



SCHOOLS & THE FUTURE OF WORK

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The Future of Work Is Uncertain, Schools Should Worry Now



An elite coder with vision, people skills, and high-powered mentors, New York City 9th grader Emma Yang is as close to future-proof as a 13-year old can get. But with technology radically reshaping the labor market, schools face a monumental challenge preparing all students to thrive in a murky future.
—Mark Abramson for Education Week

Automation and artificial intelligence are disrupting the labor market. What do K-12 educators and policymakers need to know?

By Benjamin Herold

September 26, 2017

Today's 6th graders will hit their prime working years in 2030.

By that time, the "robot apocalypse" could be fully upon us. Automation and artificial intelligence could have eliminated half the jobs in the United States economy.

Or, plenty of jobs could still exist, but today's students could be locked in a fierce competition for a few richly rewarded positions requiring advanced technical and interpersonal skills. Robots and algorithms would take care of what used to be solid working- and middle-class jobs. And the kids who didn't get that cutting-edge computer science course or life-changing middle school project? They'd be relegated to a series of dead-end positions, serving the elites who did.

Alternatively, maybe Bill Gates and Elon Musk and the other big names ringing the alarm are wrong. A decade from now, perhaps companies will still complain they can't find employees who can read an instruction manual and pass a drug test. Maybe workers will still be able to hold on to the American Dream, so long as they can adjust to incremental technological shifts in the workplace.

Which vision will prove correct?

When it comes to predicting the future of work, top economists and technologists are all over the map.

Inside schools, the result is tremendous uncertainty.

"For thousands of educators, this discussion isn't about 15 years from now. It's about the present,"

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Special Report: Schools and the Future of Work

Taking a Long Look at Schools and Work

The Future of Work Is Uncertain, Schools Should Worry Now

Preparing Students for Tomorrow's Jobs: 10 Experts Offer Advice to Educators

said former West Virginia Gov. Bob Wise, who now heads a national nonprofit seeking to transform U.S. high schools. "But schools aren't sure how to change what they're doing, or even what questions to ask."

That's why *Education Week* is launching a new line of special coverage on what the changing nature of work means for the K-12 sector. What skills will today's students need? Will the jobs available now still be around in 2030? Should every kid learn to code? What about apprenticeships, career-and-technical education, and "lifelong learning?"

Just as importantly, how can schools prepare children to participate in the political, civic, and moral debates stirred up by technology-driven changes?

The time for these conversations is now.

Because for all their disagreements, nearly all the experts say the nation's educators can take one prediction to the bank.

"Change is going to come," said Lee Rainie, who heads the study of technology for the Pew Research Center. "Standing pat is not an option."

If you could prototype a 13-year-old who is likely to thrive in the 2030 labor market, **she'd probably look a lot like Emma Yang of New York City.**

The private school 9th grader has already designed an app to help diagnose concussions. She's used neural networks to train computer programs to identify lung tumors. Her latest project, an app called **Timeless**, uses algorithms to help Alzheimer's patients recognize the family members in their photos.

Yang is insatiably curious. She asks big questions. And she has killer people skills.

"You don't have to be a doctor or a politician to effect change in the world," Yang told the crowd at her first **TEDx Talk**, delivered in July in Washington. "Solve the problems you see around you."

Elite-level technical abilities, the probing mind of a scientist, and a deft human touch: That's the experts' best guess about the combination of traits that will guarantee rewarding employment in tomorrow's economy.

Facebook, for example, recently **offered advice** to students who want to work in artificial intelligence. Take all the math you possibly can, the company suggested—while also finding time to study computer science, economics, engineering, neuroscience, and philosophy; cultivate mentors; think about vexing challenges in new ways; and publish your own open-source code.

It's heavy, heady stuff.

But such advice also raises red flags, especially for those observers who are most alarmed by the ways technology is upending the labor market.

