Creating School Library Makerspaces

By Glenda Morris

"Every child has the right to invent, tinker, create, innovate, make, and do."
Laura Fleming, Library Media Specialist, New Milford High School, New Jersey. (Fleming, 2015, p. 27)

Educational makerspaces, which derive from the philosophies of the maker movement, have become prominent recently in response to the need for students to acquire 21st Century skills. This creative and technological revolution encourages students to be active and participatory learners, critical and creative thinkers through activities that involve design, exploration, collaboration, making, tinkering, invention and sharing. While makerspaces, hackerspaces or fab labs, are commonly located in tertiary and public libraries, community centres and specialist laboratories, it is school libraries that have the potential to enhance student learning and engagement. School libraries through the provision of space, tools and resources, during formal and informal learning, encourage students to move from being users and consumers to being creators and innovators (Fleming, 2015; Slater and Howard, 2013). This article will explore the establishment of educational makerspaces in school libraries. It is targeted towards teacher-librarians who wish to establish makerspaces in their libraries and inform principals of the educational merits to support the re-purposing of their school libraries for the creation of makerspaces.

What is a makerspace?

While there is no clear, single definition to the term makerspaces (Burke, 2013; Fontichiaro, as cited in Bell, 2015), there are commonalities existing in terms of features, functions, goals and activities that makerspaces provide. A makerspace is a place where people gather as communities to be innovative, create and collaborate, to share knowledge, tools and resources (Britton, 2012). Makerspaces have transpired from the maker movement which has been popularised by Make magazine and Maker Faire founder Dale Dougherty. These creative spaces emphasise the 'do-it-yourself' philosophy while promoting a richer engagement and curiosity within the Science, Technology, Engineering, Arts and Maths (STEAM) disciplines (Dougherty, 2013) and encourages students to pursue careers in these fields, but also to create their own jobs and industries (Peppler and Bender, 2013) that may not exist yet in a rapidly changing information and technological world.

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Regardless of educational or community contexts, makerspaces are learner-centred and facilitate cooperative and participatory learning. Makerspaces also encourage students to be independent inquirers and provide opportunities for experiential hands-on exploration via iterative activities, including robotics, 3D design and printing, electronics, physical computing, textiles, craft, gaming and digital fabrication. The tools and materials that will inspire students to tinker, create and invent should allow for endless learning possibilities to emerge. While makerspaces have a tendency to incorporate high and low technology tools and materials, non-technology tools, soft making and creative activities, such as arts and crafts also hold rightful places in school library makerspace programs. Daley and Child (2015) support this notion by suggesting that not all learning opportunities in a makerspace need to be high-tech. Martinez and Stager (2015) provide a useful list of tools and materials that can be used for creating educational makerspaces. Importantly makerspaces allow students to create tangible artefacts that can be taken away while catering for a variety of learning styles and skills (Bagley, 2014).

Educational rationale & benefits of makerspaces

Educational theory and relevance to curriculum standards provide strong justification for maker education and makerspaces in school libraries. Influential maker education advocates Martinez and Stager (2013) align the maker movement, and makerspaces, to Seymour Papert's constructionism learning theory.

Constructionism, which is based on Piaget's constructivist theory, emphasises learner-driven, hands-on learning through designing, inventing and building where students are actively engaged in personally meaningful activities and creating artefacts that are shared with new knowledge and skills acquired. Makerspace activities, with educators acting as guides to developing students' knowledge and thinking processes, inspire deeper learning through deep questioning (Kurti, Kurti and Fleming, 2014a) and encourage students to think creatively, collaborate and problem solve.

Creativity is fostered through tinkering, experimentation and exploration in makerspaces without the fear of failure.

