Source: Michelle Davis, Curiosity Commons of Libraries & Learning

Makerspaces: the Benefits

The benefits of educational makerspaces are many and varied. While they do not come without their challenges, makerspaces can have a significant impact on student learning and development. In fact, makerspaces were recently identified as one of six important developments in educational technology for K-12 education by the **New Media Consortium (NMC) Horizon Report for 2015**, which states, "Makerspaces are increasingly being looked to as a method for engaging learners in creative, higher-order problem-solving through hands-on design, construction, and iteration" (p. 38). According to the **NMC** (2015), makerspaces have the potential to effectively address the necessary skillsets for students in the 21st Century (p. 38). What follows is an explanation of some of the potential benefits that can be gained through maker learning and well established makerspaces.

Making and Tinkering are Powerful and Empowering Ways to Learn

"Ultimately, the interdisciplinary and empowering natures of these makerspaces can help prepare youth for a future we can't yet imagine" (Davee, Regalla & Chang, 2015, p. 10).

Makerspaces within schools and school libraries provide powerful contexts and opportunities for students to learn and develop new skills. As the makerspace movement "draws upon the innately human desire to make things using our hands and our brains", school makerspaces can provide this necessary outlet for students, fueling engagement, creativity and curiosity at the same time (Fleming, 2015, p.2). For example, a research study conducted by Small (2014) found that "students who participated in activities involving innovation were inquisitive, imaginative and motivated. They wanted to solve real problems that could help people" (as cited in Moorefield-Lang, 2015, p. 108).

Makerspace learning can also empower students, helping them to shift from being passive consumers of information and products to active creators and innovators. As Martinez and Stager (2013) assert, "Making lets you take control of your life, be more active, and be responsible for your own learning" (p. 29). Furthermore, it is the process of making that emerges as a powerful experience for students, not necessarily the completion of a final product. As Burke (2014) explains, "What is made may not matter at all; it can still influence the thought process, vision, and ability to connect of a learning maker. These abilities can enhance a person's thinking and work in many different fields" (p.13). As Laura Fleming (2015), one of the first school librarians to pioneer a makerspace within her high school library, attests, makerspaces cultivate a multitude of advantages for students:

Maker education fosters curiosity, tinkering, and iterative learning, which in turn leads to better thinking through better questioning. I believe firmly that this learning environment fosters enthusiasm for learning, student confidence, and natural collaboration. Ultimately the outcome of maker education and educational makerspaces leads to determination, independent and creative problem solving, and an authentic preparation for real world by simulating real-world challenges (p. 48).

Makerspaces are Learner-Centered Opportunities

"When we allow children to experiment, take risks, and play with their own ideas, we give them permission to trust themselves. They begin to see themselves as learners who have good ideas and can transform their own ideas into reality" (Martinez & Stager, 2013, p. 36).

As Martinez and Stager (2013) argue, "Making is a stance that puts the learner at the center of the educational process and creates opportunities that students may never have encountered themselves" (p. 30). In a maker classroom or library, the teacher acts as a mentor and at times as a learner himself, as students are enabled to bring their own skills and ideas to the forefront. According to Kurti, Kurti and Fleming (2014), makerspaces encourage independent exploration and "owning the learning experience opens unexplored horizons to students because independent thinkers have the uncanny ability to strike out into uncharted territory" (p. 20). Makerspaces provide flexible learning arrangements that promote both autonomy and collaboration, enabling students to test out their own ideas and innovations.

Makerspaces Offer Authentic Learning Experiences Connected to the Real World

"Schools are turning to makerspaces to facilitate activities that inspire confidence in young learners, and help them acquire entrepreneurial skills that are immediately applicable in the real world" (NMC Horizon Report: 2015 K-12 Edition, p. 39).

Authentic, real-world experiences engage children, enabling them to see beyond their own context to understand the applications of what they are learning and doing. Maker learning is designed to provide such authentic experiences. As Martinez and Stager (2014) report, "Makers are constructing knowledge as they build physical artifacts that have real-world value" enabling kids to "solve real problems with their own inventions". Fleming (2015) also addresses the networked, outside-of-the-four-walls nature of makerspace learning, arguing that makerspaces "offer far wider spheres of communication and enables a critical mass of learning to be achieved globally rather than necessarily locally" (p. 10). Finally, Burke (2014) describes an example of a high school chemistry class maker activity, where students were studying ions and designing 3-D models of molecules. Burke (2014) reports that the maker activity portion of the learning "makes it more interesting and gives them [the students] a chance to learn new software, which they will have to do later in life. It has real-world connection for students beyond what they are learning in chemistry" (p. 27).

