelation of subjects and the integration of students. It is also becoming more connected, with learning closely related to real-world contexts and contemporary issues and open to the rich resources in the community, becoming project-based, and helping students to think across the boundaries of subject-matter disciplines.

Some education systems also embrace technology in ways that elevate the role of teachers as co-creators and designers of innovative learning environments. Digital learning systems cannot just teach us science; they can simultaneously observe how we learn and determine the kinds of tasks and thinking that interest us—as well as the kinds of problems that we find boring or difficult. These systems can then adapt learning to suit our personal learning style with far greater granularity and precision than any traditional classroom setting possibly can. Similarly, virtual laboratories give us the opportunity to design, conduct, and learn from experiments rather than just learning about them. There are good examples of technology enhancing experiential learning by supporting project- and inquiry-based teaching methods, facilitating hands-on activities and cooperative learning, and delivering formative real-time assessments. There are also interesting examples of technology supporting learning with interactive, nonlinear courseware based on state-of-the-art instructional

Lifelong learning requires people not only to constantly learn new things but also to unlearn and relearn as the world changes.

design, sophisticated software for experimentation and simulation, social media, and educational games. These are precisely the learning tools that are needed to develop 21st-century knowledge and skills. Not least, one teacher can now educate and inspire millions of learners and communicate ideas to the whole world.

INNOVATION IS NOW RARELY THE PRODUCT OF INDIVIDUALS WORKING IN ISOLATION BUT RATHER AN OUTCOME OF HOW WE SHARE AND INTEGRATE KNOWLEDGE.

Perhaps the most distinguishing feature of technology is that it not only serves individual learners and educators, but it also can build an ecosystem around learning to create communities that make learning more social and more fun, recognizing that collaborative learning enhances goal orientation, motivation, persistence, and the development of effective learning strategies. Similarly, technology can build communities of teachers to share and enrich teaching resources and practices and to collaborate on professional growth and the institutionalization of professional practice. It can help system leaders and governments develop and share best practices around curriculum design, policy, and pedagogy. Imagine a giant crowdsourcing platform where teachers, education researchers, and policy experts collaborate to curate the most relevant content and professional practice to achieve education goals, and where students anywhere in the world have access to the best and most innovative education experiences.

The challenge is that such system transformation cannot be mandated by government, which leads to surface compliance, nor can it be built solely from the ground up.

Governments cannot innovate in the classroom, but government has a key role as platform and broker, as stimulator and enabler; it can focus resources, set a facilitative policy climate, and use accountability and reporting modifications to encourage new practice. But government needs to better identify key agents of change, champion them, and find more effective approaches to scaling and disseminating innovations. That is also about finding better ways to recognize, reward, and give exposure to success, to do whatever is possible to make it easier for innovators to take risks and encourage the emergence of new ideas. The past was about public versus private; the future is about public with private.

The challenges look daunting, but many education systems are now well on their way toward finding innovative responses to them, not just in isolated, local examples, but also systemically. This is essential if we are to create a future for millions of learners who currently do not have one. That task is not about making the impossible possible, but about making the possible attainable.

THE TAKEAWAY

The most obvious implication of a world that requires learners to constantly adapt and grow is the need to build the capacity and motivation for lifelong learning.

LIFELONG LEARNING WILL BE THE NEW NORMAL—BUT ARE WE READY?

BY MICHELLE R. WEISE

It is time to jettison the notion that education is completed before we enter the workforce. Especially as we live longer and workplace requirements expand, continued learning and retraining are becoming essential.

Mounting evidence suggests that we can expect to live longer. The authors of *The 100-Year Life* explain: "For most of the last two hundred years there has been a steady increase in life expectancy. More precisely, the best data currently available suggests that since 1840 there has been an increase in life expectancy of three months for every year. That's two to three years of life added for every decade. ... And perhaps more importantly, there is no sign that the trend is levelling off." With advances in health care, medicine, and disease control as well as improvements in general living conditions, we have somehow, as one aging specialist has said, "found a way to slow down the process of bodily decay that was given to us by nature, a truly remarkable development that no other species has achieved before." The Global AgeWatch Index Report anticipates that by 2100, the number of people ages 80 and over will increase more than sevenfold, from 125 million to 944 million.

With a 100-year life, is it possible that our work lives will extend, too? Will the careers of the future last 60, 70, or 80 years? Already, workers who are 55 and older are staying in the workforce at historically high rates, well into their late 60s and even 70s.

How do we square projections of longer lives with those predicting massive job obsolescence? Even conservative estimates indicate that much of the work humans do today will be automated in the coming decade. At the same time, technological advancements will continue to give rise to entirely new kinds of jobs and careers.

Job transitions are already an established part of life. In the U.S. alone, 10,000 Baby Boomers will turn 65 every day from now until 2030, and many of them will have experienced at least 12 job changes by the time they retire. Those numbers will only increase with time, as people confront longer and more turbulent work lives. Gone are the days of retiring at age 65 and living on a guaranteed pension from one or a few employers that defined a person's career.

Technology's transformation of nearly every facet of our economy means that we all must learn new skills and acquire knowledge at a pace—and on a scale—never before seen. But which skills?

Policymakers, educators, and employers have been vigorously debating how best to prepare Americans for our potentially automated future. Some believe that the "hard" skills of science, technology, engineering, and math (STEM) are most critical to the future, while others believe that the uniquely "human" skills of the liberal arts are the ones that will endure in the face of automation. But this debate presents a false choice between the liberal arts and applied learning. It's not an either/or proposition but both/and: The most valuable workers now and in the future will be those who can combine technical knowledge with human skills and adapt to the changing needs of the workplace.

Companies are looking for intellectual dexterity just as much as technical expertise. A Strada Education Network analysis of more than 36 million job postings, resumes, and social profiles shows that in the first half of 2018, the skills in highest demand were leadership, research,

communications, writing, and problem-solving. Paired with technical knowledge, these uniquely human skills will endure in the face of increased automation in the future of work.

And these traits, especially in a robotized future, define us as human beings. Human skills will be critical to coordinating more closely with machines in a complementary way—a combination of skills like programming + communication, artificial intelligence (AI) + emotional intelligence, or logic + ethics.

Journalism and writing careers, for example, exemplify the need for both/and. A job seeker cannot simply count on being a good writer to get hired because journalism has morphed to include what have typically been seen as information technology skills. Real-time labor market information in the accompanying graphic illustrates the dramatic increase in demand for skills and analytics capabilities such as search engine optimization, JavaScript, CSS, HTML, and Google Analytics.

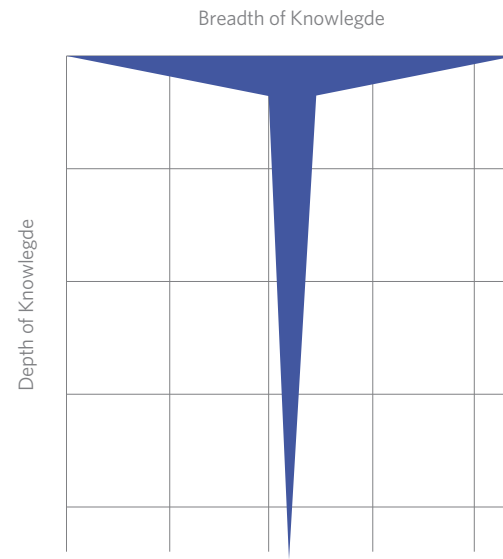
Students majoring in writing or journalism must understand that, while learning communication skills, they must also cultivate business and marketing abilities, including brand work, content development, market research, and even advertising. Those considering technical writing should be able to communicate software specifications fluently and may need to learn project management.

Skills matter a great deal, but the right combination of human + skills also depends greatly on the learners and the stage in which they find themselves as they seek to pivot between jobs or access new learning. For those about to make the first transition from college to work, we can see how stronger advising and career services are necessary earlier in the learning experience to guide them to the kinds of technical skills they'll need to acquire. Developing many of these human+ skills must begin early on—not right before graduation—with the active help of educators and other learning providers.

But there is no longer a single transition from schooling to work. As we try to make sense of a longer, more turbulent work life, we must anticipate that learning will have to be episodic and frequent. Workers will cycle through learning to acquire new skills or move between career fields—way beyond the two, four, or six years of higher education on the front end of our current work lives.

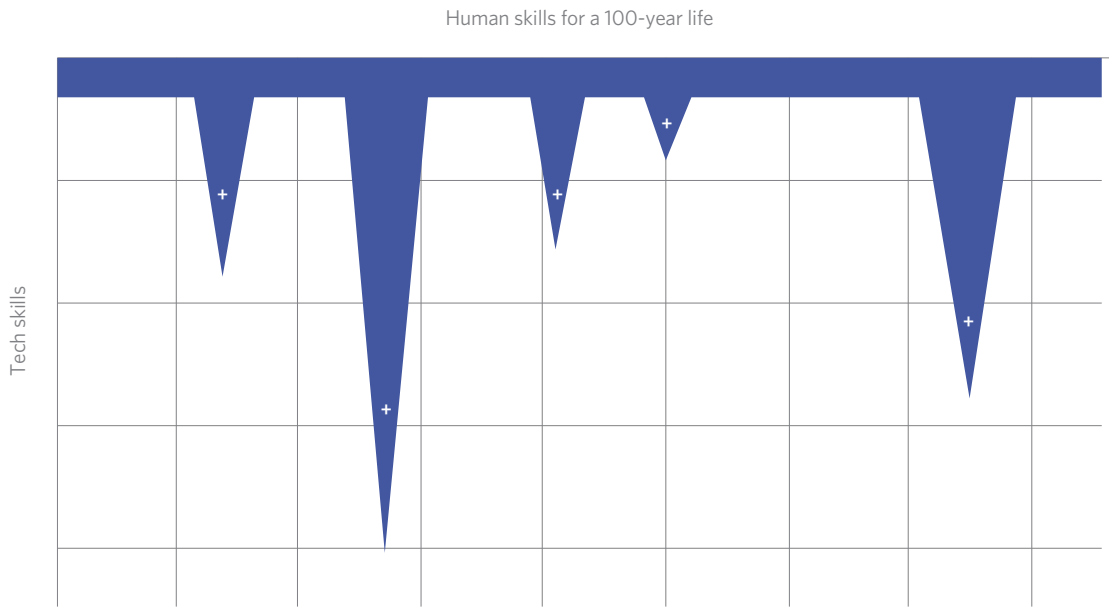
Adult workers can already sense that things are different now. The Pew Research Center found that 87 percent of adults in the workforce acknowledge that it will be essential or important for them to get training and develop new skills throughout their careers to keep up with changes in the workplace. (See page 26) Future workers will need to "virtuously combine technical and interpersonal tasks" repeatedly throughout their working lives, notes David H. Autor, an economist at the Massachusetts Institute of Technology, and make learning and continual skill development a way of life. Think back to the 1990s, when the concept of a T-shaped person entered the lexicon. The T-shape describes an individual's combination of breadth of knowledge with depth of technical expertise.

