

## EMBARGOED UNTIL 10 A.M. E.T. MAY 3, 2017

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FULL REPORT available via Pew at: <http://www.pewinternet.org/2017/05/03/2017/the-future-of-jobs-and-jobs-training/>

### The Future of Jobs and Jobs Training

*Many experts predict a wider array of education and skills-building programs will be created to meet new demands in the next decade. However, they also describe two uncertainties about the coming years: Will well-prepared workers be able to keep up in the race with artificial intelligence tools? And will market capitalism survive?*

WASHINGTON, D.C. (May 3, 2017) – Machines are eating jobs functions, including high-skilled work. How will people keep up? [A canvassing of more than 1,400](#) technologists, futurists and scholars by Pew Research Center and Elon University's Imagining the Internet Center found that most hope that the education and jobs-training ecosystems will shift in the next decade to exploit liberal arts-based critical-thinking-driven curriculums; online courses and training amped up by artificial intelligence, augmented reality and virtual reality; scaled-up apprenticeships and job mentoring and micro-credentialing of new competencies.

But some fear that education will not meet new challenges or – even if it does – bottom-line-first businesses will implement algorithm-driven solutions to replace people in many millions of jobs, economic divides will widen and capitalism will undermine itself.

A total of 1,408 respondents answered the question: *In the next ten years, do you think we will see the emergence of new educational and training programs that can successfully train large numbers of workers in the skills they will need to perform the jobs of the future?* In response, **70%** indicated that, "yes," they expect new approaches will emerge and be successful. Many expect that while exciting new options will emerge between now and 2026 those who can afford to pay for a college education will still find it relevant and valuable. Among the **30%** who said "no," most predicted that adaptation in teaching environments will not be sufficient to prepare workers for future jobs. A smaller share of these experts predicted that capitalism is in trouble as algorithms advance steadily, replacing millions of workers.

[This report](#), part three of a five-part series on the future of the internet, is based on a canvassing conducted from July 1 to Aug. 12, 2016. Participants' detailed responses are compiled in a detailed 94-page report.

Some also responded to one or more of the following prompts they were asked to consider following the primary question: **1) What are the most important skills needed to succeed in the workforce of the future? 2) Which of these skills can be taught effectively via online systems – especially those that are self-directed – and other nontraditional settings? 3) Which skills will be most difficult to teach at scale? 4) Will employers be accepting of applicants who rely on new types of credentialing systems, or will they be viewed as less qualified than those who have attended traditional four-year and graduate programs?**

**The following five themes were identified in an analysis of the overall responses:**

#### **The training ecosystem will evolve, with a mix of innovation in all education formats**

- More learning systems will migrate online. Some will be self-directed and some offered or required by employers; others will be hybrid online/real-world classes. Workers will be expected to learn continuously
- Online courses will get a big boost from advances in augmented reality (AR), virtual reality (VR) and artificial intelligence (AI)

- Universities still have special roles to play in preparing people for life, but some are likely to diversify and differentiate

#### **Learners must cultivate 21st-century skills, capabilities and attributes**

- Tough-to-teach intangibles such as emotional intelligence, curiosity, creativity, adaptability, resilience and critical thinking will be most highly valued
- Practical, experiential learning via apprenticeships and mentoring will advance

#### **New credentialing systems will arise as self-directed learning expands**

- While the traditional college degree will still hold sway in 2026, more employers may accept alternate credentialing systems as self-directed learning options and their measures evolve
- The proof of competency may be in the real-world work portfolios

#### **Training and learning systems will not meet 21st-century needs by 2026**

- Within the next decade, education systems will not be up to the task of adapting to train or retrain people for the skills that will be most prized in the future
- Many doubts hinge upon a lack of political will and necessary funding
- Some people are incapable of or uninterested in self-directed learning

#### **Jobs? What jobs? Technological forces will fundamentally change work and the economic landscape**

- There will be many millions more people and millions fewer jobs in the future
- Capitalism itself is in real trouble

“The vast majority of these experts wrestled with a foundational question: What is special about human beings that cannot be overtaken by robots and artificial intelligence?” said **Lee Rainie**, director of internet, science and technology research at Pew Research Center and co-author of this report. “They were focused on things like creativity, social and emotional intelligence, critical thinking, teamwork and the special attributes tied to leadership. Many made the case that the best educational programs of the future will teach people how to be lifelong learners, on the assumption that no job requirements today are fixed and stable.”