Makerspaces, through formal or informal learning activities within the library, facilitate the development of students' 21st Century skills, such as those outlined in the Assessment and Teaching of 21st Century Skills (ATC21s). Makerspaces target a "unique package of complementary 21st century skills and aptitudes such as creativity, innovation, transmedia navigation, visual literacy" (Bowler, 2014, p. 59). Creativity is a critical tenet that underpins maker education. Creativity is fostered through tinkering, experimentation and exploration in makerspaces without the fear of failure. The iterative nature of making focuses on continuous improvement, thinking through problems in order to derive solutions. "This is learning, not failure" (Martinez & Stager, 2013; p. 70) and this is when the most productive learning occurs. Ken Robinson (2012) asserts that schools must transform and reinvent themselves to provide creative opportunities for students. School library makerspaces are one means by which schools can redress this lack of creativity, innovation and authentic learning opportunities. Makerspaces provide schools with opportunities to teach for creativity as the activities involved give control to students over their learning, encourage innovation, to pose questions, identify problems and issues, and discuss their thinking (Craft, 2005). Importantly through making and tinkering students develop a sense of resiliency, which allows them to develop the energy for harder tasks and become experientially and naturally more optimistic in life (Preddy, 2013 as cited in Buerkett, 2014).

While makerspaces do not specifically align to curriculum standards, it is possible to devise informal and formal learning maker-based activities that relate to State or National achievement standards (Fleming, 2015) such as the Australian Curriculum's (AC) General Capabilities and International Society for Technology in Education (ISTE) standards. School library makerspace environments allow students to develop and achieve the skills, dispositions and attributes pertaining to the learning outcomes from the AC's General Capabilities Critical and Creative Thinking and the ICT Capability. Making and tinkering are inquiry-based activities that support collaboration, iterative design and improve students' higher-order thinking skills, including problem solving. Resnick (2002) supports this notion by suggesting that creative thinking should permeate all aspects of students' lives, while Starkey (2011) emphasises the need for students to be critical thinkers, learn through connections, be real-time problem solvers and create knowledge. Therefore makerspaces are places where students can play and experiment 'where innovation and creativity will be found' (Dougherty, 2013, p. 8). However, Dougherty (2013) also explicitly notes that makerspaces need to foster a maker mindset, or a 'growth mindset' (Dweck, 2006, as cited in Dougherty, 2013). Possessing a growth mindset enables students to tolerate risk and failure, and work through the iterative processes in order to improve.

So significant has the learning potential of makerspaces and 3D printing been realised in educational spheres that both have been highlighted in the New Media Consortium's Horizon Report: 2015 K-12 Edition. The report identifies makerspaces and 3D printing as significant developments to watch in educational technology. In particular, makerspaces are predicted to carve a greater niche in K-12 education within one year or less. As a mid-term trend, the report suggests that students will shift from consumers to creators of content through 'learning by making and creating' (NMC, 2015) activities which are attributable to the growth of maker communities and the drive for active, hands-on learning.

Why school library makerspaces?

. . . the establishment of school library makerspaces are an extension of the digital revolution . . .

Makerspaces located in school libraries are a powerful means for libraries to reinvent themselves in the digital age (O'Connell, 2015) and to remain relevant to 21st Century learning and teaching. School libraries need to be places where students can interact with ideas, technologies and information and a place to create, imagine and invent (Moorefield-Lang, 2015). Makerspaces

in school libraries are a natural fit with the mission and aims of the library (Britton, 2012; Foote, 2013; Hamilton & Hanke Schmidt) as many school libraries already facilitate 'making' activities for students to discover, collaborate, create and communicate via art and craft activities. School library making is burgeoning because more technology, tools, and advanced resources are being utilised resulting in a more focused, dedicated, and intentional effort that blends creativity, inquiry and kinaesthetics (Loertscher, Preddy and Derry, 2013). Therefore the establishment of school library makerspaces are an extension of the digital revolution (O'Connell, 2015) which is an evolutionary transformation of the libraries' educational programs and facilities to meet curriculum and recreational needs.

As democratic institutions, school libraries have always been information gateways in schools providing equal and equitable access to information, resources and activities for students to cultivate new knowledge and ideas. School library makerspaces facilitate free access to interactive digital learning environments, technologies and tools, such as 3D printers. This allows all students to explore their interests, to tinker, create and invent using equipment that is not siloed in faculties thereby providing access to the school community.