T-SHAPED INDIVIDUALS COMBINE BROAD KNOWLEDGE AND SKILLS WITH DEEP EXPERTISE IN A NARROW FIELD



But, in a world in which our work lives become longer and more unpredictable, this figure will change shape and turn jagged as an individual moves through life and acquires knowledge along the way.

RETURNING TO LEARNING THROUGHOUT AN EXTENDED WORK LIFE



Unfortunately, today's workplaces often aren't flexible enough to accommodate this growth.

Time off for new learning is rarely viewed as a boon to employers, so workers are often reluctant to take a break from working. Hiring managers will question: Why is there a gap in this resume? As a result, most workers try to squeeze in night or online classes on top of all of their other responsibilities. The opportunity costs, or forgone wages in pursuit of education, are simply too high.

Most working adults expect to receive training from employers, but few actually do. Peter Capelli, a professor at the Wharton School at the University of Pennsylvania, puts it bluntly: "What employers really want are workers they don't have to train," he writes. "Companies simply haven't invested much in training their workers." He notes that in 1979, young workers got an average of 2.5 weeks of training a year, but by 1995, that amount was just under 11 hours, with workplace safety as the most common topic—not building new skills.

Employers want workers who bring human skills into particular career fields and supplement them with technical skills that reflect current industry standards. But they largely look to outside candidates instead of skilling up from within.

Most working learners recognize the power of combining tech fluency with human skills on their own as their careers progress. But to keep up with the rapid pace of change, employers must redesign their practices to give workers access to learning.

The challenge is that few companies actually know the talent and capabilities of their workers. Employers tend to rely on degrees and credentials—things that transcribe, formalize, and codify our learning as comprehensible packages—while most of their employees' life- and work-based knowledge remains invisible and unrecognized.

A longer work life will mean that companies must engage differently with workers than ever before. Employers will face fluctuations in their talent pools, as more workers take on more caregiving activities. Harvard Business School professor Joe Fuller says that as many as 73 percent of employees report having some caregiving responsibility, and that 1 out of 3 leave paid work to attend to family members. These societal demands will only increase as our graying population grows.

At the same time, we will have more workers over the age of 50—a pool of deeply experienced human capital. How will employers harness this variability in abilities across the life span and consciously build age-diverse teams that strategically balance the strengths (and mitigate the weaknesses) of different-aged workers?

THE MOST VALUABLE WORKERS NOW AND IN THE FUTURE WILL BE THOSE WHO CAN COMBINE TECHNICAL KNOWLEDGE WITH HUMAN SKILLS AND ADAPT TO THE CHANGING NEEDS OF THE WORKPLACE.

We need a new learning ecosystem that addresses these evolving demands for new knowledge and training through our longer work lives. Although the notion of lifelong learning is rightly seen as a future demand, we have not made the necessary investments into the systems and infrastructure it will require.

The simple fact that our work lives may extend will force each of us to reevaluate and reimagine the on-ramps and offramps in and out of learning and employment. Working learners will have to combine their uniquely human skills with in-demand technical skills in order to thrive in the future. Where will they develop those skills?

It's time to begin building a new learning ecosystem *now.*

THE TAKEAWAY

We need a new learning ecosystem that addresses the evolving demands for new knowledge and training throughout our longer work lives.

Americans and Lifetime Learning in the Knowledge Age

The shifting economic landscape is reshaping work and society and affecting the way people think about the skills and training they need to get ahead

BY KIM PARKER AND LEE RAINIE

As the economy moves deeper into a knowledge-focused age, significant changes are reshaping the American workplace. The fastest-growing occupations demand an evolving set of skills, and that new reality is prompting many workers to upgrade their own skills and contemplate learning as a lifelong commitment. This is inspiring a new, societywide consideration of where learning and retraining should occur and what the role of colleges and other higher education institutions may be in the future.

Our 2016 Pew Research Center survey, conducted in association with the Markle Foundation, found that the clear majority of U.S. workers recognize these new demands, telling us that their future job success may well rest on learning new skills. They may be on to something: In an analysis of government jobs data, we found that employment has been growing faster in those jobs that require additional learning and experience.

A more recent center analysis of government data, released in early 2020, showed that job growth has been more robust in occupations that rely most heavily on social, fundamental, and analytical skills. From 1980 to 2018, employment more than doubled in jobs where social skills (such as negotiating and instructing) and fundamental skills (critical thinking and writing) are most important. And employment in jobs that rely on analytical skills (programming and complex problem solving) increased nearly as sharply. Over the same period, employment in all jobs grew at a rate of 58 percent. Separately, experts we canvassed in 2019 predicted that artificial intelligence tools will increasingly take over repetitive and physically taxing labor in the years ahead, exacerbating the decline in manufacturing employment.

The national survey shows how deeply Americans have internalized these trends. Of course, the economic situation now is somewhat different from three years ago. Still, the findings reflect, in broad terms, how workers and those aspiring to work see the jobs environment.

Many see personal upgrading as a constant: More than half of adults in the labor force (54 percent) said it will be essential for them to get training and develop new skills throughout their work life to keep up with changes in the workplace. In addition, 35 percent of workers, including about 3 in 10 adults (27 percent) with at least a bachelor's degree, said they don't have the education and training they need to get ahead at work. Many are already taking action or being required to do so by their employer or by licensing requirements in their jobs: In this survey, 45 percent of employed adults said they got extra training to improve their job skills in the past 12 months.

It's the most highly educated workers who feel the strongest sense of urgency when it comes to seeking out new skills and training. Some 63 percent of adults with a bachelor's degree or higher level of education feel they will need to keep advancing their skills throughout their career, compared with 45 percent of those with no college experience.

Young adults are more likely than their older counterparts to see skills and training as essential (61 percent among those ages 18-29), perhaps because of the longer trajectory they have ahead of them. Even so, 56 percent of those ages 30-49 said ongoing training will be essential for them, as did roughly 4 in 10 workers ages 50 and older.

For some people, acquiring new skills won't just be a necessity in the future: Thirty-five percent of working adults said they need more education and training now to get ahead in their job or career. A plurality of those who said they need more training said the best way for them to get that training would be through additional formal education. This is true across levels of educational attainment: Four-year college graduates said they would pursue a graduate degree, two-year college graduates said they would try to get a four-year degree, and high school graduates said they would go to college.

Americans think the responsibility for preparing and succeeding in today's workforce starts with individuals themselves: Roughly 7 in 10 (72 percent) say "a lot" of responsibility falls on individuals to make sure that they have the right skills and education to be successful in today's economy. Sixty percent believe that public K-12 schools should bear a lot of responsibility; 52 percent say colleges should have a lot of responsibility; and 49 percent believe that employers should have a lot of responsibility. After that, 40 percent assign a lot of responsibility to state governments, and 35 percent say the federal government should assume a lot of responsibility.

When people think about what it takes for workers to be successful these days, large majorities rank

Americans think the responsibility for preparing and succeeding in today's workforce starts with individuals themselves.

a mixture of technical and "soft skills" as critical, including detailed understanding of how to use computers (85 percent say this is "extremely" or "very" important), ability to work with those from diverse backgrounds (85 percent), training in writing and communications (85 percent), and access to training to update skills (82 percent).

When workers were asked about the skills they rely on most in their jobs, interpersonal skills, critical thinking, and good written and spoken communications skills topped the list. Those workers who rely heavily on these skills reported that they acquired them in different settings. Among workers who said that having interpersonal skills is extremely or very important for them to do their job, some 35 percent said they learned those skills on the job, but a sizable share—38 percent—volunteered that they taught themselves those skills or came by them naturally.

For those who rely on critical thinking skills, the workplace is an important training ground: 46 percent say they learned these skills on the job, while about 1 in 5 (19 percent) say they acquired these skills in their formal education, and a similar share (18 percent) say they gained these skills through life experience.

Among workers who said written and spoken communications skills are important for their job, 42 percent said they picked up these skills through their formal education, while 30 percent said they learned these skills through work experience. An additional 12 percent said they learned these skills through life experience or were self-taught.

The role of college is being debated: Americans have somewhat mixed attitudes about the effectiveness of traditional four-year colleges and other higher education institutions. On a personal level, many college graduates describe their own educational experience as having a generally positive impact on their personal and professional development. About 6 in 10 college graduates (62 percent) with a two-year or four-year degree think their degree was very useful for helping them grow personally and intellectually, while roughly half think it was very useful for opening up job opportunities (53 percent), or for providing them with specific job-related skills and knowledge (49 percent).

Yet even as many college graduates view their own educational experience in positive terms, the public as a whole—including a substantial share of college graduates—expresses reservations about the ability of

higher education institutions to prepare students for the workforce more generally.