One fear is that the bar for making today's students future-proof is becoming unrealistically high. And even if America's schools could churn out a steady stream of Emma Yangs, some experts worry it might not matter.

Robots and AI-powered digital agents already rival humans at translating languages, playing strategy games, and flipping hamburgers. They've started driving cars and

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diagnosing cancer. Increasingly, they're able to learn by observing humans, rather than being programmed by us.

That all means big problems, says futurist Martin Ford.

The labor market is a pyramid, Ford wrote in his 2015 book *Rise of the Robots*.

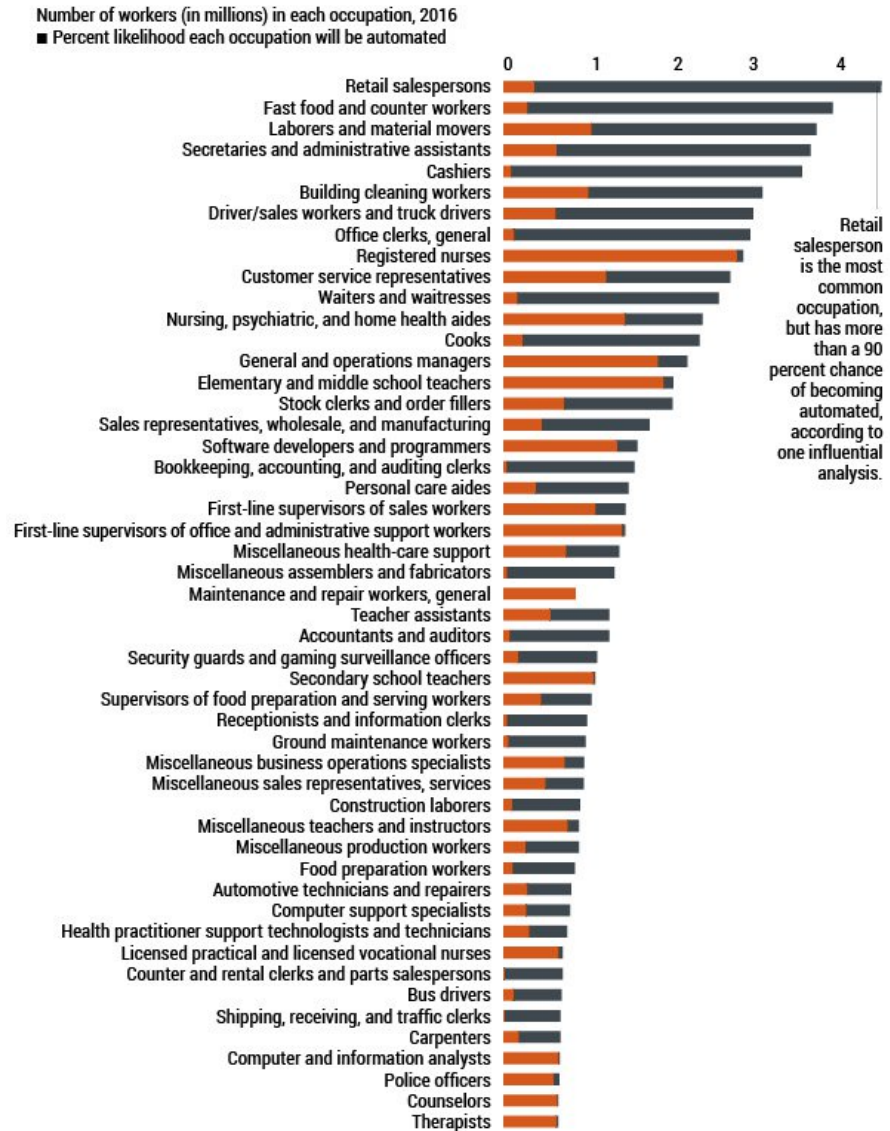
Automation has already begun devouring the pyramid's base, replacing assembly-line workers, warehouse stockers, and cashiers.

