The Maker Movement: Lessons for Educators

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ABSTRACT

As we have moved from an industrial to an information economy, there has been interest in fostering different kinds of skills in American schools. These “twenty-first century” competencies include creativity, innovation, troubleshooting and collaboration, which contrast with the “factory skills” model that remains prevalent in our school system. This older conception of learning stems from school’s history as an institution and no longer aligns with our present societal values. Out-of-school learning environments offer effective alternative models to traditional curriculum and assessment. The Maker Movement is one such example which successfully offers socially and technologically active and interested youth opportunity to learn through authentic, meaningful tasks. As an ethos, it serves as a “doorway in” to developing new interests. Maker Spaces can serve teens as “third spaces” between home and school where students can develop a unique sense of place with their peers and develop interests. Early evidence suggests that teens who are engaged in interest-driven making activities demonstrate greater constructive, critical and social dispositions and are more likely to be successful in college and active in their communities. A closer analysis of components of Making that facilitate learning might serve educators seeking to improve opportunities to learn in school.

*keywords:* Maker Movement, Maker space, interest-driven learning, idioculture, twenty-first century competencies, curriculum, choice-based assessment, learn-by-doing, badges, funds of knowledge

The last several decades have seen dramatic change in the way new technology impacts our everyday lives. Computers have become cheap, reliable and accessible. Online networking allows for unprecedented levels of information exchange. Over the last few decades, the economic landscape has also dramatically changed. Americans are producing fewer products since they are cheaper to outsource overseas. Scholars conceive of this shift in different ways. Knobel and Lankshear (2006) described two separate schools of thought: the first conceives that despite changes, the world is essentially the same, just more sophisticated. This group still sees the world in “industrial-physical” terms where truth is fixed and universal (Knobel & Lankshear, 2006). The second group conceives that through globalization, the world is fundamentally different from 30-50 years ago. In an information economy, value is no longer a product of scarcity but is a function of dispersion. As a result, the kind of knowledge we value is different. Expertise is distributed across many spaces rather than centralized in the academy or at the top of a hierarchy. Collaboration and collective intelligence are becoming more highly valued in many places than individual achievement. Ideas are not universal, but are human-constructed and therefore open to reinvention and reinterpretation.

The latter group believes the skills needed in this type of world are quite different than the ones needed in the previous industrial age. However, many American schools still use an industrial model of teaching and learning. This model originally served in public schools to provide social control and quell riots (Tyvek, 1972), foregrounding potentially useful factory skills like punctuality, obedience, and rote memorization. A more recent reform movement focused on standardization has hardly improved the situation. Schwartz and Arena (2012) wrote that our obsession with high stakes assessment is giving students the wrong message about what matters in school – “retrieval and procedural application of narrow facts and skills” (p. 5). Is this useful in measuring what counts? Is it a good predictor of success in contemporary post-industrial society? Workers today may work many different kinds of jobs throughout their lives, and need to be adaptive, innovative and flexible. Many will have to create their own jobs as technology and public need changes. Most importantly, a thriving democracy needs autonomous critical thinkers, not obedient drones. As a society, what do we value most highly in teaching students? Are schools fostering these competencies?

In any case, students are developing different kinds of skills on their own outside school. A recent poll reported that on average, American youth are using media an average of over 7.5 hours per day, rivalling time spent in school. In addition, over 85 per cent of teenagers reported owning cell phones, using them heavily to access the Internet, share photos and post to social networks (Peppler, 2013, p. 24). Peppler (2013) posited that interest-driven learning in the arts includes four critical twenty-first century competencies: technical, critical, creative and ethical. New technology allows people of all ages to build communities of practice based around shared interest rather than age, grade or geographic location. These communities provide access to expertise, position students as authentic participants in the world which makes learning meaningful.

One of the largest of these communities is made up of self-described “Makers” who are interested in producing electronics, woodworking, robotics and similar products at home rather than buying them factory-made. The Maker ethos emphasizes learning-by-doing. Makers believe that the most effective learning occurs only after you take something apart with your own hands and try to put it back together. This ethos means that any space can become a Maker space, and anyone can be a Maker. Makers stay connected, collaborate and share ideas regionally and nationally through publications and websites like MAKE Magazine, Instructables and BoingBoing, and regional events like MakerFaire. Many communities have spaces dedicated to Making including local and regional workshops setup by neighborhood collectives, private businesses and more commonly, publically supported in public libraries and museums. These physical spaces and virtual spaces provide scaffolding and support for Makers to develop new skills, pursue their interests and effect change in their communities as they tinker, explore and innovate.