Just 16 percent of Americans think that a four-year degree prepares students very well for a well-paying job in today's economy. An additional 51 percent say colleges prepare students somewhat well for the workplace. The verdict on two-year colleges is similar: 12 percent think that a two-year associate degree prepares students very well, and 46 percent say this type of degree prepares students somewhat well. When it comes to professional or technical certificates, 26 percent of adults say these prepare students very well for well-paying jobs, and 52 percent say somewhat well. These findings tie to previous Pew Research Center work showing that noteworthy majorities of adults think that colleges fail to provide students with good value for the money and that college is too expensive.

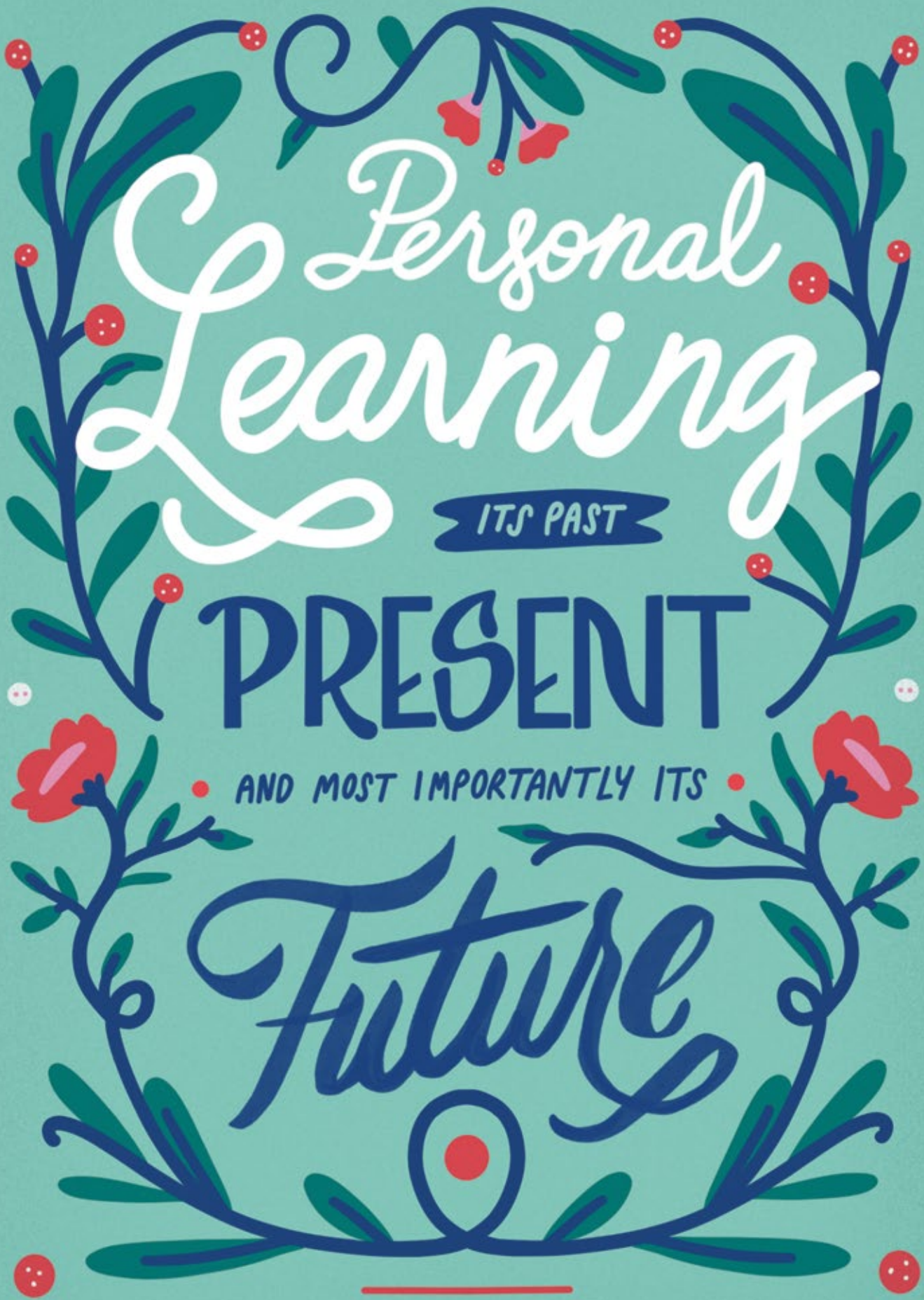
Views on certificate programs are more positive overall, with 26 percent of all adults saying a certificate in a professional, technical, or vocational field prepares someone very well for a well-paying job. Those without a college degree give these programs particularly high ratings: 44 percent in this group say these types of programs prepare people very well, compared with about a quarter (27 percent) of those with a high school diploma and a similar share of those with some college (22 percent), a two-year degree (28 percent), or a four-year degree or more (22 percent).

Workers have mixed views on the extent to which their own credentials and qualifications match up with the requirements of their job. Some 41 percent say they have more qualifications than their job requires, compared with 50 percent who think they have the right amount of qualifications and 9 percent who say they are underqualified.

Finally, we asked working Americans if they thought someone with less education than they had could develop the skills and knowledge needed to do their job. A solid majority (73 percent) said "yes." Among those with a bachelor's degree, 65 percent said someone with less education could learn to do their job, and the shares were significantly higher among those with some college (82 percent) and those with a high school diploma (80 percent). Even so, job seekers take minimum requirements seriously. A third of those who do not have a four-year college degree have elected not to apply for a job they felt they were qualified for because it required a four-year degree, suggesting that employers may be missing out on a pool of potential workers.

THE TAKEAWAY

At a time when employment is rising faster in jobs requiring more education, training, and experience, the vast majority of American workers say that learning new skills is important for their future success.


Personal
Learning
ITS PAST
PRESENT
AND MOST IMPORTANTLY ITS
Future

The lessons each of us gains from life experience are finding their places in the academic world and providing new foundations for lifelong learning as people live longer and workplace demands evolve.

BY PETER SMITH

Historically, experiential learning or personal learning was just that: personal, random, and virtually undefined. In terms of formal education, it was all but ignored. But during the last half-century—and especially in the last decade—personal learning is finally being recognized for its academic and economic value beyond what it means for an individual's own growth and worldview.

And where once the formal education system that awards degrees and certificates supported personal learning only haltingly and inefficiently, today new technology and online resources are transforming how this kind of learning is recognized and validated—and how it can help people tailor their learning needs throughout their lives. These are essential developments, because personal and lifelong learning provides indispensable skills for the workplace.

To begin, let's be clear on the meaning of personal learning: Like all learning, it leads to the acquisition of new knowledge and concrete skills. It also drives changes in attitudes and behavior as people continually grow and evolve. Both aspects are important elements in one's career and social and civic lives. What differentiates it from more formalized education is that it is based on how we live our daily lives and the lessons we take from our experiences—from personal insights we might gain from, say, a traumatic event such as the death of a spouse, to skills we might attain as a caregiver to an aging parent, to new knowledge gleaned from workplace training sessions, and so many experiences in between.

Personal learning, of course, is not a new phenomenon. Consider the phrases and stories laced throughout American folklore that celebrate the lessons of life: Live and Learn, The School of Hard Knocks, Older but Wiser.

The message is clear. You can learn from your lived experience. And there are strong and useful connections between this knowledge, personal learning, and success.

But how to measure this kind of learning so it can be recognized and more fully developed? Allen Tough, the noted Canadian educator and researcher, began to document these human truths more formally with his career-long research on personal learning, beginning in the early 1960s. Tough found that people learn actively and purposefully all the time. In fact, he found that the median adult spends about 15 hours a week on highly specific learning projects outside of college.

Consider some possible sources of this learning. You are learning when:

- You look at videos on Facebook about child development and discuss parenting with a friend to better nurture the children in your life;
- Your supervisor at work demonstrates a new technique, or the company brings in a presenter to explain new technological or process developments;
- You learn how to use a new computer program;
- You develop a health and diet plan to keep more physically fit while eating well;
- You face a humbling event in your life that causes you to reflect on your own behavior and make some changes;
- You learn how to play an instrument, engage in therapy, or learn a new sport;