Elon University professor **Janna Anderson**, co-author of the report, said respondents often focused on economic fears: “Some said people will be driven to expand their work capabilities when their only choice is to do so or become irrelevant and unemployed,” she noted. “Some warned that capitalism might completely undermine itself if governments and corporations don’t fully commit to new approaches that serve all people in society, not just the bottom line. They said cheaper, faster, more-efficient, algorithm-based solutions are poised to take over much of the workscape that undergirds the consumer culture and tax structure, thus the great society capitalism has built is in danger of collapse. An anonymous scientific editor told us, ‘Seriously? You’re asking about the workforce of the future? As if there’s going to be one?’”

Among the skills, capabilities and attributes respondents predicted to be of most future value were: adaptability, resilience, empathy, compassion, judgment and discernment, deliberation, conflict resolution, and the capacity to motivate, mobilize and innovate. Still others spoke of more practical needs that could help workers – to train for work with data and algorithms, to implement 3-D modeling and work with 3-D printers, or to implement the newly emerging capabilities in artificial intelligence and augmented and virtual reality, partnering with fast-evolving digital tools.

#### ***Following is a brief sample of thoughts shared by participants in the survey:***

**Jim Henderl**, a professor of computer science at Rensselaer Polytechnic Institute, predicted, “The nature of education will change to a mix of models. College education (which will still favor multi-year, residential

education) will need to be more focused on teaching students to be lifelong learners, followed by more online content, in situ training and other such [elements] to increase skills in a rapidly changing information world. As automation puts increasing numbers of low- and middle-skill workers out of work, these models will also provide for certifications and training needs to function in an increasingly automated service sector.”

**Justin Reich**, executive director at the Massachusetts Institute of Technology (MIT) Teaching Systems Lab, observed, “Educators have always found new ways of training the next generation of students for the jobs of the future, and this generation will be no different. Our established systems of job training, primarily community colleges and state universities, will continue to play a crucial role, though catastrophically declining public support for these institutions will raise serious challenges.”

**Matt Hamblen**, senior editor at Computerworld, wrote, “Credentials for online training will gain value, and more young people will grow more and more skeptical of traditional four-year and grad programs, definitely.”

**Jerry Michalski**, founder at REX, commented, “Today’s educational and training institutions are a shambles. They take too long to teach impractical skills and knowledge not connected to the real world, and when they try to tackle critical thinking for a longer timescale, they mostly fail. The sprouts of the next generation of learning tools are already visible. Within the decade, the new shoots will overtake the wilting vines, and we will see all sorts of new initiatives, mostly outside these schooling, academic and training institutions, which are mostly beyond repair. People will shift to them because they work, because they are far less expensive and because they are always available.”

**Barry Chudakov**, founder and principal at Sertain Research and StreamFuzion Corp., says education has been liberated because, thanks to digital innovation, everyone can embed learning continuously in their everyday lives. He wrote, “The key to education in the next 10 years will be the understanding that we now live in a world without walls – and so the walls of the school (physical and conceptual) need to shatter and never go up again. In the (hopefully near) future, we will not segregate schooling from work and real-world thinking and development. They will seamlessly weave into a braid of learning, realization, exposure, hands-on experience and integration into students’ own lives... One way we will break down these walls – we are already doing so – will be to create digital learning spaces to rival classrooms as ‘places’ where learning happen[s]. Via simulation, gaming, digital presentations – combined with hands-on, real-world experience – learning and re-education will move out of books and into the world.”

