

Creative Learning and the Future of Work

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Abstract

The workplace is undergoing a radical transformation. Some jobs are disappearing, as computers and robots take over routine tasks (and even some non-routine tasks). And the jobs that remain are changing dramatically, as workers must continually adapt to an onslaught of new technologies, new sources of information, and new communication channels. Success in the future—for individuals, for companies, for communities, and even for countries as a whole—will depend on the ability to come up with innovative solutions to new and unexpected problems. In short, people must learn to think and to act creatively.

But there is a problem. Today's education systems are not designed to help people develop as creative thinkers. Many of today's schools were originally set up to produce workers for industrial-age factories, and they have not adapted with the times. In too many schools, students are trained to do the type of work that is increasingly being replaced by computers and robots. Instead, we need to help students develop the creative-thinking skills that are needed in a rapidly-changing workplace, preparing them for jobs that will be enhanced, not replaced, by new technologies.

In this short article, we propose an alternative vision of learning, drawing on our experiences at the MIT Media Lab. We discuss how the Media Lab's creative and antidisciplinary approach to learning helps prepare students to think creatively, to reason systematically, to work collaboratively, and to learn continuously—precisely the skills that will be needed for success in future work environments. And we argue that today's education systems should be redesigned to enable more people to learn in this way.

The Future of Work

As digital technologies continue to become faster and cheaper, and the fields of artificial intelligence (AI) and machine learning continue to advance, machines are starting to excel at a broader range of tasks and to outperform humans in many ways—particularly at tasks that involve massive amounts of data, speed, accuracy, repetition, reliability, obedience, and computation. The result: machines are starting to take over certain jobs that were traditionally filled by humans.

Increasingly, creativity and ingenuity are becoming the crucial “comparative advantage” for people. As the speed of scientific discovery and technology development continue to accelerate, people will be confronted with more information and more uncertain situations than ever before. How they respond to these situations will depend on their ability to think and work creatively—that is, their ability to come up with their own ways of dealing with new and unexpected situations. Creativity will be relevant not only in high-wage jobs.

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Empowering people in low-wage jobs, by giving them more agency to come up with creative improvements to their work, will make work more interesting for them and contribute to efficiency and productivity.

Our MIT colleague David Autor argues that the increased use of technology has had a polarizing effect on the labor market. There are more job opportunities in low-education/low-wage and high-education/high-wage jobs, but there are fewer traditional middle-skill jobs (Autor 2014).

The types of low-wage jobs that will not be replaced by machines are those that require high-levels of situational adaptability, personal interactions, and complex motor skills applied creatively. For example, restaurant waiters are constantly faced with new situations or unexpected demands from customers, and hairdressers require a high level of manual dexterity and creativity that are not easily provided by an algorithm. Humans are better than machines at operating in environments like these.

At the other end of the spectrum, high-wage jobs that require complex problem-solving, analysis, and design skills will be filled by people who are able to employ technology in highly creative and productive ways—for example, data scientists who use sophisticated statistical technologies in creative, new ways to play with data in order to identify more efficient ways of producing goods. As Autor points out, the conversation is focused too much on machines replacing humans, and not enough on jobs that benefit from a combination of machines and humans. This is particularly true for high-skill jobs, but also applies to many middle-skill positions.

Middle-skill jobs are most at risk of being replaced by machines, but we might also see the emergence of new types of middle-skill jobs in which humans and machines collaborate in more deeply connected ways than was possible even a few years ago. For example, nurse practitioners might be able to take over more of the tasks of diagnosing and prescribing from doctors by combining their human strengths with expertise from AI-enhanced computer systems. AI systems could sort through vast amounts of information and detect patterns of symptoms that suggest a patient might have a serious condition. By using their own common-sense sensibilities and empathetic understanding of patients, in collaboration with AI systems, nurse practitioners would be better able to give advice and to decide when to escalate patients to a doctor or hospital. In this example, the nurse practitioner is not just a user of the AI system but also could contribute ideas to its design, including how to improve the experience for patients, helping refine the way humans and machines interact.

All three categories of future jobs rely on human abilities that are hard for machines to replace. For workers to move up to higher-wage jobs, creativity and ingenuity will become ever more important—in particular, for unlocking the benefits of powerful complementary machines. Opportunities to apply creativity in low-wage jobs may be more limited, but even here, creating space for workers to make creative adjustments to how their jobs are done not only will make jobs more meaningful but also will make workers more productive. And new types of middle-wage jobs will place greater emphasis on the creative use of technology, and the ability for humans and machines to learn to work together.