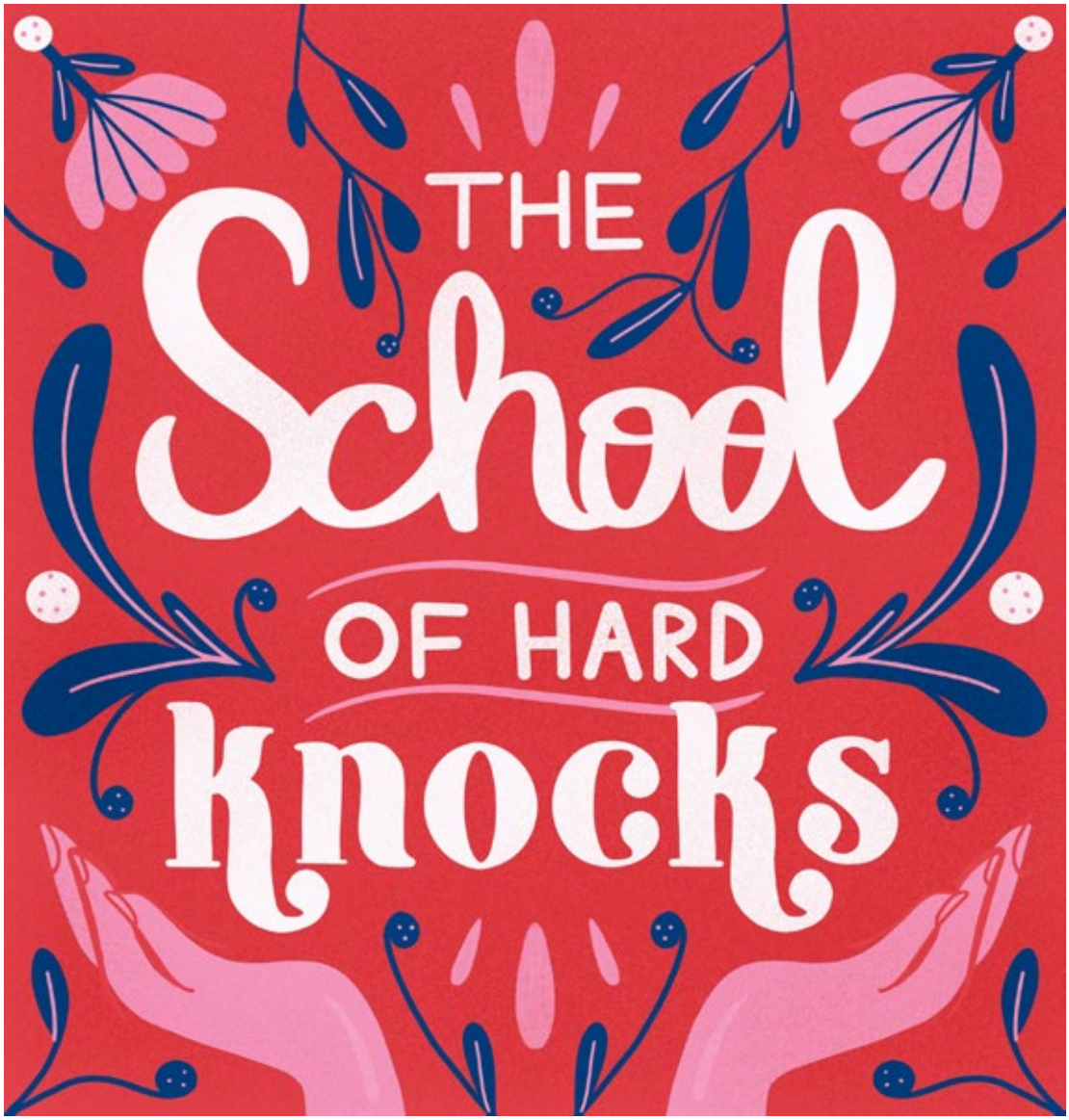
- You come to a turning point in your life and use it to transition into a new future.

This personal learning has three important characteristics:

- *It is personal.* You often learn alone or in small groups in an informal setting.
- *It is purposeful.* You always learn for a reason.
- *It is powerful.* Personal learning is continuously changing you, developing your behavior, skills, knowledge, and attitudes into a constantly evolving set of hidden credentials.

But there is another, more difficult truth about personal learning: You tend to internalize it and, in the process, "forget" the learning you have done. As Tough wrote in his 1971 book, *The Adult's Learning Projects:*

"If you are like most people, you haven't seriously considered the possibility that you have achieved significant personal learning, let alone tried to put a value on it. But it is there throughout



your life, an iceberg of knowledge, but only revealing tips of ability while leaving the larger body of knowledge and ability hidden beneath the surface. If you do not understand and value your experience and the learning it contains, you can be imprisoned by it, unconscious of its influence on your worldview, your skills, and your knowledge. *Losing track of your learning and its value means losing track of who you are becoming and why.* (*Italics added.*)

We know that people undertake a median number of 15 learning projects a year totaling about 800 hours. But interestingly … *when asked about their learning efforts, many of our interviewees recalled none at first. As the interviews proceeded, however, they recalled several recent efforts to learn."* (*Italics added.*)

Since personal learning is, well, personal, here is an example from my own life that illustrates those findings.

On a lazy winter Sunday afternoon in the mid-1980s, I was sorting through old photographs. I came across a picture of me cradling one of my sons, taken at least a dozen years earlier, when I was president of the Community College of Vermont.

As I looked at the smiling person holding the infant in the photo, I felt a physical shock as I realized that I was looking at a stranger. This was not the person I saw in the mirror each morning when I shaved. This was someone much younger, insulated by his own naivete, mostly unscarred and unseasoned. The man in the picture had not known failure in business, had not suffered defeat in politics. In the 12 years since that photo was taken, I had developed and evolved into a different version of myself.

The events of the intervening years had rushed by: my father's death, becoming a father myself for the third time, elections won and lost, and serving in statewide political office. There was a chasm of unreflected experience between the man in the picture and the person I had become. I realized that I had become, for better or for worse, a new and more nuanced person. And I needed to get to know this Peter Smith better.

There are countless similar stories, many with more direct applications to preparing yourself for the workforce. A student I knew at the Community College of Vermont, Jason DeForge, had not finished college in his younger years because of family circumstances and plunged into work. He grew in his job, and one day a supervisor noticed him leading a training session. The supervisor was impressed by his abilities and urged him, 20 years after leaving college, to return to school. The initial coursework had DeForge prepare an assessment of his experiential learning. It was a revelation, he recalled:

KNOWLEDGE GAINED THROUGH PERSONAL LEARNING CAN BE VERY VALUABLE WHEN APPLIED IN THE WORKPLACE.

"I was totally divorced from any knowledge of my personal learning. Had no idea what was in there. But as I got going, I saw my life rolling out in front of me. … I had worked at a print shop, and I discovered that the learning I did there was equal to some early college-level courses. The big difference was this: When you learn something for the first time in college, it is an abstraction. … When you learn it at work … it is in a real-world context. This has been a life-changing experience for me."

These sorts of assessments remind us that personal learning is present, powerful, and there to be harnessed for economic, social, civic, and personal gain in millions of adults. Think of it this way: There is an enormous untapped source of talent and capacity walking around this country. And if it is tapped, not only will the individuals whose learning is being respected benefit—socially, civically, and economically—but our society will benefit as well.

Happily, there has been significant change in the ways we can generate, support, and harness personal learning. As we have moved toward an information-rich society, there have been two major developments.

The first is that the traditional academic conceits that belittled personal and experiential learning as being less valuable than college-

based learning are crumbling. In fact, there is mounting evidence that suggests that personal learning is a critical (and majority) component in workplace and personal success in many cases. The Strada Institute for the Future of Work, where I am on the advisory board, is plumbing the depths of the many ways in which knowledge gained through personal learning can be very valuable when applied in the workplace.

The second development is that technologies, applications, platforms, and dynamic databases are emerging that will be able to identify, support, and validate personal learning at a scale and with precision that was previously unimaginable. At the University of Maryland Global Campus, where I currently work, we are developing the capacity to scale assessment of prior learning and map it to learning outcomes in the curriculum through a program called Qualified.

This marks a new phase of how larger society is recognizing the value of personal learning. Whereas personal learning was once purely individualistic and random, the late 1940s saw the beginning of the progressive education

movement, which developed practices to organize the assessment of personal and experiential learning. These practices became institutionalized through such organizations as the Council for Adult and Experiential Learning. As important as those developments were, the new technologies will allow us to take the recognition of personal learning global.

There are also a number of services and practices already underway or in design that will support recognition of personal learning. These include algorithms that will analyze learners and provide feedback on their place in their learning journey and what gaps need to be filled, the creation of "continuous academic records" that will travel with people throughout life to record and value their learning, and the development of open education resources that, without cost, build microcredentials and degrees tailored to learners and their employers.

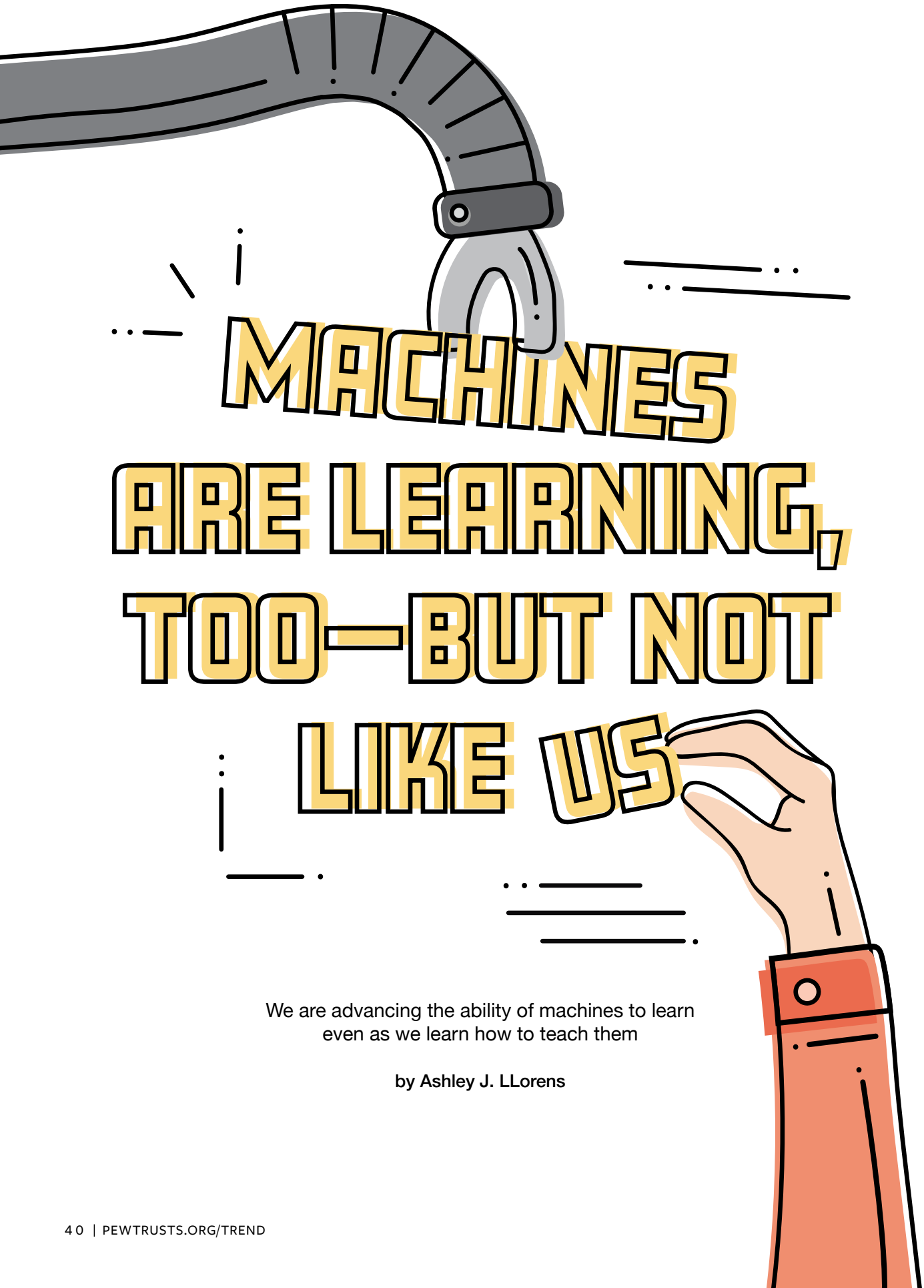
Fortunately, there is also an institutional foundation to build upon. "Adult-friendly" colleges such as the University of Maryland Global Campus develop learning programs around the needs and the existing strengths of the adult learner. And when I interviewed the presidents of several similar colleges, they agreed that a closer connection between learning and work was becoming essential for the future of both.