Makerspaces Help to Prepare Students for the Future

"The turn of the 21st century has signaled a shift in the types of skillsets that have real, applicable value in a rapidly advancing world. In this landscape, creativity, design, and engineering are making their way to the forefront of educational considerations, as tools such as robotics, 3D printers, and web-based 3D modeling applications become accessible to more people. Makerspaces are increasingly being looked to as a method for engaging learners in creative, higher-order problem-solving through hands-on design, construction, and iteration" (NMC Horizon Report: 2015 K-12 Edition, p. 38).

By providing opportunities in entrepreneurialism**,** exposing students to new skills and technologies and opening doors to new career paths, makerspaces can help to prepare students for the future and ignite a passion for lifelong learning. Martinez and Stager (2013) argue that making exposes young learners to engineering skills which provides a helpful context for some of the more abstract concepts in math or science. Furthermore, "for older students, making combines disciplines in ways that enhance the learning process for diverse student populations and opens doors to unforeseen career paths" (Martinez & Stager, 2013, p. 3). Fleming (2015) further expounds on the valuable characteristics encouraged by maker learning, such as the development of a growth mindset and a toleration for risk and failure, arguing that "failure is a necessary step on the road to success and innovation" (p. 9). Finally, as Kalil (2010) reports, "The maker mindset empowers people not just to seek out jobs in STEM or creative fields, but to make their own jobs and industries, depending on their interests and the emerging needs they see in a rapidly changing society" (as cited in Pepplar & Bender, 2013, p. 23).

Makerspaces Address Differentiation and Multiple Intelligences

Makerspaces, like the new school library learning commons model, are flexible, adaptable learning environments that can address differentiation and multiple intelligences, modifying the educational experience for those who learn differently. According to Martinez and Stager (2013), "hands-on learning through the sort of rich projects advocated by makers offers flexible opportunities for students to learn in their personal style or styles" (p. 22). As Fleming (2015) asserts, makerspaces are "uniquely adaptable, learning environments that our students need, want, and will flourish in" (p. 46). Makerspaces, by their nature, reflect community interests and needs and adapt as those interests and needs evolve over time.

Makerspaces Engage Community and Invite Cross-generational Learning

"Community is the defining element of the maker movement on both a local and international scale", and as communities, makerspaces exemplify the following qualities: co-working, collaboration, teaching, learning and an open sharing of ideas (Burke, 2014, p. 12). Makerspaces invite local "experts" to share their skills and passions with students so that they in turn can share with others, thus bringing the community into the classroom. Furthermore, there is often a role-

reversal involved in makerspace communities. For example, Burke (2014) reports on a makerspace in an academic setting where "Students, staff, and professors have regularly come to participate in workshops. The experience is really creating a community of peers in that faculty and staff members are often learning from students" (p. 91).

Makerspaces also invite cross-generational learning and lifelong learning (Fleming 2015). As Peppler and Bender (2013) report, cross-generational can range from "parents with expertise in fixing or modifying cars, to grandparents who sew or crochet, to aunts and uncles who carve at home in a woodshop. Makerspaces are a place for individuals with a range of expertise to share their passions" (p. 27). Much like libraries, makerspaces are designed as an entire community invitation, offering "something for everyone".

Makerspaces are Inter-disciplinary Reflections of Real Life

Similar to school libraries, makerspaces promote inter-disciplinary learning and knowledge, effectively dissolving the artificial barriers that schools create for subject areas. Martinez and Stager (2013) argue against these subject distinctions, stating, "the real world doesn't work that way! Architects are artists. Craftsmen deal in aesthetics, tradition and mathematical precision. Video game designers rely on computer science. Engineering and industrial design are inseparable. The finest scientists are often accomplished musicians" (p. 2). Makerspaces can create a more realistic environment that reflects how professionals approach their work. Peppler and Bender (2013) also discuss how makerspace "cross-disciplinary and interest-centeredness contrasts with traditional school participation in which disciplines are isolated from each other and problems or projects are imposed upon learners" (p. 27). Makerspaces promote an innovative blend of disciplines that can ignite problem solving and spark new invention.

Makerspaces Can Function as Catalysts for Change

"Makerspace education also has the potential to empower young people to become agents of change in their communities" (NMC Horizon Report: 2015 K-12 Edition, p. 38).

Finally, as Peppler and Bender (2013) assert, "it's clear that the maker movement is an innovative way to reimagine education" (p. 26). Fleming (2015) also supports the view that makerspaces can support the redesign of school learning opportunities, stating:

I firmly believe that makerspaces are more than capable of driving real and sustained systemic change from within the system…That, in my opinion, has things exactly the right way around: real change has to come from within the system, from a growing recognition of a need for change in the schools and classrooms themselves (p. 55).