**Cory Doctorow**, activist-in-residence at MIT Media Lab and co-owner of Boing Boing ([boingboing.net](http://boingboing.net)), responded, “It’s an article of faith that automation begets more jobs [than it] displaces (in the long run); but this is a ‘theory-free’ observation based on previous automation booms. The current automation is based on ‘general-purpose’ technologies – machine learning, Turing-complete computers, a universal network architecture that is equally optimized for all applications – and there’s good reason to believe that this will be more disruptive, and create fewer new jobs, than those that came before.”

**danah boyd**, founder of Data & Society, commented, “I have complete faith in the ability to identify job gaps and develop educational tools to address those gaps. I have zero confidence in us having the political will to address the socio-economic factors that are underpinning skill training. For example, companies won’t pay for reskilling – and we don’t have the political power to tax them at the level needed for public investment in reskilling.”

**Richard Stallman**, Internet Hall of Fame member and president of the Free Software Foundation, commented, “I think this question has no answer. I think there won’t be jobs for most people a few decades from now, and that’s what really matters. As for the skills for the employed fraction of advanced countries, I think they will be difficult to teach. You could get better at them by practice, but you couldn’t study them much.”

**Nathaniel Borenstein**, chief scientist at Mimecast, replied, “I challenge the premise of this question [that humans will have to be trained for future jobs]. The ‘jobs of the future’ are likely to be performed by robots. The question isn’t how to train people for nonexistent jobs, it’s how to share the wealth in a world where we don’t need most people to work.”

**Richard Adler**, distinguished fellow at the Institute for the Future, predicted, “AI, voice-response, telepresence, VR and gamification techniques will come together to create powerful new learning environments capable of personalizing and accelerating learning across a broad range of fields.”

**Mike Roberts**, Internet Hall of Fame member and first president and CEO of ICANN, said, “The jury is very much out on the extent to which acquisition of knowledge and reasoning skills requires human interaction. We now have empirical evidence that a substantial percentage – half or more – can be gained through self-study using computer-assisted techniques. The path forward for society as a whole is strewn with obstacles of self-interest, ignorance, flawed economics, etc.”

**Jeff Jarvis**, professor at the City University of New York Graduate School of Journalism, replied, “[By 2026] we will likely see a radical economic disruption in education – using new tools and means to learn and certify learning – and that is the way by which we will manage to train many more people in many new skills. I believe that many – not all – areas of instruction should shift to competency-based education in which the outcomes needed are made clear and students are given multiple paths to achieve those outcomes, and they are certified not based on tests and grades but instead on portfolios of their work demonstrating their knowledge.”

**Amy Webb**, futurist and CEO at the Future Today Institute, commented, “Gill Pratt, a former program manager of the Defense Advanced Research Projects Agency (DARPA), recently warned of a [Cambrian Explosion of robotics](#). About 500,000 years ago, Earth experienced its first Cambrian Explosion – a period of rapid cellular evolution and diversification that resulted in the foundation of life as we know it today. We are clearly in the dawn of a new age, one that is marked not just by advanced machines but, rather, machines that are starting to learn how to think. Soon, those machines that can think will augment humankind, helping to unlock our creative and industrial potential. Some of the workforce will find itself displaced by automation. That includes anyone whose primary job functions are transactional (bank tellers, drivers, mortgage brokers). However, there are many fields that will begin to work alongside smart machines: doctors, journalists, teachers. The most important skill of any future worker will be adaptability. This current Cambrian Explosion of machines will mean diversification in our systems, our interfaces, our code. Workers who have the temperament and fortitude to quickly learn new menu screens, who can find information quickly, and the like will fare well.”

