

THE MAKER MINDSET DALE DOUGHERTY

The Maker Movement continues to gain momentum. We can see the growth of maker communities online as well as the development of physical community workspaces, called makerspaces, and the spread of Maker Faire around the world. The Maker Movement is spurred by the introduction of new technologies such as 3D printing and the Arduino microcontroller; new opportunities created by faster prototyping and fabrication tools as well as easier sourcing of parts and direct distribution of physical products online; and the increasing participation of all kinds of people in interconnected communities, defined by interests and skills online as well as hyper-local efforts to convene those who share common goals.

Yet the origin of the Maker Movement is found in something quite personal: what I might call “experimental play.” When I started Make magazine, I recognized that makers were enthusiasts who played with technology to learn about it. A new technology presented an invitation to play, and makers regard this kind of play as highly satisfying. Makers give it a try; they take things apart; and they try to do things that even the manufacturer did not think of doing. Whether it is figuring out what you can do with a 3D printer or an autonomous drone aircraft, makers are exploring what these things can do and they are learning as well. Out of that process emerge new ideas, which may lead to real-world applications or new business ventures. Making is a source of innovation.

While technology has been the spark of the Maker Movement, it has also become a social movement that includes all kinds of making and all kinds of makers, connecting to the past as well as changing how we look at the future. Indeed, the Maker Movement seems to be a renewal of some deeply held cultural values, a recognition rooted in our history and culture that making comes to define us. As Frank Bidart has written in his poem “Advice to the Players”: “We are creatures who need to make.”

All together, makers are seeking an alternative to being regarded as consumers, rejecting the idea that you are defined by what you buy. Instead, makers have a sense of what they can do and what they can learn to do. Like artists, they are motivated by internal goals, not extrinsic rewards. They are inspired by the work of others. Most importantly, they do not wait until the future to create and make. They feel an urgency to do something now— or lose the opportunity to do it at all.

Making is no longer, however, a mainstream activity or aspiration, although it once was a core attribute of the American middle class. Today, making lives on the margins of society, but it is thriving nonetheless. Makers are likely to see themselves as outsiders, like some artists and writers, who do not follow the traditional paths. They create their own paths, which is what innovative and creative people do. Quite simply, we need to encourage more young people to explore, create, discover, and make their own way.

The biggest challenge and the biggest opportunity for the Maker Movement is to transform education. My hope is that the agents of change will be the students themselves. Increasingly, technology has given students more control over their lives, and even the simplest cellphone can change a person’s sense of agency. Students are seeking to direct their own education lives, looking to engage in creative and stimulating experiences. Many understand the difference between the pain of education and the pleasure of real learning. Unfortunately, they are forced to seek opportunities outside of school to express themselves and to demonstrate what they can do.

Formal education has become such a serious business, defined as success at abstract thinking and high-stakes testing, that there is no time and no context for play. If play is what students do outside school, then that is where the real learning will take place and that is where innovation and creativity will be found.

The rigid academic system is short-changing all students, even though an elite few seem to do well by academic standards. However, there is increasing skepticism that even those who succeed academically are not the kind of creative, innovative thinkers and doers that we need.

Dr. Stuart Brown’s book, *Play: How It Shapes the Brain, Opens the Imagination, and Invigorates the Soul*, tells the story of how the Jet Propulsion Laboratory realized that although they were hiring the best and brightest college graduates, they were hiring the wrong kind of people. Something had changed in the kind of people that came to work at JPL:

The JPL managers went back to look at their own retiring engineers and . . . found that in their youth, their older, problem-solving employees had taken apart clocks to see how they worked, or made soapbox derby racers, or built hi-fi stereos, or fixed appliances. The young engineering school graduates who had also done these things, who had played with their hands, were adept at the kinds of problem solving that management sought. Those who hadn't, generally were not. From that point on, JPL made questions about applicants "youthful projects and play" a standard part of job interviews. Through research the JPL managers discovered that there is a kind of magic in play.

We must try to bring this kind of magic into schools, hard as it may be. I have been focusing on the importance of creating a space where kids have the opportunity to make—a place where some tools, materials, and enough expertise can get them started. These places, called makerspaces, share some aspects of the shop class, home economics class, the art studio, and science labs. In effect, a makerspace is a physical mash-up of different places that allows makers and projects to integrate these different kinds of skills.

We can create a workshop or makerspace, and we can acquire tools and materials, but we will not have succeeded at creating innovative thinkers and doers unless we are able to foster a maker mindset.

