ONE-TO-ONE INSTITUTE

June Newsletter

www.one-to-oneinstitute.org Issue 6-2017

A Global Revolution Goes to School: The Maker Movement

By Sylvia Martinez

Making projects come alive

The "maker movement" is a global technological and creative revolution underway that celebrates using technology to make, repair, and customize the things we need. Hundreds of thousands of adults and children alike are frequenting Maker Faires, makerspaces, and DIY (Do-It-Yourself) websites. A growing library of print literature inspires learners of all ages and experiences to seize control of their world. Making brings engineering, design, and computer science to anyone who is willing to dive in and try something new. Fortunately for educators, the maker movement overlaps with the natural inclinations of children and the power of learning by doing.

Educators around the world are building makerspaces in schools, libraries, and museums. They are finding that by giving children the opportunity to explore, design, and build creates excitement and deep learning experiences. But not all maker technology is alike. In our book, Invent to Learn: Making, Tinkering, and Engineering in the Classroom, we named three game-changing maker movement technologies that should be on every educator's radar:

- **Computer controlled fabrication devices** – Over the past few years, devices that fabricate three-dimensional objects have become an affordable reality. These 3D printers can take a design file and output a physical object. Plastic filament is melted and deposited in intricate patterns that build layer by layer, much like a 2D printer prints lines of dots that, line by line, create a printed page. With 3D design and printing, the ability for students to design and create their own objects combines math, science, and craft. Easy to use yet sophisticated software allow students to program their 3D designs for reuse and sharing.
- **Physical computing** – New open source microcontrollers, sensors, and interfaces connect the physical world to the digital world in ways never before possible. Many schools are familiar with robotics, one aspect of physical computing, but a whole new world is opening up. Wearable computing – where circuits are made with conductive thread makes textiles smart, flexible, and mobile. Plug and play devices that connect small microprocessors to the Internet, to each other, or to any number of sensors mean that low cost, easy to make computational devices can test, monitor, and explore the world.
- **Programming** – There is a new call for programming in schools, from the Next Generation Science Standards to the White House. Programming is the key to controlling this new world of computational devices and the range of programming languages has never been greater. Today's modern languages are designed for every purpose and every age.

While school traditionally separates art and science, theory, and practice, such divisions are artificial. The real world just doesn't work that way! Architects are artists. Craftsmen deal in aesthetics, tradition, and mathematical precision. Scientists tinker. Video game designers rely on computer science. Engineering and invention are inseparable. The traditional boundaries between subjects can and should be more flexible to match what is happening in the real world. Worlds that used to seem separate from "real school" can now have remarkable relevance to curriculum.

Lessons from the maker movement

There are myriad lessons from the maker movement for educators. Of course the tools are cool and amazing, but it goes deeper

than that. Making is not a shopping list or a special place, it's a stance towards learning. It's a conviction that problems are made to be solved, challenges are fun, and that "doing" is what matters.

The maker movement values the intensity of the learning experience with endless choices about what a person might find interesting or fall in love with. Giving kids the opportunity to learn about what they love means they will love what they learn. Crafts are valued as much as high tech tools, which creates the opportunity for students with a wide variety of interests to participate. Instead of telling students that science is just for some people, and making math a barrier to entry, this openness offers a way into programming and building technology for all. By adding whimsy, art, and design into programming, you can attract students who might not realize that coding is creative, or that robots don't have to be fighting machines.

Some educators like to say that technology is "just a tool" that should fit seamlessly into classrooms. In contrast, the maker movement sees tools and technology as the essential element for solving unsolvable problems. To Makers, a robot is not just a toy, but is the raw material for solving problems. And when you can solve interesting problems that's never the end of the story, it's just the beginning. The Maker philosophy prepares kids to solve problems their teachers never anticipated with technology we can't yet imagine.

Maker technologies like robotics, wearable computing, programming, and more give students the ability to create real things, rather than simply report about things. They provide onramps to success in STEM and other subjects for students who are non-traditional learners. Students are empowered by mastering difficult things that they care about, and supported by a community that cares about their interests.

These opportunities are not just good because it's about getting a good grade, but it's about making the world a better place with technology that is magical and modern. When your robot or your software finally works, it's a tremendous feeling of accomplishment. It's what Seymour Papert called, "hard fun," which will be familiar to anyone playing a video game. Video game players don't love these games because they are easy, but because they are hard, but in a way that enthralls and challenges. Making your robot work transcends getting the right answer by adding creativity, complexity, and best of all, you get a real thing in the end. For some students, this makes all the difference.

Look for ways to:

- Introduce challenges that are open-ended
- Solve real problems (student-designed rather than teacher-assigned)
- Use an iterative design methodology
- Allow time for mistakes and refinement – there should be time for things that don't work the first time
- Support collaboration with experts in and out of the classroom

Maker mindset

Another aspect of the maker movement is the "maker mindset." Similar to a growth mindset, this is a personal trait valued by makers world-wide. Like MacGyver, the TV show about a tinkering crime-fighter, the maker mindset is more than just persistence. The maker mindset is about being flexible, thinking on your feet, looking for the unconventional answer, and never, ever giving up.

It's a mistake to think that you can teach students persistence about tasks they don't care about. That's not persistence, that's compliance. When the classroom is about invention and making real things, persistence becomes personal.

Students who experience success on their own terms can translate that to other experiences. Frustration can be reframed as a needed and welcomed step on the path to the answer. Students who figure things out for themselves need teachers to allow a bit of frustration in the process. In the maker mindset, frustration is a sign that something good is about to happen. It's also an opportunity to step back and think, ask someone else, or see if there is another path. This may be a role shift for teachers who are used to answering student questions quickly as soon as they hit a small speed bump.

Luckily, with maker technology, it changes so rapidly that no one can be an expert on everything! In fact, this rapid evolution may

make it easier to adopt the attitude of "if we don't know, we can figure it out." This attitude is not only practical, but models the maker mindset for students.

Our new book, *Invent To Learn: Making, Tinkering, and Engineering in the Classroom* explores the maker movement and makes the educational case for bringing making, tinkering, and engineering to every classroom. The book combines theory, history, practical classroom tips, and countless resources to help K-12 schools make creativity, construction, and children the focus of education once again.

Common Core and the new Next Generation Science Standards emphasize critical thinking, creativity, and 21st century skills. To achieve these goals requires taking a hard look at both what we teach and how we teach it. The maker movement offers lessons, tools, and technology to steer a new course to more relevant, engaging learning experiences for all students.

Additional resources

- **Sylvia Martinez website and blog**: http://sylviamartinez.com
- ***Invent To Learn: Making, Tinkering, and Education in the Classroom*** – Read the book that is known as the "bible" of the classroom maker movement. http://www.inventtolearn.com