Paralegals, radiologists, line cooks, truck drivers, insurance underwriters, travel agents, lab technicians, tax preparers, and office assistants could all be next.

And with artificial-intelligence systems starting to write their own code, it's entirely possible that many of the six-figure computer-science jobs currently available could eventually be lost to technology, too.

THE FUTURE OF EMPLOYMENT? Automation could wipe out millions of jobs

In 2013, Oxford University researchers Carl Benedikt Frey and Michael A. Osborne published an influential study estimating that 47 percent of U.S. jobs were at high risk of automation in the coming two decades. For this analysis, independent information designer Henrik Lindberg applied Frey and Osborne's projections to 2016 data from the U.S. Bureau of Labor Statistics. The chart shows how many Americans currently work in a wide range of occupations, and how likely Frey and Osborne believed each occupation is to be automated.



Sources: U.S. Bureau of Labor Statistics, Frey & Osborne (2013); Analysis by Henrik Lindberg @hnrklnbrg

In such a scenario, how many jobs would be left at the top of the labor-market pyramid?

Turn your gaze back to Facebook, Ford suggests. The company may be worth \$500 billion, but it employs just 20,000 people. Only 75 work in artificial intelligence.

Now you can see why lots of reasonable people are drawing dire conclusions.

In 2014, for example, the Pew Research Center surveyed 1,896 experts. Nearly half said they "envision a future in which robots and digital agents have displaced significant numbers of both blue- and white-collar workers." Many are worried that the trend "will lead to vast increases in income inequality, masses of people who are effectively unemployable, and breakdowns in the social order."

What would such a future mean for today's schools?

"Whatever you do," Ford warns, "it isn't going to be enough."

Like many people in public education, Laura Arnold has mostly tried to avoid such gloomy forecasts.

It's not that workforce preparation is missing altogether from the K-12 conversation. For decades, the sector has talked about "vocational education," "linked learning," "21st century skills," and more.

And it's not that Arnold herself is busy fighting other battles. As an associate commissioner in the Kentucky education department, she's helped turn her state into a national leader in career-and-technical education.

But the horizons for such efforts in public education tend to be short-term. Reliable data on local workforce trends only extend out five years, Arnold said. Companies are focused on what they need right now. Schools struggle to meet even those immediate demands.

Taking time to consider the long-term implications of artificial intelligence can seem overwhelming.

"We need to be at the table for these discussions," Arnold said. "But it's so much bigger than K-12 education."

That's where *Education Week* aims to help. We talked to more than two-dozen experts in the fields of artificial intelligence, computer science, economics, education, and history. We also reviewed dozens of reports and studies.

Here's what we think you need to know.

Many economists are not nearly as worried as futurists like Martin Ford.

Yes, technology is going to eliminate some jobs, said MIT's Paul Osterman, who used to run workforce-training programs for Massachusetts. But doomsday predictions about the future of work overlook the forces of history, human ingenuity, and demography, he said.



—Taylor Callery for Education Week

A century ago, for example, the United States transitioned from an agricultural to an industrial economy. More than 90 percent of farm jobs were lost. But new technologies also created new jobs, new wealth, and new consumer demands. That all led to new work opportunities that all those displaced farmers couldn't have previously imagined.

Still, most experts foresee substantial upheaval.

Even skeptics recognize that industrial robots and artificial-intelligence-powered digital agents have already made significant inroads into fields as diverse as manufacturing, health care, logistics, and customer service.

And it's clear that winners and losers are already emerging. Wages for highly educated people have gone up, because information technologies complement the creative, problem-solving, and managerial work they tend to do. But at the same time, technology has helped push many less-educated workers into the service sector, where they receive lower pay and less job security.

Under President Barack Obama, the White House concluded that automation will likely continue to erode the fortunes of workers who don't have a high school diploma and who earn less than \$20 per hour. The National Academies of Science, Engineering, and Medicine, meanwhile, warned that technology will begin eating away at jobs currently filled by some highly educated workers.