There also are many new organizations and businesses joining the field with the express intent of removing the barriers between learning and work by building on and supplementing what adult learners already know. Some are creating enormous databases of credentials and employing common language to identify the commonalities among different credentials. The common denominator that runs through all of these and many other new efforts is that the learning you do outside of college and away from formal educational programs is being recognized as valuable both personally and in the workplace. For example, online platforms are available that identify the needs of a learner, match learning resources to those needs, and then match the learning done with employers' needs for new employees.

While these systems and supports are being established, it is essential that people take responsibility for their personal learning. We all should value the chances life gives us to grow. We can embrace the new technologies and programs to get better information about how our skills align with the needs of the workplace. And we can learn to recognize the turning points in our lives as opportunities for change and improvement.

THE TAKEAWAY

A closer connection between personal learning and work is becoming essential for the future of both.



MACHINES ARE LEARNING, TOO—BUT NOT LIKE US

We are advancing the ability of machines to learn even as we learn how to teach them

by Ashley J. LLorens

Despite amazing progress in our understanding of the brain and how it works, we have yet to develop a rigorous scientific understanding of how we translate experience into knowledge—in other words, how we learn. And even as we continue to unravel the mysteries of our own cognition, we are beginning to teach machines how to learn, searching for ways to enable robots and other intelligent systems to begin to translate experience into knowledge that can guide their future actions.

Recent advances in the field of deep learning, an approach to machine learning inspired by the human brain, have catalyzed an explosion of innovation. The potential for artificial intelligence to improve our lives is growing with our ability to tap big data and provide seemingly boundless amounts of information to machines. For all the excitement, however, it is time to sound a note of caution. As we have seen in the fatal accidents caused by self-driving cars, we are at an early stage in which machines are beginning to learn faster than we are able to guide the learning process and rigorously assess its outcome.

One lesson at this precarious moment is this: To realize the promise offered by artificial intelligence, we must mitigate risks. And key to doing that is advancing the ability of machines to *learn* at the same pace as our ability to *teach*.

Computer programmers have long taught machines by developing precise instructions, mapping inputs to specific outputs. When a program can turn these inputs into the desired outputs repeatedly and reliably, voila, the developer has successfully automated a physical or cognitive task—often one that had been previously performed by a person. For example, many of us are able to do our taxes online thanks to these kinds of traditional computer programs. More sophisticated examples would be operating systems in a personal computer or software systems in spacecraft that can autonomously detect and address technical issues.

Despite tremendous advances in machine learning, our most powerful machines still must rely heavily on information—the inputs—that humans provide. Let's consider computer vision systems that are needed for self-driving cars and high-end security systems. These systems must be able to differentiate objects in images and video. Yet computer scientists don't know how to write the very precise instructions necessary for assigning the color values of hundreds of thousands of pixels in a video feed to the labels of the objects in the video—at least not repeatedly and reliably. Machine learning makes this possible when a programmer uses a particular kind of algorithm—basically, a set of instructions for the computer—that lets the machine effectively program itself to perform the task. Yet, it still requires human insight to make the choices about data selection and other factors that affect the outcome of the learning.

As machines are learning to learn, we are just beginning to understand how to teach them.

We must ask ourselves these questions: Under what conditions can a machine outperform a person at a particular task and by how much? If a machine learning algorithm can be thought of as a student, how do we best design that algorithm's learning curriculum? How do we enable it to take experience gained from a training dataset and apply it to the complexities of the real world? And to continue our education analogy, what final exams should that system have to pass before it can be trusted to perform a task—such as driving a car or performing surgery—where the cost of mistakes may be measured in people's livelihoods or even human lives?

IF A MACHINE LEARNING ALGORITHM CAN BE THOUGHT OF AS A STUDENT, HOW DO WE BEST DESIGN THAT ALGORITHM'S LEARNING CURRICULUM?

Teaching a machine requires us to specify the outcomes we desire with extreme accuracy while avoiding the temptation to underestimate the human influence inherent in the process. Let's go back to our computer vision system example: Specifying outcomes begins with a developer providing millions of photos along with the correct labels of the objects they portray. The algorithms that will learn to classify the contents of these images may contain thousands or even millions of parameters. The machine's "learning" occurs as these parameters are selected through a process of optimization usually involving extensive trial and error on the part of both the human and the machine. Through this process, people are shaping the way that machines interpret data and how they perceive the world. Machine learning developers encode numerous biases in the algorithms they develop—some explicit and intentional, many more implicit and often unintentional. Without any common sense of their own, machines can't tell the difference.

Let's try to explain this with a specific example again using the computer vision system: Suppose we'd like to develop a computer vision algorithm that can recognize vehicles on the streets of Chicago. If we venture out on a sunny day to collect photos of sedans, motorcycles, bicycles, and other vehicles, that dataset will be biased toward the conditions under which the photos were collected. Those include the angles of the sun in the sky when the vehicles were recorded, the positions of the video camera relative to the vehicles, and the extent to which the vehicles are partially blocked by other objects in the scene. By themselves, biases are not inherently good or bad—the question is whether specific biases are appropriate for the problem at hand. In our example, the bias may be acceptable in Chicago, but if we want to use this algorithm in a rural setting where the vehicles could be different—say, farming equipment or tractors on the road—then it could be harmful. Getting more photographs under more varied conditions—i.e., creating a larger and more diverse dataset—certainly would help, but data alone will never fully address the limitations of our current technology.

These limitations mean that algorithms can also "learn" to recognize inaccurate correlations that result from an unlucky series of events or, even worse, intentional tampering. For example, if all the sedans we record in Chicago happen to be red, our algorithm would learn to rely on this distinction as a defining feature. Consider now how this concern could translate to an algorithm that determines eligibility for a home loan. Without appropriate controls in place, correlations learned from data could reinforce deep-seated inequities in our society. When our human values—and societal ethics—are at stake, it is essential to ensure the right balance between machine learning and human teaching.

Of course, we know that undesirable human values and tendencies exist. At the criminal level or even the national strategic level, there are opportunities to exploit algorithms or create

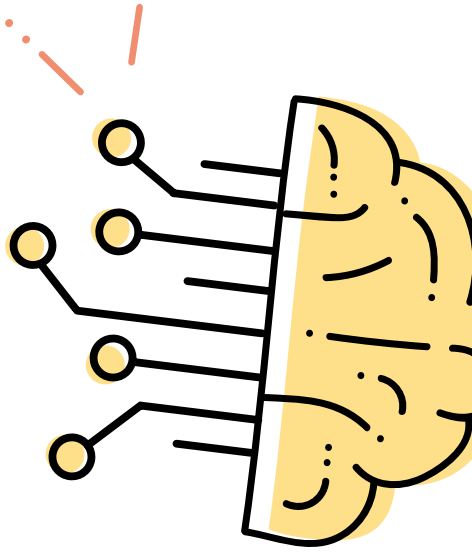
vulnerabilities in them for nefarious outcomes. A bad actor could add an image of a skull-and-crossbones onto the side of half of the sedans photographed for the Chicago database and mislabel these doctored cars as fire hydrants. This would poison the algorithm and create the opportunity for a vehicle with a skull-and-crossbones sticker to vanish in plain sight. The machine itself would neither find this transformation strange nor alert us if the fake hydrant began driving down the street. Even as modern machine learning propels incredible innovation, we're still learning about these inherent limitations.

In fact, as artificial intelligence continues to advance, there are growing concerns that we are creating increasingly powerful machines that may learn to pursue the goals we give them in undesirable or even catastrophic ways. Artificial intelligence luminary Stuart Russell muses about a superintelligent system that learns to stop climate change by reducing the number of people on the planet because science has shown human activity as a central cause of a warming Earth. Although artificial intelligence this powerful—if it's even possible—is a long way off, such doomsday scenarios underscore the importance of establishing a theoretical foundation for correctly specifying the outcomes—the goals—we hope machines will learn to accomplish.

Researchers are beginning to integrate language, geometry, physics, biology, and other foundations of human knowledge into machine learning algorithms. If this research pays off, it could simultaneously make machines smarter and more compatible with human intelligence. Connecting pattern recognition with descriptive language and geometric concepts, for example, could allow our computer vision algorithm not only to recognize a vehicle, but also to describe it. It could relay that a passing truck is "made of metal" and "carrying two passengers," and flag unexpected details like "missing a tire" or "driving backward." Such a system could more easily explain its decisions and actions and make correcting its mistakes as intuitive as holding a conversation. It might also be harder to fool through adversarial attacks.