School library makerspaces enable the library to further embed itself into the curriculum, especially in STEAM subjects, thereby cementing its position as integral to the school's academic program. Collaborative partnerships between teacher-librarians and teachers can strengthen as units of project or inquiry-based learning activities are integrated into the library makerspace (Smay and Walker, 2015). Smay & Walker (2015) emphasise that these collaborations can enhance the curriculum by facilitating opportunities to integrate critical-thinking and problem-solving skills into the design process of creating 3D printed artefacts.

Planning a school library makerspace

Planning and establishing school library makerspaces should not be complicated – it takes a commitment to learn new things, school community support and 'a willingness to begin a journey to somewhere where you've never been before' (Kurti, 2015; p. 54). By connecting to the global community of school library maker educators, such as Laura Fleming, Diana Rendina and Colleen Graves, teacher-librarians can draw upon their experiences for ideas, inspiration and best practices or follow Twitter such as hashtags #makered, #makerspaces and #makerspace.

Every makerspace is different and they are as individual as the students and staff who occupy them. Canino-Fluit, 2014; Foote, 2014; Fleming, 2015; Preddy, 2013 emphasise that the planning of school library makerspaces must consider students' interests, needs, curiosities and skill levels over the technology and tools to ensure the space best serves its learners. Furthermore Fleming (2015) recommends evaluating the school's curriculum and programs in order to ascertain a profound understanding of the school's needs and to identify gaps particularly in STEAM-related concepts. Consequently the identification of makerspace themes emerge which provide a framework for the activities, tools, technologies, resources and materials to be considered and purchased (Kurti, Kurti & Fleming, 2014c). Additionally, the type, or setup, of school library makerspaces is also an important consideration.

According to Foote (2013) a makerspace can be a temporary program or event where students are invited to 'make' items or it can be a permanent feature of the library allowing students to drop in, tinker, collaborate and make. Similarly Kurti, Kuri & Fleming, 2014c refer to a combination of flexible and fixed stations because it allows the makerspace 'to run itself' (p. 23) with teacher-librarians providing minimal instruction to enable students to be independent and take ownership of their learning through creating while making mistakes and finding solutions. However, Foote (2013) in establishing her school library makerspace believed her schools' student population was more attracted to events rather than a dedicated space. Therefore the type of makerspace that is adopted should reflect the interests and needs of the school community. Teacher-librarians wanting to find out more about creating a school library makerspace should follow the links below or consult the Reference list at the end of this article.

- Makerspace Playbook School Edition
- Invent to Learn
- Instructables
- Make magazine
- DIY.org.

A lack of technical expertise should not prevent teacher-librarians from starting a makerspace and incorporating technologies such as 3D printers. Buerkette, 2014; Canino-Fluit, 2014; Fleming, 2014 all contend that technical expertise is not a requisite for creating a makerspace because the strength of the collective and participatory nature of makerspaces enables students and teachers to learn from each other and teacher-librarians become makers themselves and learn along the way. Furthermore, Kurti, Kurti & Fleming 2014b add that effective educational makerspaces will grow students to be experts who will seek to find their own answers.

In summary, school libraries are a natural home of makerspaces for K-12 education (Daley & Child, 2015). Such facilities foster critical and creative thinking, experimentation, collaboration, exploration through inquiry-based learning while promoting active engagement in STEAM. Guiding students to explore their passions and interests in and outside of the core curriculum helps to grow students as life-long learners and empowers them with the 21st Century skills that are transferrable to life beyond school. Learning through tinkering, making and engineering in makerspaces provides the opportunity to reignite curiosity in young people (Martinez & Stager, 2013). Educational leader and former Principal Eric Sheninger (2014) believes that school library makerspaces should be a priority for all schools in the 21st Century because the self-directed learning is so rich and inspires a love of formal and informal learning.

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