Then there's this: As the future-of-work conversation evolves, many analysts are focusing on the specific tasks, rather than the entire occupations, that technology will likely take over from humans. An analysis this year by the McKinsey Global Institute, for example, estimates that existing technologies could be used to automate roughly half of all the activities that workers are currently paid to do.

In the crosshairs: anything that involves routine physical motions, operating machinery in predictable environments, or collecting and processing data.

Robots could take over specific tasks, rather than entire occupations

Percent of job activities that can be automated with existing technologies

Technology may not eliminate many jobs entirely, but it could change the way most work looks.



SOURCE: U.S. Bureau of Labor Statistics; McKinsey Global Institute analysis **EDUCATION WEEK**

If that's how things play out, today's students are going to need a new set of skills, regardless of what field they enter.

Every young person entering the 2030 labor market might need a solid grounding in statistics and data science, the thinking goes. Farmers, for example, would need to make sense of torrents of data generated by sensors and drones on soil and weather conditions.

To maintain their edge, workers would also need to focus on cultivating the human qualities that robots still lack, such as creativity, empathy, and abstract thinking.

And because most jobs could constantly evolve, today's students could eventually face a make-or-break question: Can you adapt?

"I don't think there's any way we can accurately say what skills and competencies students will need 15 years from now," said Michael Chui, a partner at the McKinsey Global Institute. "That's why it's incumbent that we prepare young people for a world of constant uncertainty."

With so much up in the air, what will determine how disruptive the future of work turns out to be?

For all the attention to technology, the answer may have more to do with our laws, policies, and values.

And it's here that K-12 schools might play their most significant role, many experts believe.

Imagine, for example, that millions more people do lose their jobs to automation. Will tomorrow's lawmakers be able to overcome today's partisan divides to craft an effective social safety net?

Or imagine that being a home health aide is one of the few in-demand jobs that most Americans can still do better than a robot. Will tomorrow's workforce insist on greater status and pay for such professions?

And consider how deeply robots, algorithms, and digital agents are being woven into important aspects of our lives, from loan applications to dating to criminal sentencing.

Will tomorrow's citizens be thoughtful and vigilant in deciding how much control they're willing to give to technology? Will they be able to recognize and challenge automated

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Join us for this webinar, part of *Education Week's* yearlong initiative to provide special coverage of workforce-preparation trends and their implications for K-12 schools, to take a deeper look at what kind of job market the 6th graders of today will face when they hit their prime working years in 2030 and what it means for educators now. [Register now.](#)



decision-making systems that replicate existing racial, gender, and other biases?

Public education has always been about creating good citizens, not just good workers. In the age of artificial intelligence, that could be more important than ever.

"Preparing students for the future means helping them think critically about the new ways decisions are made," said Osonde Osoba, a RAND Corp. engineer and researcher.

Are schools up for such a many-sided challenge?

In 2030, will today's 6th graders be afraid of change, or will they embrace it?

If robots lead to a future flush with leisure time, will today's students be able to find purpose in making art, doing citizen science, or helping a neighbor?

"It doesn't have to be a job," said Arizona State University professor James Paul Gee. "But each person needs the skills to make some kind of contribution to a changing world with a lot of problems that need solving."

This is the reality facing the K-12 sector. No one really knows what happens next. Many jobs will likely be destroyed. New types of work, requiring new types of skills, will hopefully be created. The problems and opportunities and paradoxes associated with automation and artificial intelligence won't be limited to the workplace.

For the nation's educators, the most daunting thing about this uncertain future may also be the most exciting.

They get to help make it.

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Terry Schmitz • 2 years ago

Transferable skills need to be identified, understood and incorporated in the educational process. Transferable skills are those skills that can be used across occupations. The most common of these are basic math, communication and soft skills such as planning & organizing, critical thinking and more. Social emotional development is the foundation for soft skills. If you listen to what employers are saying it is soft skills that keep coming up in conversations with educators.