Making is already being recognized as important by those interested in the direction of educational institutions. President Obama recognized during the Educate to Innovate Campaign that makers “see the promise of being the makers of things, not just the consumers of things” (Obama, 2009). In 2013, Obama said, “future economic development and job creation is dependent on our ability to innovate and the maker movement exemplifies the kind of passion and personal motivation that inspires innovation (New York Hall of Science, 2013). This supports the idea that in reevaluating our goals for what we want schools to do, we can look to models of interest-driven learning for ideas.

If we value twenty-first century competencies, and schools are not fostering them, it is time for a change. Why can’t schools tap some of the Maker momentum to get students excited about learning, especially in science and math? What affordances for learning do Maker spaces offer? This paper will attempt to draw out some answers to these questions by looking deeper into “Making” and the Maker ethos as a valuable and transformative model of learning, and the implications it offers for improving schools.

**Conceptual Framework**

During the Clinton presidency, national attention focused squarely on extracurricular learning as an important supplement to school. Many millions of dollars were directed towards supporting after-school programs for youth with the hope that these spaces would open up new opportunities for engagement in the arts and sciences, and serve as safe spaces for social and emotional development (Vadeboncoeur, 2006, p. 239). This new interest at informal learning environments drew increased public attention to the relationships between learning and school. Should we still assume “formal” school learning is more valuable than interest-driven “informal” learning? Vadeboncoeur (2006) indicated that the terms “formal” and “informal” were commonly stereotyped as a dichotomy between in-school and out-of-school contexts. She questioned the usefulness of these constructs in education research, as there seemed to be no consensus about their definitions. Did they refer to education, teaching or learning? Many researchers she noted used these words interchangeably. She also found no epistemological agreement in how informal learning might be related to social or historical context.

Most, but not all followed a sociocultural line of reasoning emphasizing the bound nature of learning to the practices embedded in those contexts. It sees institutional education as one space among many where learning takes place (Vadeboncoeur, 2006). Lave and Wenger (1991) posited that no matter the setting, learning occurred through participation in communities of practice, of which school was one of many. This epistemology became widely adopted in academia after the work of Russian researcher Vygotsky and his students foregrounded the socially, culturally and historically situated nature of human knowledge. Wertsch (1991) emphasized the importance of social context in individual mental functioning. He wrote that in these contexts, we use tools and signs to mediate our actions to make meaning. Therefore, we can study social and discursive practices to understand learning.

Which practices do we value teaching? Resnick (1987) indicated that to answer that question, we need to rethink our goals for education. Do we wish to train students for particular jobs or do we want them to be adaptive and able to handle change? Do we want pliable individuals who follow directions or do we want people who ask questions? Do we place more value in being workers or citizens? What practices does school in its present form support? She found school mostly focused on isolated individual activity: a sort of practice couched in the particular history of the institution of school, and very different from that of practical life. When she shifted her goals to focus on cultivating high order cognitive abilities and thinking skills, she found that programs that supported these skills looked quite different from school. First, they involved socially shared cognitive work organized around shared goals and tasks. Second, they had elements of apprenticeship. Finally, they were based around specific bodies of knowledge, not generalized abilities. This suggests that the formal-informal dichotomy might not be so important. Rather, if we reexamine what knowledge we truly value as a society, we might be able to “renew [school’s] academic value” (Resnick, 1987, p. 18).

**Context**

If Knobel and Lankshear’s (2006) assessment is correct - that advancements in technology are fundamentally changing how we conceptualize knowledge construction - then it’s the older among us who will have the hardest time imagining that change. The post-millennial generation has always had access to software which allows them to create, collaborate, remix and share media with each other. They have grown up participating and communicating directly with each other without having to rely solely on institutional mediation, expertise or physical proximity. And they’re spending more time using media each year. Peppler (2013) cited studies showing teens increasing their daily media use by over 2.5 hours through the last 5 years (p. 26). In 2010, 4 out of 5 teens were using social media sites like Facebook; 85% owned mobile devices (Peppler, 2013, p. 26). How are teens spending this time? Largely it is to connect with their friends via social media or play games (Peppler, 2013, p. 26). However a significant portion are producing creatively. Two thirds reported being basic content creators online (Peppler, 2013, p. 27).