There are still many questions about the future of work, but one thing is very clear: developing a narrow set of skills or specific content knowledge will be less relevant for any type of job in the future. Yet, that is exactly what most education systems focus on today.

Today's Education Systems are Rooted in the Past

It is ironic (and distressing) that at the same time that machines are increasingly taking over workplace tasks that don't require any uniquely human abilities, our education systems continue to push children to think and to act like machines. This approach to education became entrenched during the Industrial Revolution, when there was an increasing need for workers who were predictable and punctual, and could accurately perform repetitive tasks. Education systems evolved to the demand of the market and became factories for people who would work in factories, converting playful, creative, and unique human beings into workers who were expected to function more like machines.

One byproduct of the factory model of education is an emphasis on standardized testing to assess the performance of students, teachers, and schools. Standardized testing fit naturally in an industrial-era school system that focused on the delivery of instruction and the management of students. But standardized testing is at odds with the new need to spur curiosity and to foster creativity among learners. We can most easily measure and track the types of routinized skills and knowledge that were needed in industrial-era jobs—and are increasingly being handled by machines. Instead, we need to stop training students for exams that a computer could pass, and instead prepare them to do the type of creative work that robots and machines won't be good at.

Learning over Education

The MIT Media Lab is an experimental testbed for the way technology will shape how we live, work, play, and learn. At any given time, our academic program includes about 150 master's and PhD students who are developing tools and technologies for a better future. These students work on specific research projects that lead to graduate degrees. But more important, the Media Lab aims to prepare the students to thrive in a future that we cannot fully anticipate today—a future in which the ability to use advanced technology creatively will be a crucial skill.

At the core of the Media Lab experience is a focus on learning rather than on education. The difference may seem subtle, but it is important. Media Lab Director Joi Ito, a three-time college drop-out, whose job now includes convincing graduate students to stay in school, describes it this way: "Learning is something you do for yourself, and education is something that feels like it is being done to you." This is not to say that there is not a lot of learning that takes place in the education system. Teachers can play a crucial role in fostering, encouraging, guiding, and supporting learning. But too often, schools focus on delivering information and instruction, rather than on helping students develop as curious, creative, lifelong learners.

Since its founding in 1985, the Media Lab has taken a learner-centric approach in its academic and research programs. Media Lab students spend little time in classrooms listening to lectures from faculty members. Rather, they are constantly working on projects and learning through a process of designing, creating, experimenting, and exploring. This approach is based on the constructionist learning theories of Seymour Papert, one of the founding faculty members of the Media Lab. In his research, Papert applied his constructionist ideas to new computer technologies, arguing that computers would be most transformative in children's lives not by delivering information and instruction, but rather by providing them with new opportunities to design, to create, and to express themselves (Papert, 1980). Papert's ideas remain foundational to the Media Lab's research and learning culture today.

Below, we discuss two core elements of the Media Lab's learning approach: creative learning and antidisciplinary research. We believe that these ideas have helped the Media Lab earn its reputation as one of the world's most innovative research labs, and, at the same time, also have helped prepare Media Lab students to thrive in the workplace of tomorrow, where they will need to adapt constantly to ever-changing needs and challenges. Although we developed these ideas in the context of the Media Lab, we believe that they can serve as guiding principles for the design of schools, universities, and other learning organizations.

Creative Learning

Extending the work started by Seymour Papert, researchers in the Media Lab's Lifelong Kindergarten group (led by Mitchel Resnick) have identified four components of a creative learning experience, which we refer to as the "Four P's of Creative Learning": Projects, Peers, Passion, and Play (Resnick, 2014). We use these four P's as guiding principles for the way we design learning environments and experiences, both for our students at the Media Lab and in our outreach efforts beyond the Lab. Indeed, each of the four P's is essential:

- **Projects** - We learn best when we are actively working on projects—generating new ideas, designing prototypes, making improvements, and creating final products. In the course of working on projects, we learn to improvise, to adapt, to debug, and to iterate. By reflecting on the process of design and iteration, we learn not only to solve specific problems but also to hone our abilities to understand and to design solutions to any problem.
- **Peers** - Learning flourishes as a social activity, with people sharing ideas, collaborating on projects, and building on one another's work. The hardest problems cannot be solved by one person alone, and in our professional lives, we rarely work in isolation. That's why the ability to engage others in our work and to collaborate with them constructively is so important. Sharing ideas with others, and helping them learn, is a great way to deepen our own understanding, because it requires us to explain empathically what we know.
- **Passion** - When we focus on things we care about, we are likely to work longer and harder, to persist in the face of challenges, and to learn more in the process. Research

studies have shown that people make their most creative contributions when they are following their passions, not when they are motivated by external rewards. Rewards and pressure can squash, rather than foster, creative thinking. The educational challenge is to help students identify their passions and then to provide them with the support they need to turn their ideas into realities.