**Vint Cerf**, vice president and chief internet evangelist at Google and an Internet Hall of Fame member, noted, “The internet can support remote training and learning. These need not be MOOCs. Even mobiles can be sources of education. I hope we will see more opportunities arising for sharing this kind of knowledge.”

**Ray Schroeder**, associate vice chancellor for online learning at the University of Illinois, Springfield, commented, “It is projected that those entering the workforce today will pursue four or five different careers (not just jobs) over their lifetime. These career changes will require retooling, training and education. The adult learners will not be able to visit physical campuses to access this learning; they will learn online. I expect that we will see the further development of artificially intelligent teaching specialists such as [‘Jill Watson’ at Georgia Tech](#), the virtual graduate assistant who was thought to be human by an entire class of computer science students. I anticipate the further development and distribution of holoportation technologies such as those developed by Microsoft using [HoloLens](#) for real-time, three-dimensional augmented reality.”

**Kate Crawford**, a well-known internet researcher studying how people engage with networked technologies, wrote, “We clearly need new educational and training programs to address the [deepening precarity of the labor market](#). But to make it ‘successful,’ in that the right training could be developed to make it possible that everyone will have jobs, is very unlikely.”

**Uta Russmann**, communications/marketing/sales professor at the FHWien University of Applied Sciences in Vienna, Austria, said, “In the future, more and more jobs will require highly sophisticated people whose skills cannot be trained in ‘mass’ online programs. Traditional four-year and graduate programs will better prepare people for jobs in the future, as such an education gives people a general understanding and knowledge about their field, and here people learn how to approach new things, ask questions and find answers, deal with new situations, etc. – all this is needed to adjust to ongoing changes in work life. Special skills for a particular job will be learned on the job.”

**Susan Price**, a digital architect at Continuum Analytics, commented, “Increasingly, machines will perform tasks they are better suited to perform than humans, such as computation, data analysis and logic. Functions requiring emotional intelligence, empathy, compassion, and creative judgment and discernment will expand and be increasingly valued in our culture.”

**Jamais Cascio**, distinguished fellow at the Institute for the Future, responded, “We will certainly see attempts to devise training and education to match workers to new jobs, but for the most part they’re likely to fall victim to two related problems. 1) The difficulty of projecting what will be the ‘jobs of the future’ in a world where the targets keep shifting faster and faster. Jobs that seem viable may fall victim to a surprising development in automation (see, for example, filmmaking); new categories of work may not last long enough to support large numbers of employees. 2) We’re in an era of general-purpose computing, which means that our systems are not physically or procedurally limited to a narrow type of work. Automation and semi-automation (e.g., self-checkout stands) don’t need to completely eliminate a job to make it unable to support large numbers of workers. As learning systems improve, we will soon (if we’re not already) be at a point where adaptive algorithms can learn new jobs faster than humans.”

**D. Yvette Wohn**, assistant professor of information systems at the New Jersey Institute of Technology, wrote, “Formalized apprenticeships that require both technical skills and interpersonal interaction will become more important.”

**Ian O’Byrne**, an assistant professor of literacy education at the College of Charleston, replied, “In the future we’ll see more opportunities for online, personalized learning. This will include open, online learning experiences (e.g., MOOCs) where individuals can lurk and build up capacity or quench interests. I also believe that we’ll see a rise in the offering of premium or pay content that creates a space where one-to-one learning and interaction will allow mentors to guide learners while providing critical feedback. We will identify opportunities to build a digital version of the apprenticeship learning models that have existed in the past. Alternative credentials and digital badges will provide more granular opportunities to document and archive learning over time from traditional and nontraditional learning sources. Through evolving technologies (e.g., blockchain), this may provide opportunities for learners to document and frame their own learning pathways.”

**Charlie Firestone**, communications and society program executive director and vice president at The Aspen Institute, replied, “There will be a move toward more precise and better credentialing for skills and competencies, e.g., badging and similar techniques. Employers will accept these more as they prove probative. And online learning will be more prevalent, even as an adjunct to formal classroom learning. New industries such as green energy and telemedicine will increase new employment opportunities. Despite all of these measures, the loss of jobs from artificial intelligence and robotics will exceed any retraining program, at least in the short run.”