^ | v • Reply • Share >



Davesci → Terry Schmitz • 2 years ago

I have had conversations with many business people over the years too. And similar to what you have heard, soft skills has been a common thread. But more specifically, what I hear business people express great concern about, by far, is lack of work ethic among young new hires.

SEL "alone" is not going to fix the serious systemic problem of inappropriate behaviors, or more generally... poor attitude that obstruct a student's potential to be constructive/productive later in life. I think wrap around "can do all things" for every student type of public school policy is COMPLETELY unrealistic. SEL is a complicated multi faceted issue. In addition to school based SEL what can schools also try to do?

Suggestions: Perhaps if building principals, district superintendents (and all the rest of bureaucracy) spent less time scrutinizing teachers and more time holding parents accountable to supporting good behavior/attitude in their kids, then employment outlook for kids would not be so uncertain. Teachers might integrate "economic activism" into their lessons, teaching the choice of either -patronizing a company that systematically eliminates jobs for cheap automation -or patronizing companies who keep their job opportunities for actual people.

^ | v • Reply • Share >



Tina Goss → Davesci • 2 years ago

When you come up with a viable plan for making parents accountable, you will be a millionaire. As an educator of 25 years, I have seen the shift in parental involvement many times. In the early years, parents fully backed teachers and worked in tandem to shape students into responsible, productive citizens. Later came the era of the overindulged child, when parents believed their children did no wrong and spent all of their time pampering, defending, and cleaning up their child's messes. Now we are in an age of the absent parent, where children are raising themselves while their parents "live their own lives". Through all of this, the school and the teacher is still held accountable for the kind of citizens "we turn out". If the pendulum ever swings back to a time when parents actually parent their children, when soft skills are taught by example, when common sense is king again, we will actually have a chance to advance as a society.

1 ^ | v • Reply • Share >

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Joe Kokinda • 2 years ago

The working environment today is all about automation. Being involved in the Mechanical Trades, specifically Thermodynamic Energy being used to refrigerate product, we need cognitive thinkers, and those willing to make a 6 figure income right out of High School.

However, science classes do not preach or point to Thermodynamics. Our young are not being prepared to partake in a skill set that can never be outsourced, and is a long way from robotics doing the tasks.

1 ^ | v • Reply • Share >



This comment was deleted.



Joe Kokinda → Guest • 2 years ago

See IBM and Seimens Walter. They both live on our Planet, and actually do teach curricula that is in fact STEM related in high schools here and in Germany. Getting Tech Schools decent STEM interested attendees is not happening, and interest in how our world works in climates that have populations that would not exist if not for air conditioning or refrigeration advancements. How is Puerto Rico doing now?

Promoting my own trade? Please make sure you check your ego before you post, as the young are the future. Our education system here in the US treats our young just as you say, incapable of adapting to the needs of our Industry. Students are not treated like they are special, hence the disinterested abound.

Learning the periodic table is not science.

1 ^ | v • Reply • Share ›

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wpewen • 2 years ago

Essentially propoganda for STEM. Yes , Mr Herold your young Chinese prodigy is both a wonder and quite lovable. Most students in the Unites States will never come near this. If you want to turn K-12 into a polytechnic for industry be my guest. This is unbalanced and not realistic. She is a genius, most students are not. I'm not at all impressed. The points are valid but not like this.

3 ^ | v • Reply • Share ›



Bruce Harris • 2 years ago

This is such a critical issue, that we should all be very concerned about. Our systems of accountability even with their increased rigor do very little to address transferable skills and do not address soft skills at all. I just wrote about this in my blog: <https://textteachers.blogspot...>

Thank for being a vocal prophet. I believe this is going to be huge in the years to come, especially when you take Moore's Law into account. .