According to Peppler (2013), this activity is primarily interest-driven. Teens reported being motivated simply out of interest in a particular medium or out of personal pride. She posited several key competencies that interest-driven arts learning instills. First is technical proficiency. Interest-driven arts among teens requires them to learn coding, debugging and remixing, using computationally rich software. Second are critical practices. In engaging with the work of others, teens learn to deconstruct, evaluate and reflect on meaning. They use this critical sensibility to rework and remix others’ work into their own. Third, they become well versed in aesthetics, learning to connect meaning across different modes or mediums. Finally, they learn ethical practices associated with production like respectful collaboration, providing insider hints to newcomers and crediting ownership where it is due.

This research into interest-driven arts learning supports Vadeboncoeur’s (2006) research and Resnick’s (1987) appeal to look beyond school for examples of learning. The above skills fall outside the scope of traditional arts learning but are arguably more practical to teens’ lives than memorizing dead painters. Peppler (2013) wrote she was less concerned with defining “good art” than conceptualizing what a “doorway in” to learning looks like (p. 13). If learning takes place in context within a community of practice, then how permeable are those communities? Access to online communities is so ubiquitous that anyone with any interest can find their people on the web. How can other disciplines besides art open up communities of practice to those with interest?

Luckily for young people, or people of any age, there is the Maker Movement. While the web can provide virtual space and resources for digital media artists, the Maker Movement can provide a “doorway in” for those interested in using physical tools. It is an interest-driven network of people interested in learning and innovation. As with the digital media community, the Maker Movement demonstrates how communities can support individual interests and provide opportunities to learn valuable practices. In a not so distant future, schools might become similar communities which stimulate students and open doors into new interests.

**The Maker Movement Ethos**

“We can’t live in a computer or on the internet, but we do live in houses, drive cars, wear clothes, use medical devices, play with toys, eat, grow, and live in the real world,” wrote Mark Hatch (2014), cofounder of Maker space TechShop (p. 3). “For the Internet to work, there must be physical ‘things’ to be attached to. What is happening and helping to drive the Maker Movement is that the nature of making things is changing” (p. 3). Maker spaces allow anyone with the interest the opportunity to use advanced production tools which were normally available only to large companies with capital to invest in factories. For small fees, people can take classes in spaces like TechShop where they can use laser cutters and 3D printers, and get support and training from experienced Makers. For Hatch, this represents a fundamental change in the way we make things. Providing access to powerful tools is essentially democratizing, he wrote, and because now anyone can innovate and change the world.

In his Maker Movement Manifesto, Hatch (2014) outlined the key components that make up the Maker ethos. Making is fundamental to being human, he argued. Makers share. Their work is public so it can inspire others. Makers give freely because their focus is improving human lives, not profiting on their designs. Makers see themselves as lifelong learners. They invest in local access to tools. They bring a sense of play to their making which supports collaboration and innovation. They participate and support each other in communities to provide opportunities for each other to learn. Finally, they embrace change as natural to making and consequently, to life. Ultimately, making has a message of equity and social justice rooted in collective action. “Together we can use our creativity to attack the world’s greatest problems and meet people’s most urgent needs” (p. 10), wrote Hatch (2014).

A political ethos is part of what makes Making a Movement, rather than just a large-scale trend of hobbyists, interested in building with their own two hands like their grandfathers did. After all, haven’t human beings been using tools to make things our entire history? Of course, the question is always who gets to use the tools and to what end? Hatch pointed out that when Marx was writing about labor and capital, it was capital that was scarce. However in today’s world, we have great access to low-cost, computer-controlled tools of production. This “flips Marxism on its head,” he wrote (Hatch, 2014, p. 40). People are starting to rent capital as needed, instead of labor. This is exactly what happens in Maker spaces.