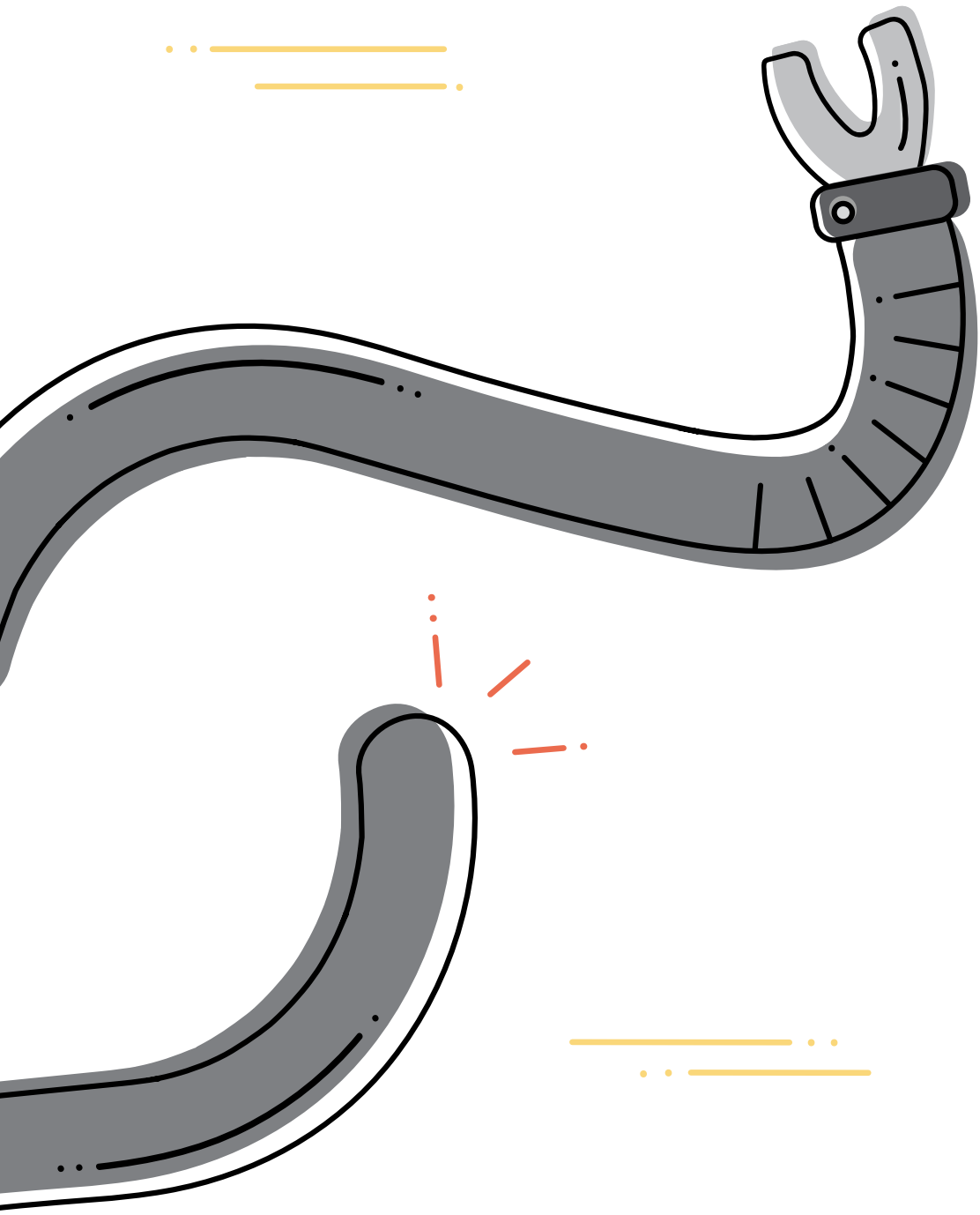
However, some researchers think that encoding knowledge about the world into a machine learning algorithm is a doomed enterprise and argue that creating more capable algorithms instead requires better mimicking of the structure of the human brain. Although today's deep learning algorithms contain layers of artificial neurons with interconnections that are somewhat analogous to synapses in the brain and can have millions of parameters, our brains have on the order of 100 billion neurons with 100 trillion synaptic connections. If we do one day succeed in developing an algorithm as complex as the human brain, its inner workings would be nearly impossible to understand. Could we ever reliably teach, test, and ultimately trust such a system?

TEACHING A MACHINE REQUIRES US TO SPECIFY THE OUTCOMES WE DESIRE WITH EXTREME ACCURACY WHILE AVOIDING THE TEMPTATION TO UNDERESTIMATE THE HUMAN INFLUENCE INHERENT IN THE PROCESS.



Creating a machine that achieves or surpasses humanlike intelligence remains well beyond the limits of our current technology. In the near-term, we must carefully consider the roles and responsibilities of people throughout the life cycle of an intelligent system—from design and development through testing and deployment.

If we one day reach the point where teaching machines to perform complex tasks such as understanding a scene is no longer necessary, it may be that all we then have left to teach them are our values and long-term goals for humanity. A task that important is one we should never automate.



THE TAKEAWAY

To realize the promise offered by artificial intelligence, we must mitigate risks and consider the roles and responsibilities of people in its development.

Roozbeh Kiani: How the Brain Learns

Roozbeh Kiani is an associate professor of neural science and psychology at New York University and a 2016 Pew biomedical scholar.

WHEN WE THINK ABOUT LEARNING, WE OFTEN CONJURE UP IMAGES OF SITTING IN A CLASSROOM, NOSE BURIED IN A TEXTBOOK. BUT IS THAT WHAT NEUROSCIENTISTS STUDY WHEN THEY INVESTIGATE LEARNING?

A good portion or maybe even the majority of what we do in our daily lives is not based on knowledge that is acquired in a classroom. Most of the learning that we do, the learning that shapes our behavior, we acquire by living our life and interacting with the environment around us. The associations we make, habits we build, experiences we recall, and skills we acquire—like riding a bike or playing the piano or being able to distinguish one face from another—these are all types of learning. For these fundamental types of learning, we know a fair amount about the underlying neural mechanisms.

Now, when we consider forms of learning that require direct acquisition of knowledge—like how we learn physics or literature or math in a classroom—these higher levels of learning are significantly less understood. It would be rewarding if what we discover about the mechanisms of learning put us in a position to have better curricula and better learning environments.

WHAT IS OUR CURRENT LEVEL OF UNDERSTANDING ABOUT HOW LEARNING TAKES PLACE IN THE BRAIN?

The human brain has about a hundred billion neurons. And the number of connections each neuron makes ranges from hundreds to maybe 10,000. So we are talking about networks that are very very vast. These large networks can be broken down into circuits that interact with each other to communicate and store information. Learning is associated with changes in the neural responses within these circuits in different parts of the brain. To change the response of the circuit, you have to modify the strength of the connections—or synapses—between one neuron and another. For many types of learning, for example the acquisition of some skill, new synapses may form or existing synapses may become stronger (or in some cases weaker). As these synapses are modified through learning, the knowledge is ingrained in the brain and influences the future operations of the circuit. We're now beginning to understand how modification of the activity of one circuit during the learning

process can influence other circuits in the brain. The more we discover, the more we realize how much we still have to learn!

YOU HAVE BEEN STUDYING MONKEYS AS THEY LEARN TO VISUALLY DIFFERENTIATE BETWEEN DIFFERENT SHAPES. WHAT HAS YOUR WORK REVEALED ABOUT HOW CIRCUITS OPERATE IN TANDEM AS AN ANIMAL ACQUIRES A NEW SKILL?

We track the responses of neurons in different parts of the brain throughout the learning process to find out where in the brain the learning takes place—and how. What we find is that neurons in the planning areas of the brain—like the frontal cortex—are the first to change their responses in a way that reflects the time course of learning. The information is then transmitted, with a little bit of lag, back to the visual cortex, the area dedicated to processing patterns of light that enter the eyes. So the brain is using neural connections within the visual cortex as a longer-term memory system for the acquired knowledge.

It's as if, when the training begins, the animal has to actively think about what it's learning. But as the animal practices more and more, that knowledge is sent to the visual cortex, which is involved in the earlier stages of information processing. When the knowledge is stored there, it becomes a more automatic form of behavior for the animal. So the animal doesn't have to push itself to see the differences in shapes—the differences just emerge, the same way that a parent can distinguish between identical twins without having to pay a lot of attention to their faces.

A similar thing happens when people are learning to drive. During the initial learning process, drivers are very consciously and actively involved in the task. But as they practice more and more, the information is transferred to regions in the brain that enable automation of the task, so we can have a conversation and drive without thinking about each of our actions.

DO THESE SAME PROCESSES TAKE PLACE AS BABIES LEARN?

We have a toddler at home and this past year and a half has been educational for me observing our son learn. As an adult, it's easy to forget what it actually takes to develop even the most trivial behavior, for example the brain's motor program required for walking. But then you observe a toddler try to stand up and walk. Our son is at the stage where everything is very conscious and effortful and full of mistakes. He falls all the time! But in a few months or a year from now he will be walking around without even thinking about it. This is how the brain works and it's amazing to watch. Moving forward there's going to be a strong motivation for me to design new experiments to pursue lessons I'm learning from our son as he grows.

OVER THE PAST 20 YEARS, RESEARCHERS HAVE DEVELOPED INCREASINGLY SOPHISTICATED METHODS FOR MANIPULATING THE ACTIVITY OF INDIVIDUAL NEURONS. HOW ARE THESE TECHNIQUES BEING USED TO PROBE THE MECHANISMS OF LEARNING AND MEMORY?

