Maker Education: The Convergence of Digital and DIY

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Abstract

This paper explores the origins of Maker Education and its alignment with the needs of the 21st century learner. As Maker Education is a relatively new phenomenon, little research is available as to its effectiveness and impact. Therefore, the author will rely heavily on literature that describes the Maker Movement, which is considered to have inspired the development of Maker Education. Hatch (2014) provides a framework for understanding the Maker Movement. Sivek (2011) offers a critique of the Movement’s Technological Utopian viewpoint. Specific information about implementation of Maker Education was found on the Websites of the Massachusetts Institute of Technology and the Urban Assembly Maker Academy. Descriptions of school and library-based Makerspaces are taken from Kurti Kurti, and Fleming (2011) and Bowler (2014).

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Maker Education, akin laboratory situated, project-based learning, is “hands-on, iterative, and experimental and touches a wide array of literacies” (Bowler, 2014, p.58). Maker education is an outgrowth of the Maker Movement, a growing community that is “deeply committed to local, collaborative, community-based invention” (Gobble, 2013, p.65). Maker communities have formed both online and in physical locations known as Makerspaces. Maker education is beginning to bring this type of collaborative and creative learning process into schools and non-formal learning environments.

 The new millennium has been a time of change and challenge for education in the United States. Burgeoning technological development and the growth of the Internet have contributed to the general dissatisfaction with American education. Although recent administrations have offered national educational master plans with lofty sounding names, these have generated little substantive change. As Christensen (2008) suggests: “Today’s system was designed at a time when standardization was seen as a virtue… (today’s) schools need a new system” (p.38).

Current educational research has pushed forward a number of new approaches based on an increased understanding of brain function, a desire for alignment with the needs of the 21st century learner, and a vision of the evolving marketplace. The desire to find the most effective way to develop citizens and workers for a rapidly evolving workplace has created a veritable Petri dish for the cultivation of new educational ideas. Rising from this rich medium is a new contender in the literal race to provide effective 21st century education: Maker Education.

Maker Education engages students as real world problem solvers; encourages them to understand and solve challenges with the goal of improving the world; and empowers them to address the needs of a rapidly changing society, while developing personalized solutions that reflect empathy for others. Maker education encourages learning by trial and error, along with vigilant awareness of the impact of actions and solutions. Maker education fosters resilience and determination in its learners. (UA Maker Academy, 2014, para. 1).

 One starting point for measuring the validity of a new educational movement is its alignment with the needs of the 21st century learner. Tapscott (2009) identifies eight norms that apply to this generation of students. Maker Education is congruent with six of Tapscott’s norms: Freedom (Choice); Customization; Scrutiny; Customization; Integrity: Collaboration: and Innovation (p.74). The Partnership for 21st Century Skills, a national coalition of businesses, education leaders, and policy makers, defines collaboration, critical thinking, communication, and creativity as the four critical skills needed to prepare students “for increasingly complex life and work environments in the 21st century” ([www.p21.org](http://www.p21.org)).

 In Maker Education student choice drives the search for solutions to real world problems. As a result, the solutions, and often the tools that produce the solutions, are customized in accordance with the knowledge, interests, and aesthetic taste of the student.

Maker Education is both student-centered and personalized. It requires that the student develop a deep understanding of the problem and apply critical thinking skills for its solution. Bowler (2014) observes that the Maker process requires design thinking and could be described

as an “open-ended, nonlinear, and often messy way to generate innovation and creative solutions” (p.58). She adds that a benefit of learning that uses design thinking is that it can help students develop creative confidence, a necessary tool for innovation.

 Most often, these projects are the collaborative work of a team, and in every case the sharing of ideas and group vetting of models is encouraged. The lab environment promotes the development of a community of practice. Here the students not only learn by doing, they also learn from one another in an experience of situated learning (Lave & Wenger, 1991, p.31). The social component of this process is critical. Each student must become a strong communicator both within the team and as an advocate for the final product

 Twenty first century “learner biases … establish the particular importance of developing assignments that have relevance to real world events, which require learners to spend time and effort understanding the events (their) relevance” (Vito, 2013). Maker Education is authentic learning in that it simulates “the real-world environment…increase(ing) the chance that a lesson will be remember and can be used in similar situations (Trilling & Fadel, 2009, p. 107-108).

 Unlike traditional education, which stigmatizes failure, Maker Education accepts failure as a part of the process of learning. This approach, valued by the business world, is called “failing forward” (Maxwell, 2007). Maker Education involves design thinking, “which typically involves trial and error, multiple design/test stages, figuring out workarounds, “good enough”

solutions, and ongoing cost/benefit analysis” (Bowler, 2014, p.60). Thus, Maker Education is effective preparation for the workforce that requires all of the above skills.

Education at the Intersection of “Bits and Atoms”

 “Bits and Atoms”, an expression that has achieved meme status, is the combination of technology and physical science that was made popular by MIT’s Center for Bits and Atoms. The MIT Fab lab is the prototype for the kind of Maker workshops that are being established in many schools (http://cba.mit.edu/about/index.html). The Industrial Arts and Home Economics classes of the last century have almost disappeared, replaced by computer labs and technology courses. Makerspaces and Fab Labs are now taking over as the address for real world design and innovation that incorporates the tools of wood shop, craft making, and home economics, along with the technology. In some instances, libraries are the choice of location for Makerspaces, transforming these environments “from a place for consumption to a place of creation” (Bowler, 2014, p. 60).