The relative inexpensiveness associated with many of today’s tools of production means that Makers can take risks. In the past, there might be hundreds of thousands of dollars between a designer and the manifestation of a design, meaning only the very wealthy could afford to innovate. Now, the risk is substantially less. The new mantra for designers is fail fast and fail often. Lang (2013) wrote in his experience, he realize Makers thought about failure differently. Instead of something to be avoided, they embraced it as a part of the process. This is more than just being a worldview, Lang wrote. It is a different value system. Traditionally, a product’s value equaled the cost of the materials plus the cost of the assembly labor. A new model of value includes embedded value in assembling the product oneself. We end up with the “thing,” as well as an opportunity to learn and a story about our experience. Likewise, there is still value in failure to produce a quality “thing” because Makers still get an opportunity to learn and a story to tell others. This ability to incorporate failure into the process makes it easier to takes risks.

Maker communities are essentially grassroots learning ecologies sustained by interest in the medium. Connecting online forums, blueprints and tutorials with physical Maker spaces and production tools is this Maker ethos. Underlying this ethos is a love of learning and connecting to the broader world – similar to the interest-driven arts learning described by Peppler (2013). Similarly, it is the process itself, not the end- product, which drives interest. This is a radical perspective and a departure from capitalism’s conventional wisdom.

Maker culture can offer important insight into potential ways we could “do” school better. First, as illustrated above, it gives us some sense of who students are today and the connected nature of the world in which they live. Second, Maker spaces show the importance of creating learning environments that provide safe places for students to take risks, try new things and learn how to incorporate failure into the learning process. Third, it suggests how educators might rethink instructional curriculum to be richer by making it hands-on, multimodal and involve authentic practices that connect to relevant local and global issues. Fourth, Maker spaces offer new models of assessment based on level of participation within a community of practice. Some supportive Maker spaces have used badges or levels to describe different levels of participation, from refuser to waverer, explorer and director. Choice-based assessments offer more useful information about students’ learning than standardized testing. Schools can draw inspiration from these components of the Maker Movement to promote the kind of learning students need in the twenty-first century.

**Learners: Motivated To Find a Space of their Own**

This paper focuses on teen Makers, though there are many younger students who are actively involved in creative production and Making. As indicated above, students are actively engaged and interested in using new technology. Part of the interest stems from being able to share and engage with each other. Boyd (2014) wrote that the teens she interviewed across the US said that they were primarily motivated to use technology to connect with their friends and socialize. They are using social media so much because they feel like it is one of the only free spaces they have. One girl named Emily explained that it was important to have time “where you can just fool around and be free and do whatever you want. You need that little bit of freedom” (Boyd, 2014, p. 199). Many said that they were only allowed to go to school, work (if they had a job), school functions and maybe each other’s homes during the weekend. “I really can’t go see [my friends] in person…I’m way too busy,” explained another student named Heather (Boyd, 2014, p. 200). Their lives were highly regulated by parental and legal structures of control which excludes them from opportunities to authentically engage with the world. Boyd said they were “desperate” for the opportunity to socialize with their friends (Boyd, 2014, p. 200). Because they lack those public spaces to engage with each other and the world, they go online.

We might seek to provide both virtual and physical “publics” where teens can develop relationships, build on their interests and take reasonable risks. This is something the Maker Movement already does well. Their ethos supports a design process that is used by professional engineers, scientists and artists which emphasizes the positive ramifications of trial and error and failure. However, the “Maker” identity is not restricted to adults. Children and teens can authentically use this label to connect with a larger authentic community across many ages.

Maker spaces directed specifically at teens have popped up around the US in the last few years. There are too many to list, but a few examples suggest the interest and energy behind the movement. Peppler and Bender (2013) found a nonprofit called the Makers Education Initiative whose goal is to “build stronger bridges between making and the demands of education” (p. 27). They sponsor organizations like Young Makers program in California which brings together students ages 8-18 to work on projects and learn from each other, under the guidance of mentors. They also sponsor Maker Corps which recruits teens to work on service projects around rebuilding infrastructure around the US. Make Magazine sponsors camps associated with their publication called Maker Camp. One young camper tweeted that it “been awesome to collaborate with people across the world with similar interests” (Chang, 2013).