Some labs are using these techniques to induce new memories or to tamper with existing memories in mice. For example, if you condition mice to associate a certain sound with a mild foot shock, certain circuits of neurons will modify their response properties. Now if you identify those neurons and change their response properties, you can potentially erase the memory that has been stored there. This is a very exciting direction for research because if it could be expanded into a practical tool, that could be used to help patients suffering from conditions like post-traumatic stress disorder. We are not at the stage where we can replace memories in people. But if we continue to refine the tools that we have, maybe at some point it will lead to artificial management of memory in a way that could help patients.

LEARNING REQUIRES...

LEARNING REQUIRES FAMILY

By Alejandro Gibes de Gac

Not long after graduating from college, I joined Teach for America and became a first grade teacher in Philadelphia's most impoverished barrio. In my students, I saw myself; and in their parents, I recognized my own. The connection was deeper than even our shared language, complexion, and experience of poverty. My students' parents gazed at their children with the same unconditional love, unbridled optimism, and unwavering commitment with which my parents gazed at me. The same eyes with which my sister looks at my newborn niece. And yet my new school—and, more broadly, our system—seemed to approach these parents as liabilities rather than assets. The more deeply I became involved with education, I realized that instead of proactively inviting families into the learning process, schools serving low-income communities tend to focus inwardly and exclusively on classroom instruction.

Picture a child's time as an orange. Their classroom experience—just 25 percent of their waking hours—is a small wedge from which the education sector is fixated on squeezing more and more juice. So I became interested in the complementary question: How can we juice the rest of the orange?

That has meant figuring out how we could enlist the single greatest—but most underutilized—natural

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LEARNING REQUIRES REMEMBERING

By Pooja K. Agarwal, Ph.D.

When you walk into my classroom on a Monday morning, you'll see students hard at work. Silent, heads down, writing furiously, concentrating. Are they taking an exam? Quite the contrary.

On the very first day of the semester, I explain to my students at the Berklee College of Music that in my psychology class, there are no midterm exams, final exams, or papers. Immediately, they're sold. But when I tell students they'll be practicing their knowledge in our class, I always get blank looks. What do you mean, "practicing our knowledge?"

Of course, musicians know they have to practice their instruments—from voice and piano to guitar or saxophone—in order to learn and improve. They spend hours taking lessons, practicing independently, and performing every week. For musicians, practicing is like breathing: automatic and necessary. As musicians have known since the advent of music, when you practice what you know, you know it better. After the initial confusion, my students catch on that practicing their knowledge works the same way as practicing their instruments.

In my classroom, Monday mornings are an opportunity for students to practice their knowledge. For example, students respond to the following questions:

- What's one thing you learned about neuroscience last week? Why is it memorable?

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LEARNING REQUIRES DESIRE

By Liz Beigle-Bryant

Seven years ago, I was laid off from my job as an administrative assistant at a major technology corporation. I was 55 years old.

While there, I learned to administer multiple team intranet sites through a then-new software platform that helps teams collaborate. After losing my job, I realized a lot of people would hire me if I specialized in knowing how to customize intranet sites and pages, so I decided to learn how to do that. Then, I realized I needed to learn other skills to support the collaboration software, so I decided to learn the principles of user design and how to code.

When I told my family what I was going to do to find a new job, they thought I was crazy. Nobody would hire someone my age to work with some kind of specialized technology or software, they told me. But I was determined to do it anyway. There's an old saying that you can't teach an old dog new tricks. I promised myself I'd turn that on its head.

After all, this was not a new endeavor for me: I'm a lifelong learner. I learn new things not because other people are telling me to learn them, but because I want to. It's an internal drive. I'm motivated to do it—and I'm motivated to follow through.

I taught myself the software program and the coding online. I found a website that offers lessons in bite-sized pieces, which allowed me to learn a

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resource in education: parents' love for their children. Parents across the socioeconomic spectrum want the best learning outcomes for their kids; low-income parents often just need more guidance to juice the orange.

Classroom intervention without family engagement just isn't enough.

Growing up, I witnessed firsthand the lengths to which parents will go to offer their children a brighter future. In 1973, my father was imprisoned in his native Chile for writing a play that protested the country's dictatorial leadership. After years of torture, he made it out alive. He was luckier than many; even luckier, he met my mother while living in exile in Paris. My mother is from Puerto Rico, the youngest of 12, and the first in her family to go to college. Though it meant giving up their own dreams, my parents immigrated to the U.S. so that my sister and I could have better educational opportunities. It is the kind of sacrifice that only a parent would make.

My mother and father may sound erudite the way I describe them; however, my teachers all too often perceived them as pushy immigrants with broken English. They failed to see in low-income parents the very same love, commitment, and potential easily recognized—and celebrated—in higher-income parents.

Over the last decade, college-educated parents have quadrupled their investment of time and money in their children; parents without a college degree have only modestly increased their investment. These mothers and fathers want the best for their children, and they are capable of being effective advocates; however, they often need extra guidance to help break the cycle of intergenerational wealth inequality. Harvard University economist Raj Chetty's research has found that the best predictor of a child's educational success is not the quality of their school but, rather, their parents' income. To me, this means that classroom intervention without family engagement just isn't enough. And the data bears me

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- A few weeks ago, we talked about strategies to avoid "choking under pressure," or performing poorly under stress. What is one of those strategies? Have you used it before? Did it work?
- Design an experiment related to your own life. What would be your independent variables (what you would manipulate or compare) and your dependent variables (what you would ultimately measure)?
- Should humans conduct research on animals? Why or why not?

As a cognitive scientist, I practice what I preach. There are two specific research-based strategies I use in my classroom every day: retrieval practice and spacing.

In responding to these questions, my students engage in retrieval practice. When they retrieve their knowledge—that is, when they think back and pull information out of their heads—their long-term learning increases. More than 100 years of research demonstrates that retrieval practice is a powerful strategy to boost learning for all ages and in varied content areas (including math, science, and the humanities).

Learning requires remembering, and the way I see it, learning is remembering.

When we mentally travel back and have to remember something we learned, we might struggle a little bit. For example, what's the name of the first president of the United States? That's easy, but do you know the name of the fourth president of the United States? (Try to retrieve first, before you Google the answer.) The mental struggle you may have experienced is what scientists call a desirable difficulty. Struggling is good for learning, and yet we have a tendency to jump in during the learning process when a student seems stumped. In my classroom, I'm comfortable with silence. If students are struggling to little bit at a time and build on it. I didn't have to spend two hours in a classroom. I didn't even have to spend 40 minutes online. I could learn something new in five minutes, 10 minutes, or even two minutes. I'm comfortable with this way of learning. I learn visually and take notes, old-school style, because it helps me remember. Learning online or through the new educational services on the web really opens up the world.

There's an old saying that you can't teach an old dog new tricks. I promised myself I'd turn that on its head.

This desire for learning began when I was young. I was bullied as a kid. My favorite place became the library and books became my friends. It was natural for me to go learn something new. I came from a family without much money, and the only way that I could learn to do something was to find free access. As online learning became more popular and the internet became part of our everyday lives, I found I could access more learning tools for free.

In high school, the counselors discouraged me from studying computers in college, so I went to UC-Irvine and majored in art, with a minor in biology. When I got out, I worked for aerospace and petroleum companies drafting technical illustrations, publications, and engineering diagrams. When engineering software became the industry norm, I couldn't afford to buy it or take the expensive courses to learn it. I started volunteering at work to learn word processing, spreadsheets, and desktop publishing on a PC. This allowed me to transition to work as an administrative assistant. I continued to volunteer for any project that would let me learn new productivity software throughout the early 1990s.

After taking a long break to raise my son, I had to reenter the job market in the early 2000s, so I retrained myself by reading time management books

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out: Fourth grade literacy rates in America have not budged in 25 years—and the achievement gap remains unmitigated—despite trillions invested in classroom intervention.

In 2011, I decided it was time for the education sector to finally try parent engagement in a systematic, outcome-oriented way. I founded Springboard Collaborative the next year to close the literacy gap by bridging the distance between home and school. Our primary goal is simple: We coach teachers and family members to help their children read on grade level.

There is no smaller classroom than a family's living room, and there is no better way to personalize instruction than through a parent. What could be more personal than a parent and child sharing a book at bedtime? By training parents and teachers to collaborate in pre-K through third grade, Springboard puts kids on a path that closes the reading achievement gap by fourth grade. In a nation where you can draw a straight line from fourth grade reading scores to incarcerations rates, this changes lives.

Since its initial launch in Philadelphia, Springboard has grown its reach from 40 students to nearly 10,000 and has expanded to 12 additional cities. In schools that struggle to get 20 percent of parents to report-card conferences, our weekly family workshops average 91 percent attendance.

We're off to a good start but have bigger dreams. Springboard will help 100,000 students reach reading goals and 30,000 students read on grade level by 2023. To do that, we are innovating to grow our impact exponentially. We developed a franchising model that trains others to use Springboard's playbook. We also launched an app that helps families cultivate home reading habits. Finally, we are distilling the best practices from our programs and weaving them into a framework for embedding parent engagement into the school day, school year, and, ultimately, school culture.

In short, Springboard wants family involvement to be the new normal in learning. And when it is, our country will be raising a fully literate, upwardly mobile generation. That is the promise that brought my family to America, and it is a promise we can fulfill for millions more.

remember something, that's a good thing.

To further increase my students' learning, I ask them to retrieve concepts they learned a while back—a strategy called spacing. When I ask my students to retrieve something they learned in class last week, they give me the classic "deer in the headlights" look. I smile, and I reassure them that this is how learning works. When they first encounter spacing, they are a bit embarrassed by what they have forgotten from the previous week. But pretty soon, they're fascinated by what they do and don't remember. "Gee, I remember more than I thought!" Or "How could I have forgotten that?" Spacing is like returning to a foreign country after 10 years and picking up the language more quickly than you expected—or performing a song you haven't played in a long time, yet it feels like second nature.