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bloolight • 2 years ago

K-12 public schools have never been a job training forum, and I don't think they should be in the future. We teach fundamental skills such as reading, mathematics, history, grammar, and science. We have never taught how to fold clothes in a Gap, bag groceries, dig ditches, or work in a factory. The idea that there are some sort of magical "critical thinking" or "lifelong learning" skills that will turn kids into Silicon Valley CEOs is absurd. The idea that we should teach everybody computer programming because computers are so prevalent is also absurd. If we trained six billion computer programmers in our public schools, we'd just have roughly five and half billion unemployed programmers because the job market is not a bottomless pit for any single career.

4 ^ | v • Reply • Share ›



Marcus Walker → bloolight • 2 years ago

I must say, you stated exactly my thoughts Bloolight. Very well put!

2 ^ | v • Reply • Share ›



wpewen → bloolight • 2 years ago

FINALLY, SANITY SPEAKS.

2 ^ | v • Reply • Share ›

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Marcus Walker • 2 years ago

This topic has been at the front of my thoughts every since my latest child was



This topic has been at the front of my thoughts every since my latest child was born. Every time I look at self checkout lanes I can't help but think about it. I don't think that everyone becoming a programmer is the answer. This will test us all to our core. The author is right in that the one certain thing is that change will happen. For all of our kids sake, I know that we must adapt and think very differently.

^ | v • Reply • Share ›



Ali Mercier • 2 years ago

Welp, my concerns start at the title: the time is not to worry—the time is to act! Sure, the article is wonderful at elucidating myriad aspects of the future landscape, and that the education system is not properly preparing students; however, what I'm seeing is hemming, hawing, and hand-wringing, and what I'm not seeing is what we should do. We know that businesses are *already* complaining that the folks entering their companies are not ready for today's work landscape for myriad reasons. Sure, we might not know how severe the change will be and what direction it will eventually take, but will do know that *change is already here*. And there are a few fail-safes that we can start acting on now without worrying whether or not we're moving in the right direction. We do know we need team players. We do know we need flexibility and adaptability and growth-mindsets. We do know we need social-emotional intelligence. The article does, awesomely, get to the need for empathy, creativity, and abstract thinking—making the last quarter of its contents its most valuable.

Why not stop *worrying*, and /start/ there?

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Mark Lang • 2 years ago

The answer is very simple, but hard to do. We must transform our schools to prepare kids to be successful in jobs and life in this new, very different world. Anyone who believes that most kids are not capable of thriving in this tech-oriented world has never worked with kids in a way the really brings out the best in each. Frankly, most of what we have kids do now in school relates to memorizing different facts and formulas. They don't need to memorize most of the facts because the information will change or is readily available anyway, and memorizing formulas does not give them the working understanding of math and science they need for today's world. That curriculum was designed in the 1890's for a very different age. We must prepare kids to be learners and thinkers and collaborators, who can deal with any issue than arises by researching and learning and working in teams to develop novel solutions. That means letting them work on problems in a supportive environment where they take the lead and initiative but are guided, guided a lot at first and gradually less and less until they understand their own strengths and have the confidence and experience to tackle ambiguous issues and problems. Kids prepared in this way will be able to adapt and do just about anything that fits their passions. They will be able to learn whatever else they need along the way when they need it. They will also

[see more](#)

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Sootie • 2 years ago

I'm going to address 3 concepts in the story:

There are many lucrative career fields wherein people cannot be replaced by automation that are missing from the list. The reason, of course, is to craft the story so people will believe that predictions based on opinion are fact, and to repeat the melange that is made of fact and opinion to such a great extent that easily-led people go where instructed. The article claims that there is a 5-year reliable trend about the future. So-called reliability about the future depends on all current trends remaining the same - nationally and internationally - which is a mind-blowing stretch because job data is collected from actual events. All "data" about the future is the data of opinion, even when the opinion is based on current trends, and therefore, should not be reacted to in the same way as the data of real events. There is no job data about the future. Predictions are derived by extending a trend line on a graph of what has occurred in the past and assuming

that nothing else will change. However, unless you do this, the mass of people cannot be convinced to helplessly lock-step march into a future that companies producing automated services and products want for themselves. Electronic automation has not created uncertainty in the future; the future, intrinsically, is

[see more](#)

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Diene • a year ago

You do realize that preparing future workers isn't the purpose of education, right? If that's all it's about, let's close down the schools and businesses can pay to train their own damn workers.