There has also been an increase in the use of library and museum space to promote making. This coincides with several trends in American learning sciences. The first has to do with how we conceive of the library’s purpose in the Information Age. The Westport Connecticut public library, for example, offers Makers the opportunity to use a 3D printer to build model airplanes. Peppler and Bender (2013) noted that libraries across the country are moving away from sharing just information resources, but all kinds of resources. The second trend has to do with providing safe after-school spaces to youth to keep them involved in productive activities after school. The Nashville Public Library teen space, according to 18 year old Alexis Woodward, is more “like a family reunion” than a library. She saw it as a safe place where she could meet other students from “bad neighborhoods” and work on things that interested them (Grinberg, 2014). In 2014, according to the Institute of Museum and Library Sciences, the Nashville Public Library Foundation was one of 24 sites to receive grants from the John D and Catherine T MacArthur Foundation to build innovative learning environments for teens. These teen centers are ideal sites for incorporating Maker spaces as another way of engaging teens, and we will see more of them in the coming years.

The interest among teens in engaging in real tasks in public spaces of their own is useful to educators who are interested in engaging and motivating students. Can teachers in schools provide authentic and meaningful tasks? Can students have the opportunity to build and collaborate with their peers? Can classrooms be spaces where students adopt a Maker ethos – to safely take risks and learn-by-doing?

**Maker Curriculum: Hands-On Inquiry**

Hatch (2014) was keen to differentiate the Maker approach to curriculum from that of academia. He set up a scenario asking the reader how they would learn how to make something out of plastic using molding machines. The traditional way, he offered, might require trade school or even a four year bachelor’s program in mechanical engineering. Either of these options might take years and in the latter, would probably not bring you anywhere near real molding machines. He countered that there Makers might take an alternative path, signing up for a handful of specific classes at local co-working spaces and be ready to get started within a month. Of course, this does not mean you would be anywhere close to being an expert, but that is not the point. Hatch (2014) said that he thought Maker curriculum is about “impart[ing] the minimum amount of information learners need to operate a machine safely and move their projects to the next step” (p. 79). This kind of curriculum is about opening doors not creating experts. “You have to physically bore into the details of something to fully understand it,” he wrote (Hatch, 2014, p. 72).

Wiggins and McTighe (2011) wrote that all curriculum developers should design for this kind of understanding. Understanding is different from just “knowing” because it involves the effective use of knowledge and skill applied to a real-world setting or problem (Wiggins & McTigue, 2011, p. 6). To design curriculum that produces understanding, focus on the desired results and work backwards from there. Designers should always first identify the desired results, then determine the acceptable evidence to meet those results and then plan learning experiences accordingly. Curriculum too often falls into the trap of providing a “collection of activities” that does not add up to coherent learning because they do not relate back to any larger goal (Wiggins & McTigue, 2011, p. 9). Big ideas and genuine problems can prompt students to confront “essential questions” which might have various plausible answers and require sustained inquiry.

Sustained inquiry is also something the Maker Movement does well. Their essential question is always, as Mark Hatch (2014) put it, “how can we collectively use our creativity to attack the world’s problems and meet people’s most urgent needs” (p. 10). This question is broad yet relevant, and prompts Makers to constantly revisit it through endlessly possible projects. As Wiggins and McTigue (2011) wrote the purpose of essential questions overrides the format of the questions. Hands-on projects are the format of Maker inquiry, meant to keep Hatch’s question alive. Perhaps “how do I address the world’s problems” becomes “how do I address my community’s problems?” which might become “how do I build a sustainable backyard garden instead of buying tomatoes that were transported across the country?” Before long, it becomes meaningful to acquire skills like using a band saw or gardening when those skills are tied to larger essential questions. The Maker Movement curriculum is inherently about learning for a purpose, which results in models of cohesive and effective curriculum that does not teach to a test.

**New Forms of Assessment**

Despite shifts in education theory toward valuing experiential hands-on learning for understanding, our education system has gone in the completely opposite direction. Standardized testing scores tied to teacher evaluations make many teachers afraid of taking risks, opting instead to “stand and deliver” state-approved curriculum. It seems like the goal of school has become to make high marks on tests, so many classes are designed backward from that end goal. Is that what we want our schools to assess? What does making high marks on a standardized test say about that student’s understanding or ability to transfer knowledge to new contexts? Not much, argued Schwartz and Arena (2012). They suggested that we need to move from assessing knowledge to assessing choice. Choosing to one path over another is a more accurate representation of students having learned the independence they will need to act in the world.