Just like a weekly meeting with co-workers, I could start class by reviewing the "minutes" with my students: "OK, everyone, here's what we discussed last time." Instead, I combine retrieval practice and spacing in my classroom (and in meetings) by simply asking, "What did we discuss last time?" By switching from reviewing to retrieving, I no longer have to rehash or reteach content that was learned and quickly forgotten.

Zoom out with me for a moment. In one semester, I spend about 45 hours with my students. What do I want them to learn? Actually, I feel there's a more critical question at stake: What do I want them to remember?

For me, what's the value of learning without remembering? We remember life experiences from high school or college—a favorite professor, time spent with friends, the stress of exams—but we don't (and won't) remember every detail from every class. Don't we want students to walk away from 12 years, 16 years, or 20-plus years of education having remembered at least a little bit of what they spent their time learning?

Learning requires remembering, and the way I see it, learning is remembering. Each week, my students aren't writing furiously on an exam to prove what they've learned. They are retrieving to see what they know and to remember what they know. On Monday mornings, my students are practicing their knowledge, as simply as practicing their instrument.

to improve scheduling and meetings for executives and teams, and went to work as an administrative assistant. I learned a lot about strong collaboration, communication, and following through on tasks. It's amazing how many soft skills, such as working well with people, are actually needed in a job.

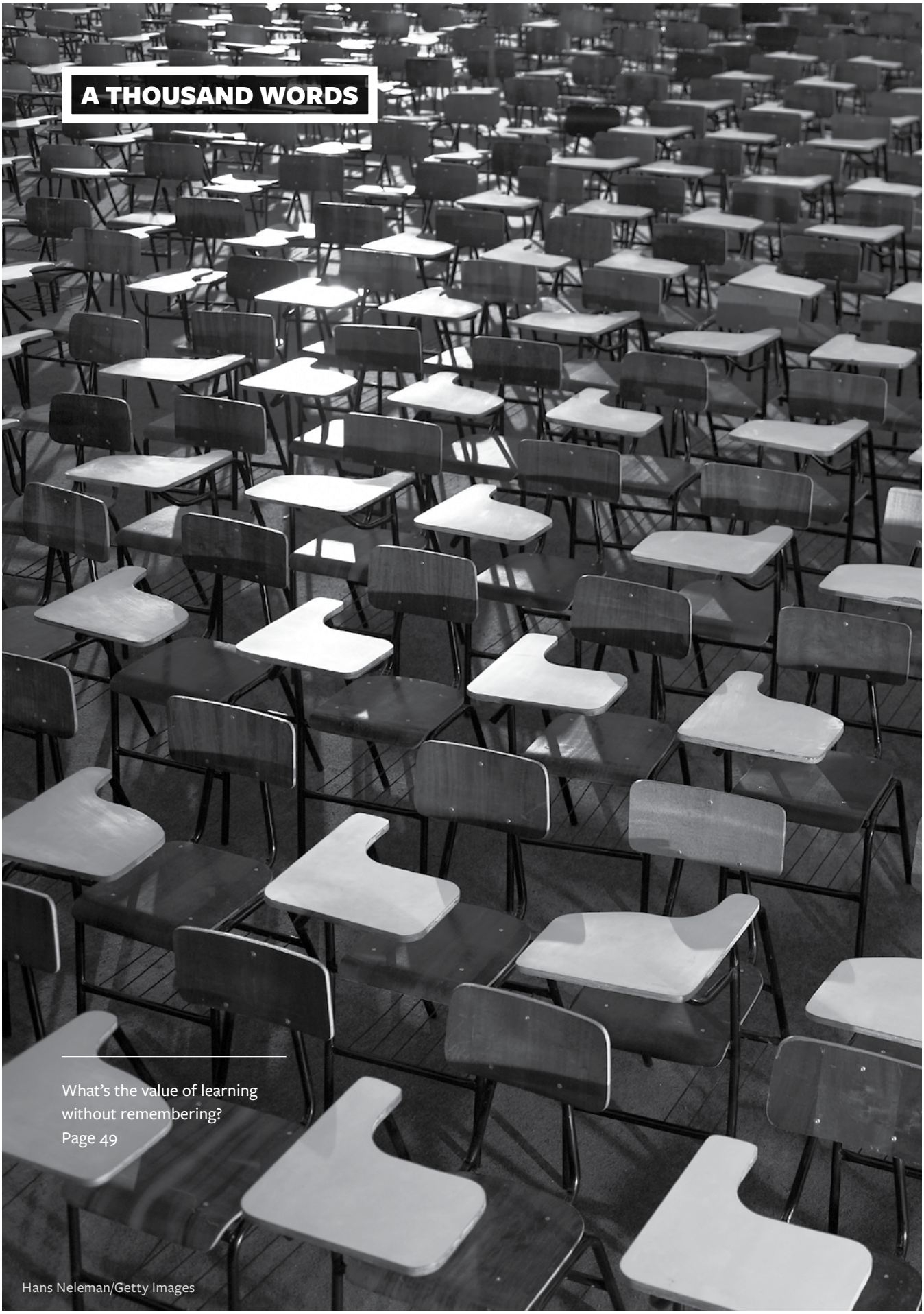
For each of the different jobs I had, I needed new skills. And learning new skills helped me gain the confidence that I could do it again. In today's marketplace, you have to always be willing to make changes and find the inner strength to do it. Continuing to learn is one way to give yourself that strength.

Within a month of learning web coding in 2012, I received an offer from a local company to be a specialist for the collaboration software I first worked with seven years ago. It's my dream job, and the trajectory of my life has totally changed.

I now realize I want to be an engineer, that I have always wanted to be an engineer. I work with policies, procedures, and processes, and thinking through risks and what could go wrong, so a process engineer makes the most sense so that I can continue to move up within my company. It seems kind of crazy to want to do that at age 60, but it would be so much fun. I'm capable of learning a new trade—and I've done it a number of times—so I can do it again. And I will.

When I think about all the different things that I can do, it makes me happy. It gives me hope. It's important to keep learning because it keeps you energized, keeps you engaged with living, and helps you grow. You also discover new things about yourself. The biggest gift you can give yourself is to learn new things.

A THOUSAND WORDS



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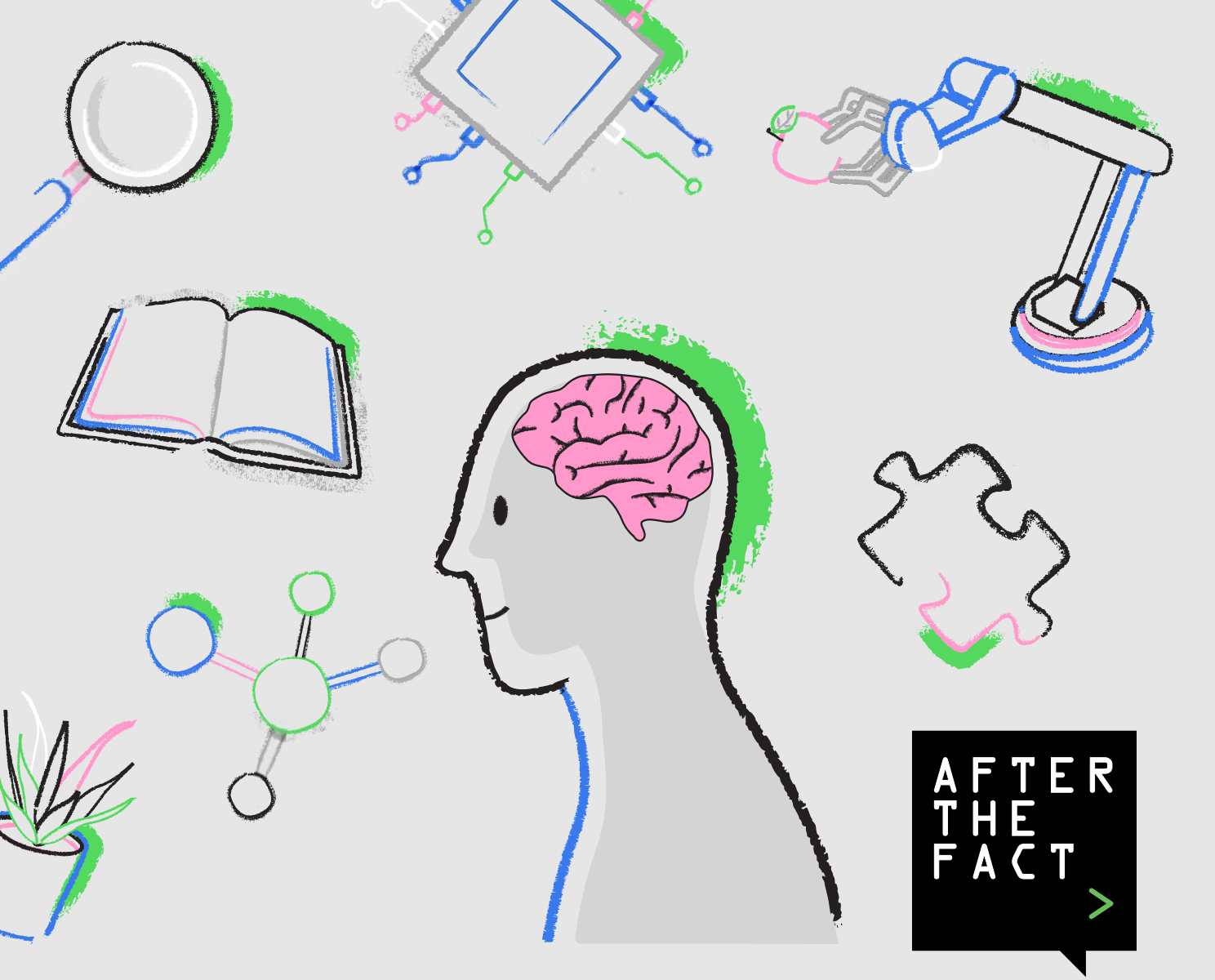

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