Carol Dweck, a Stanford psychology professor, has written a book called *Mindset* that distinguishes between fixed and growth mindsets. People with a fixed mindset tend to believe that their capabilities are set, as though these abilities were out of their control. People with a growth mindset tend to believe that capabilities can be developed, improved, and expanded. A growth mindset tolerates risk and failure, while a fixed mindset avoids risk and its accompanying frustration. It is obvious which mindset helps someone adapt to and contribute to a world that is constantly changing. Dweck points out that many who excel academically have a fixed mindset, which limits them to exploring only the areas they were told they were good at. Conversely, many who do poorly in school have taken too seriously the judgment of others about their ability in subjects such as math or science. In both cases, such limiting views of oneself are self-defeating and can hold people back from exploring new areas and developing unknown capabilities. Making is about developing one's full potential.

Dweck's growth mindset maps very well to the maker mindset, which is a can-do attitude that can be summarized as "what can you do with what you know?" It is an invitation to take ideas and turn them into various kinds of reality. It is the process of iterating over a project to improve it. It is a chance to participate in communities of makers of all ages by sharing your work and expertise. Making can be a compelling social experience, built around relationships.

Fostering the maker mindset through education is a fundamentally human project—to support the growth and development of another person not just physically, but mentally and emotionally. Learning should focus on the whole person because any truly creative enterprise requires all of us, not just some part. It should also be rooted in the kind of sharing of knowledge and skills that humans do best face to face.

One might reasonably fear that making will be reduced to another failed approach at education reform. Making can be described as "project-based learning" or "hands-on learning," yet doing projects or working with your hands is only what making looks like, not what it is. In his book on education, *To Understand Is to Invent*, Jean Piaget wrote that educators should "lead the child to construct for himself the tools that will transform him from the inside—that is, in a real sense, and not just on the surface." [Q7] It is the difference between a child who is directed to perform a task and one who is self-directed to figure out what to do. That kind of transformation, that kind of personal and social change, is what making is about.

Here are some thoughts for bringing the Maker Movement to education:

- to create a context that develops the maker mindset, a growth mindset that encourages students to believe they can learn to do anything;
- to build a new body of practice in teaching making and develop a corps of practitioners;
- to design and develop makerspaces in a variety of community contexts that serve a diverse group of learners who do not all share the same resources;
- to identify, develop, and share a broad framework of projects and kits, based on a wide range of tools and materials, that connect to student interests in and out of school;
- to design and host online social platforms for collaboration among students, teachers, and the community;
- to develop programs especially for young people that allow them to take a leading role in creating more

- makers in schools, afterschool programs, summer camps, and other community settings;
- to create a community context for the exhibition and curating of student work in relationship with all makers and making, such that new opportunities are created for more people to participate;
- to allow individuals and groups to build a record of participation in the maker community, which can be useful for academic and career advancement as well as support the student's growing sense of personal development;
- to develop educational contexts that link the practice of making to formal concepts and theory, to support discovery and exploration while introducing new tools for advanced design and new ways of thinking about making (practically, this means developing guides for teachers, mentors, and other leaders); and
- to develop in all students the full capacity, creativity, and confidence
- to become agents of change in their personal lives and in their community.

In summary, we can think of organizing this work in terms of places, projects, and practices. The Maker Education Initiative (<http://Maker Ed.org>), a nonprofit launched in spring 2012, was founded to work on many of the above ideas. Its mission is to create more opportunities for young people to make, and, by making, build confidence, foster creativity, and spark interest in science, technology, engineering, math, the arts, and learning as a whole. One way that the Maker Education Initiative will approach this is by working to help existing organizations, such as libraries, to build the capacity to engage and develop young makers. Empowering makers of all ages to play an active role in introducing students, and educators, to making will be a key component of these efforts.

Finally, I would like to share a quote by John Boyd, which gets at why making is a gateway to understanding why science and technology matter. Boyd wrote that the goal of education is “to make evident how science, engineering, and technology influence our ability to interact and cope with an unfolding reality that we are part of, live in, and feed upon.”¹

The kind of change we seek in education is part of the change that we are seeing all around us, the kind of change we seek in ourselves. If those interactions with the world we live in inform and inspire us to create, then we are makers.

NOTE

- 1 Frans P. B. Osinga (2007). *Science, strategy and war: The strategic theory of John Boyd*. New York: Routledge, p. 220.

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