Currently, schools rely on knowledge-based assessments which test students’ ability to recall disconnected bits of information that are deemed important before some point in the future. How important is memorization and recall in the Information Age where so many of us have access to huge bodies of information on mobile devices in our pockets. What use is that information? What use is assessing recall? Schwartz and Arena (2012) are two of many educators pushing for us to reconceptualize assessment around our values as a society. To them, education is a practical matter, and as such, should measure what we as a society value. The “twenty-first century skills” that are often outlined are concepts are difficult to quantify. How would we measure “Collaboration,” “Goal-Setting” or “Interest” through multiple choice exams? Are we looking for proof or are we looking for improvement? Schwartz and Arena wrote that assessing the choices that students make now is a better indicator of choices they might make in the future than assessing the facts they have memorized. A choice-based focus will provide a better measure of what parents want and what society needs which are autonomous thinkers.

What else might these assessments look like? For interest-driven activities, Ito, Baumer, Battanti’s et al. (2010) showed how to assess student progress according to level of participation: students reported “hanging out,” (low) “messing around” (medium) or “geeking out” (high). Similarly, Peppler (2013) found a system setup by a new media workspace for teens called RecallYOUMedia. According to what students said about their interests, facilitators could identify them as either “refusers” who choose to engage in their own way; “waverers,” who are still building self-confidence; “explorers,” who are beginning to build confidence and a sense of accomplishment; and “directors” who have a clear sense of direction and a lot of self-confidence (Peppler, 2013, p. 60). These categories were used by teachers or site leaders to scaffold instruction or access to resources according to different needs.

Another way of assessing choice might be using “badges.” Schwartz and Arena (2012) explained that badges are achievement markers that learners can show off in public. They help in goal setting, persistence and building a reputation in a community. They are great for virtual worlds where there are no material rewards for achievement, and are widely used in gaming. Some Maker groups, especially those geared towards younger Makers, are also adopting skill badges. DIY.org is a website and app that helps young Makers share their skills and projects and connect with one another around interests. They offer badges – virtual and physical – after Makers complete a series of challenges in diverse interest areas like animation, backyard gardening, pranking and “meme hacking.” Makers begin to build portfolios of their work which they can share with others.

Maker assessments are not high stakes. They are not about college admittance, individual cognitive intelligence or state standards. They primarily serve the learners so they can track their own progress and learn from each other in a space of their own. This makes it safe to take risks and truly innovate. They also provide information to site leaders or more experienced Makers so they can better support learning opportunities.

**Future Considerations**

Should we replace schools with Maker spaces? Or does Making only work as an interest-driven activity? Vadeboncoeur (2006) cited research that warned against “school’s invasion of after-school,” suggesting that after-school learning environments risk destruction through co-option or standardization (p. 254). She gave an example of a dance studio that was closely coordinated with a public middle school which diminished as an inclusive, creative space as it was used as a reward system to motivate students to complete daily school-tasks. It became an add-on to “school as usual” as opposed to a space that supported engagement in the arts.

The unique social and discursive practices that arise in informal environments are the medium through which learning happens. This is evident in Cole’s (2006) description of the Fifth Dimension after-school programs which support a unique “third level of context” for teens between school and home (p. 17). By providing an opportunity to play and explore in a non-competitive, low-risk environment, the program gave students space to build their own microculture or “idioculture.” An “idioculture” arises from joint activity and shared experiences which create a meaningful set of beliefs, behaviors and customs that can serve as reference points for future activity (Cole, 2006, p. 32). The practices that make up this joint activity are meaningful because they are mutually understood by members of the culture.

Maker spaces are similarly idiocultures. As Makers construct hands-on projects, they simultaneously construct localized social and cultural practices which involve sharing and collaboration. The social practices make the hands-on projects meaningful and the hands-on projects provide a medium for the creation of social practice. The risk for incorporating Maker spaces into schools is that this relationship will become disrupted. Making might stop being an authentic and meaningful activity when it is embedded in a context that only values extrinsic goals like grades and state standards. Maybe it needs to stay separate and interest-driven to work.