**Frank Pasquale**, author of “The Black Box Society: The Secret Algorithms That Control Money and Information” and professor of law at the University of Maryland, said: “The biggest danger for the United

States educational system is premature vocationalism. Rigorous science and humanities courses help students learn how to learn. Skills training all too often does not. Of course, it can complement core academic courses, and is likely to be part of a lifetime of learning for those switching occupations. But turning high school and college into narrow vocational education programs would make their graduates more vulnerable to robotic replacement, not less. We need to invest in higher education, shoring up support for traditional universities and colleges, lest they eventually become bastions for reproduction of an elite, leaving the rest of society to untested experiments or online programs.”

**Meryl Krieger**, career specialist at Indiana University, Bloomington’s Jacobs School, replied, “Credentialing systems will involve portfolios as much as resumés – resumés simply are too two-dimensional to properly communicate someone’s skillset. Three-dimensional materials – in essence, job reels – that demonstrate expertise will be the ultimate demonstration of an individual worker’s skills. I see credentialing as a piece of a very complex set of criteria; these will also incorporate an individual’s ability to communicate and work with teams, which can more readily be documented and tracked through online portfolio tools than through traditional resume formats. Thus, the educational and training programs of the future will become (in their best incarnations) sophisticated combinations of classroom and hands-on training programs.”

**B. Remy Cross**, assistant professor of sociology, Webster University, commented, “Lacking a significant breakthrough in machine learning that could lead to further breakthroughs in adaptive responses by a fully online system, it is too hard to adequately instruct large numbers of people in the kinds of soft skills that are anticipated as being in most demand. As manufacturing and many labor-intensive jobs move overseas or are fully mechanized, we will see a bulge in service jobs. These require good people skills, something that is often hard to train online.”

**Stowe Boyd**, managing director of Another Voice and a well-known thinker on work futures, discussed the intangibles of preparing humans to partner with AI and bot systems: “Employers may play less of a role, especially as AI- and bot-augmented independent contracting may be the best path for many, rather than ‘a job.’ Homesteading in exurbia may be the answer for many, with ‘forty acres and a bot’ as a political campaign slogan of 2024.”

**Calton Pu**, professor and junior chair in software at the Georgia Institute of Technology, wrote, “The most important skill is a meta-skill: the ability to adapt to changes. This ability to adapt is what distinguished Homo sapiens from other species through natural selection. As the rate of technological innovation intensifies, the workforce of the future will need to adapt to new technology and new markets. The people who can adapt the best (and fastest) will win. This view means that any given set of skills will become obsolete quickly as innovations change the various economic sectors: precision agriculture, manufacturing 4.0, precision medicine, just to name a few. Therefore, the challenge is not only to teach skills, but also how to adapt and learn new skills. Whether the traditional programs or new programs will be better at teaching adaptive learning remains to be seen.”

**Simon Gottschalk**, a professor in the department of sociology at the University of Nevada, Las Vegas: “The skills necessary at the higher echelons will include especially the ability to efficiently network, manage public relations, display intercultural sensitivity, marketing and generally what author Dan Goleman would call ‘social’ and ‘emotional’ intelligence. Creativity, and just enough critical thinking to move outside the box.”

The full report is available via **Pew** at:

<http://www.pewinternet.org/2017/05/03/2017/the-future-of-jobs-and-jobs-training/>

On **Imagining the Internet**'s site the full report and complete sets of for-credit and anonymous responses to the question can be found here:

[http://www.elon.edu/e-web/imagining/surveys/2016\\_survey/future\\_jobs\\_training.xhtml](http://www.elon.edu/e-web/imagining/surveys/2016_survey/future_jobs_training.xhtml)

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