Education is about developing the potential of young human beings so that as they grow in life they can live to their full potential as a citizen of a democratic republic.

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Citizens → Diene • a year ago

They can't grow and prosper in this democratic republic if they know nothing about it. Giving them liberal biased information from K-12 may produce Democrat voters but only extends the liberal propaganda to the next generation. Considering the mess handed over to this administration, I believe it is time to eliminate the bureaucracy of the Dept. of Ed. and the NEA and begin anew with giving parents the power to direct their children's education.

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katharine • a year ago

We do need to start changing the educational system now to help children be ready for the future- but the need for work skills will pale in comparison to the needs required in an ever warming world with all the challenges that will entail. We need to be training teachers to help students develop first, an appreciation for our interdependence on nature and on each other, and second, to participate in the regeneration of our resources, our ecosystems, and a new social and economic story that is not based on unlimited material growth and resource depletion. We need regenerative design of education and of society. This solution will also result in new, non-exploitive jobs in circular economies. We are working in Norway to develop initiatives in deep ecology for the regeneration of schools. I wonder if this seems totally alien to the readers here, or if there are some who interested in learning more: www.smallearthinstitute.com

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AlanP • a year ago

I am an 87 year old retired electronic engineer who has always had an interest in education. During my career, I worked for eleven companies, the majority of which do not exist currently. I had to learn about things which were not recognized when I studied -- microwave circuits, computers, semiconductors, integrated circuits, etc. I have been auditing classes since I retired eleven years ago, and I always tell the students that they are going to have to reinvent themselves multiple times during their careers. All this is to say that, as I always felt about my education, one goes to school to learn how to learn. I was way ahead of the smart phone toting students in deciding that you do not have to learn facts which you can easily look up (those which you use constantly are stored naturally). It is being able to use those facts in an innovative way which is much more important. Educators should be fostering the curiosity with which we are all born.

I see a program called Philosophy for Children (P4C) which sets up an 'intellectually space' in which a group of children, of any age, can discuss ideas for which there are no concrete answers so that every child can put forward ideas and have them discussed without ever being labelled a failure. I see this as both a bridge between the way infants learn and the to face teacher who is trying to

make a concept clear to a class of students each approaching it from a different direction. P4C, universally applied, could also result in adults being capable of having rational discussions with people with different political views. Google 'P4C Hawaii' to learn more about P4C.

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pigbitinmad • a year ago

You do realize that 99.99% of the people on the planet are not going to be qualified to do even one thing on this list ie. "computer science, economics, engineering, neuroscience, and philosophy," much less be masters of all of the above. Talk about Purple Squirrels!! Most people are so stupid they can barely spell simple words

I don't know how the masters of the universe think all the idiots today are just going to transition to these highly specialized things that only Albert Einstein and a handful of others can only begin to understand. I don't even consider myself stupid and I don't know most of that stuff.

Anyway, I don't really think it's realistic to expect 100 or so "smart" people to want to share the finite resources of the universe with idiots like us, especially when they can program robots to exterminate us all so they don't have to. It would certainly solve the global warming problem. Besides, I don't want to work in a profession that requires "empathy and people skills." Figures all the jobs that introverts might want to do are the jobs that robots will do better.

Consequently, I don't really see why anyone should even bother to have children or why you would even want to go on living. It's completely pointless at this stage and it will not get better.

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