Another risk of standardization of Maker culture into schools is the implication for diversity. Leah Buchley (2013) criticized the idea to incorporate Make Magazine-sponsored Maker spaces into public school classrooms because of their lack of diversity. She questioned who Make presented as Makers? Exploring back issues of the magazine, she found 85% of people on Make covers were boys and men, 13% were women and 0% were people of color. She said the majority of the Make projects she found were about robotics, electronics and rockets. But what about other things people make? This corresponds to Moll, Armanti, Neff and Gonzalez’s (1992) work exploring “funds of knowledge” which asks educators to look for utility in all of the positive resources that students bring into school from home. What if students have “funds of knowledge” about making things that Make Magazine does not consider relevant? Would standardized making programs in schools prioritize certain cultural practices of making over others? Would it include cooking? Rapping? Fashion design? What kinds of people would we tell students are Makers, and what do they make?

**Findings and Recommendations**

It is becoming clearer that learning is distributed across many spaces, and school is not necessarily the most important one. Whether or not it is wise to incorporate Maker culture as it exists “in the wild” into school systems, however, it is a valuable model for educators to reconceptualize what school could be and should be. There is evidence that young Makers, innovators and artists are developing some worthy competencies outside school that may have positive ramifications in their academic studies in school. Peppler (2013) cited her colleague Brigid Barron’s research which found young American digital media-makers consistently scoring above their peers in showing constructive, critical and social dispositions. This included, among other characteristics, the belief that they could come up with interesting new ideas, interest in learning more in the future, seeking other sources to validate online information, and predicting they would create for social change in the future (Peppler, 2013, p. 48). Catterall’s (2009) study of the long-term effects of involvement in the arts in high school in tens of thousands of students, and found compared to their peers who were not involved in the arts, these young adults were more successful in college and more involved in community service. Being active in making – in broad terms- rather than consuming what they are given seems to have long-term ramifications in students’ political and civil lives.

The Maker ethos explicitly positions participants to take charge of their own learning, to work with others and to be constructive, though the ethos is hardly exclusive to Makers. As a belief about the role of the teacher and the learner, it seems to be extremely productive. Perhaps there is a lesson here for teachers who believe their students learn best by sitting still, memorizing bits of information and repeating it back on a test. It suggests learning is much more of a process of construction which takes place in conversation with social and historical context. It is an ethos that is not limited to any particular space, but can position someone’s stance towards learning and inquiry in any environment.

Feedback from students today suggests that they are hardly wasting time using technology, but rather using it as a tool to carve out a space for themselves in the world. The relationship between tools, context, environment and control is very relevant to teens who often feel they have no public “third space” in which to develop interests, take risks and practice authentic “adult” skills. They are deeply interested in collaboration and building meaningful social relationships. As we find them carving out spaces online to build culture, we can also look to the Maker Movement as an example of how to provide physical space to pursue their interests and build relationships. Making shows how identity formation and learning support each other, and this is particularly relevant in the teenage years.

Maker spaces can sustain interest and promote learning through a choice-based assessment structure. Since the goal in making is about play, personal fulfillment and building understanding, there is no purpose to high stakes grades. Assessment serves to help mentors or site facilitators make sure that participants have access to the level of feedback and resources that they need. It also serves to help participants track their own progress, build confidence and help direct them to their next project. It can also position them as experienced mentors to newcomers whom they can support in turn. This raises the question about the purpose of assessment in traditional schools. What does it really measure, and for whom? What are we as a society most interested in measuring? If it includes constructive, critical and social competencies, than perhaps the Maker Movement can point to a new kind of assessment structure.

**Conclusion**

The world has changed and requires new literacies. Schools can still serve a relevant learning environment in contemporary society if we stop to ask important questions about its purpose and methods. No matter how much technology changes, new generations do not automatically or immediately understand its significance. No one is born with the various competencies listed above, no matter what era they live, and schools can still serve as places to learn. However, the emphasis on testing in our school system is not addressing those competencies. For students who grow up in privileged homes, they may find access to learning environments outside school where they can develop them. However, there are many who do not have access. We need to provide relevant education that is equitable, but until we can change our school system’s curriculum, we should explicitly encourage learning in many different manifestations. Let colleges and workplaces accept portfolios that showcase wide varieties of interest-driven projects that students engage in. Let us dethrone school from the top of the hierarchy of learning environments and support diverse environments that engage students in productive activity and support positive social competencies. The Maker Movement is getting it right by not waiting on institutional change; they’re bypassing it. Makers are excited because they know that real learning is happening right in their own garages.

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