- **Play** - Learning involves playful experimentation—trying new things, tinkering with materials, testing boundaries, taking risks, iterating again and again. Play teaches us how to fail early and often, and how to learn from our failures. These skills are critical for entrepreneurs—or anyone who wants to innovate. We need to recognize that different people play and learn in different ways, and we need to provide them with the space and time they need for exploring their own paths.

The four P's not only shape the learning culture at the Media Lab but also inform the goals and design of our learning research. For example, the four P's have inspired the design of a variety of initiatives: Read Out Loud, a learning tool for adults with very low literacy; Wildflower, a network of store-front schools that translate Montessori methods for the twenty-first century; and Scratch, a programming environment and online community that enables young people to express themselves creatively and to develop computational fluencies in the process. The four P's could equally be applied to the design of new types of workplaces, credential systems, or corporate learning experiences.

Antidisciplinary Research

The creative jobs of the future will not fit into boxes as neatly labeled and divided as the professions of today. The positions that involve mastery and the use of powerful technologies will be filled by people who combine a range of different skills from different disciplines. These jobs will require not just interdisciplinary but antidisciplinary thinking and doing.

An interdisciplinary approach seeks to bring different disciplines together; for example, when researchers from different departments collaborate, or ideas from different research groups are combined. But antidisciplinary work isn't the sum of a bunch of disciplines; it is something entirely new. What it means to us is someone or something that defines a new and unique approach rather than fitting within a traditional academic discipline that has its own particular language, frameworks, and methods.

This is a problem for traditional education systems, because today's schools and colleges are set up for clearly separated domain-specific instruction. Throughout much of formal education, courses are arranged by subject and neatly stacked in linear progressions of increasing difficulty. Calculus follows pre-calculus, which follows algebra, which follows pre-algebra.

Moving into higher education, further specialization is not just suggested but required. In most fields, top researchers need deep expertise in narrow micro-disciplines. The call for interdisciplinary work rings hollow when promotion and tenure are based on publications in highly specialized journals. And even if academic programs tried to articulate new

combinations of interdisciplinary skills, the patterns of competencies required for the jobs of the future are likely to change much faster than new degree programs could be designed to develop them.

Promoting antidisciplinary learning and research requires unconventional approaches. The kind of scholars we are looking for at the Media Lab are people who don't fit into existing disciplines, because they are either between or simply beyond disciplines. To attract and to find them, we create new positions, such as the "Professor of Other," or we arrange our faculty searches around major issues, such as climate change, rather than around disciplines. Another strategy is to maintain high expectations, but to create much lower barriers to entry. It might seem counter-intuitive, but to be eligible for graduate study at the Media Lab, students need no previous degrees or standardized test scores whatsoever. What we look for instead are interesting projects, surprising combinations of interests, and a curiosity for things that require new connections.

Future work environments will require more designers, thinkers, and innovators with antidisciplinary mindsets. Recruiting, supporting, and nurturing them requires a departure from the silos of our current education systems.

Learning to Shape the Future of Work

The future of work will force us to ask hard questions about the social fabric of our global society. How will we distribute the profits from highly productive labor, when a small number of skilled people with a billion robots can produce most of the things the rest of us need? How will we, as a society, deal with the inequities that result as great wealth accumulates in the hands of a few? There are a wide range of possible outcomes. At one extreme is a utopian vision in which everyone has access to the things they need, with plentiful leisure time to pursue their interests. At the other extreme is a dystopian vision in which most people toil in low-income jobs that don't require significant cognitive or creative abilities, envious of the opportunities that are open to only a tiny elite.

These are knotty questions, and we believe that the path to answering them requires us to step outside the boundaries of traditional disciplines. We need to redesign the education systems of today, engaging all learners in antidisciplinary and creative learning experiences, and equipping them to shape the work environment of tomorrow and to thrive in it. At the heart of any long-term strategy to prepare people for the jobs they will want to occupy in the future, we need to have a much more intentional approach to support creative learning and antidisciplinary research throughout our education systems.

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