 Maker Education requires a significant investment in hardware and software. Dozens of tools can be found in Educational Makerspaces, depending upon the size of the space and the investment of the school. Among those most common would be: Laser cutters, Milling machines, 3D printer, 3D scanner, Arduino circuit boards, woodworking tools, sewing and crafting materials, and computers with licenses for a variety of 2D and 3D modeling programs (Hatch, 2014). The principal idea is to make certain that these labs have similar capacities, so that students will be able to collaborate and share ideas with Maker groups in other schools (MIT, 2014).

A Maker Call to Action

 The double-edged sword of Maker Education is its call for integrity. Maker Education, like the larger Maker Movement is a values-based. “Share” and “Give” are key words in the “Maker Manifesto,” which states: “There are few things more selfless and satisfying than giving away something you have made” (Hatch, 2014, p. 18). *Make* magazine, the one of the movement’s most widely read publications, “effectively build(s) and reinforce(s) a collective identity for “makers” through the use of key themes of American ideology and even nationalism, while also motivating individual readers to participate in the “making” project for personal fulfillment and self- actualization” (Sivek, 2011, p.5). Similarly idealistic, the goal of Maker Education is summarized by the UA Maker Academy as follows: “When we see a human need that’s not being met, we make things. We solve problems by making objects, ideas, and actions’ UA Maker, 2014, para. 1).

 These statements are idealistic; perhaps even reflective of technological utopianism. Sivek suggests that there might be unanticipated consequences from the use of such narratives (2011). Can Maker Education truly deliver on these promises? Can good intentions and innovative spirit, aided and abetted by Bits and Atoms, compete with the established industrial complex? The Maker Movement already has it critics. Gobble (2013) points to David Rotman’s critical review of Anderson’s popular book, *Makers: the New Industrial Revolution.* “The Maker Movement as it currently exists can’t have a significant economic effect until they are less fascinated by digital design and more interested in how things actually get made” (p.66). Will Maker Education inevitably be hobbled by the same limitations?

 “Educational Makerspaces and maker education have the potential to revolutionize the way we approach teaching and learning” (Kurti, Kurti, & Fleming, 2014, p.8). Maker Education appears to offer the best of what has been identified as valuable in a 21st century education. It is student centered, multi-modal, open-ended, inquiry- based, experiential, and values-driven. Maker Education may even be the apotheosis of Educational constructs at this moment in time. It is, however, not without challenges. Maker Education requires space and resources; administrators who understand “messy and open-ended learning;” and talented teachers who can inspire and guide, but not interfere with this largely student-driven process. The critical question is “how can this educational approach, which is so clearly altruistic, make an impact in the greater, politicized, and competitive Education market?”

References

Bowler, L. (2014). Creativity through "maker" experiences and design thinking in the education

of librarians. *Knowledge Quest, 42*(5), 58-61.

Christensen, C.M. , Horn, M.B., & Johnson, C.W. (2008). *Disrupting class: How disruptive innovation will change the way the world learns*. NY: McGraw Hill. p.38.

Gobble, M. M. (2013). The rise of the user-manufacturer. *Research Technology*

 *Management,* 56(3), 64-66.

Hatch, M. (2014). *The maker movement manifesto*. NY: MacGraw Hill.

Kurti, R., Kurti, D., & Fleming, L. (2014). The Philosophy of Educational Makerspaces.

 *Teacher Librarian, 41*(5), 8-11.

Lave, J. & Wenger, E. (1991). *Situated learning: legitimate peripheral participation*. NY: Cambridge University Press. p. 31.

Maxwell, J.C. (2007). *Failing forward: Turning mistakes into stepping stones for success.* Nashville, TN: Thomas Nelson, Inc.

MIT’s Center for Bits and Atoms. (2014). About. *Center for bits and atoms*. Massachussets Institute of Technology. <http://cba.mit.edu/about/index.html>

Sivek, S.C. (2011). We need a showing of all hands: Technological utopianism in

 Make magazine. Journal of Communication Inquiry, *35*, 3, 187-209,
 [doi:10.1177/0196859911410317](http://dx.doi.org/10.1177/0196859911410317).

Tapscott, D. (2009). *Grown up digital*. NY: MacGraw Hill. p.74

Trilling, B. & Fadel, C. (2014). *21st century skills:Learning for life in our times*. San

 Francisco, CA: John Wiley & Sons. P.107-108.

UAMaker. (2014). Mission and Core Values. *Urban Assembly Maker Academy*. Retrieved from

 http://www.uamaker.nyc/about/

Vito, M. E. (2013). Collaborative, experiential and technology

 approaches for 21st century learners. *American Journal of Educational*

 *Studies, 6*(1), 47-64. Retrieved from

http://search.proquest.com/docview/1369815770?accountid=12793