Abstract

Over the last 12 months, makerspaces have become an important means for both public and academic libraries to engage with the community, providing additional services or programs to what is currently on offer. The next major step forward for library makerspaces is to incorporate more STE[A]M (Science, Technology, Engineering, Arts and Maths) principles into their programs and services to help people develop important 21st century learning skills. This paper argues that library makerspaces play an important role in contributing to the library's mission of supporting lifelong learning, in particular through STEAM-based activities. It demonstrates this with reference to "Light Makers", a week long event facilitated by Curtin University Library Makerspace in 2015 during National Science Week. Reflections on the event highlight the importance of collaboration between academic and public libraries, university and community groups, to effectively engage the wider community in STEAM-based maker activities.

Introduction

Libraries around the world are changing significantly. Widely recognised for the role they play in literacy and learning, they have moved from using spaces for shelves of books to thriving, innovative places, offering environments for communities to gather to learn, play, explore and share. Libraries recognise that literacy nowadays involves much more than simply reading and writing; the concept has evolved to include 'transliteracy', the ability to exercise a variety of skills and communicate across a range of platforms. In recent years, there has been considerable interest amongst libraries in all sectors to facilitate the development of multiple literacies by taking the lead in developing hands on, experiential learning spaces now popularly known as makerspaces.

Along with their traditional support for literacy, (incorporating reading and writing) and information literacy (finding, evaluating and managing information) libraries have fresh opportunities to explore when providing services to the community. The role they already play in providing access to technology and helping to develop digital literacy skills, particularly to those without ready access, is significant. The rapidly changing digital and technological environment means the necessity of exposing communities to the kinds of skills that are quickly becoming fundamental in society has become more acute (British Library 2010). Makerspaces have sparked a huge interest internationally as part of this learning landscape and their prevalence in public and academic libraries in Australia is becoming more pronounced.

Over the last 12 months, makerspaces have become an important means for both public and academic libraries to engage with the community, providing additional services or programs to what is currently on offer. The next major step forward for library makerspaces is to incorporate more STE[A]M (science, technology, engineering, arts and maths) principles into their programs and services to help people develop necessary 21st century learning skills. This paper argues that library makerspaces play an important role in contributing to the library's mission of supporting lifelong learning, in particular through STEAM-based activities. It demonstrates this with reference to "Light Makers", a week long event facilitated by Curtin University Library Makerspace in 2015 during National Science Week. Reflections on the

event highlight the importance of collaboration between academic and public libraries, university and community groups, to effectively engage the wider community in STEAM-based maker activities.

Makerspaces in a library setting

Innovation Lab, Digital Media Lab, T.E.A. Room, Fab Lab, Bubbler, Ideas Box. What do these all have in common? These spaces come under the umbrella term of makerspaces, places which offer public and/or shared access to equipment not always readily available to the community, where people can gather to create, share, learn and develop ideas (Cavalcanti, 2013; Educause, 2013). Makerspaces can have different focus areas, such as digital media, arts and craft, electronics and technology.

Generally, the emphasis of a makerspace determines the resources, programs and equipment it has available and this emphasis can vary according to community needs. Thus, there is no 'set template' to follow when creating a makerspace, no list of requirements that must be acquired. Makerspace creators can use what is free, readily available and already in existence (Kurti, Kurti & Fleming 2014). Martinez and Stager (2013) contend most places are unaware of the potential they already have, stating "you are better prepared than you think". The organic nature of a makerspace means that it can grow over time, as experience, resources and time permit. Burke (2014) refers to this as 'the slow build'.

Libraries are an ideal place to establish makerspaces. While they have traditionally played a significant role in helping clients be consumers of knowledge, libraries are now providing facilities for users to become creators themselves. Libraries can provide interactive, digital learning environments and technologies for content creation as well as high tech cutting edge technologies, such as 3D printers and 3D scanners. In some cases, the library may be the only means of obtaining access to these technologies and information on their use. Consequently makerspaces in libraries enable users to share their knowledge whilst creating and learning simultaneously through activities such as film making and editing, recording studios, programming/coding, 3D printing, electronics and craft. Many makerspaces offer a blend of flexible access (to equipment, tools and resources for individual and group projects) as well as programs (to foster learning, discovery and exploration).

The increasing prevalence of makerspaces in Australian public and academic libraries can perhaps be attributed to a recognition of the role libraries play in providing access to resources and technology, giving exposure to new technologies that may not be readily available to their communities. Britton (2012) adds an additional perspective, stating that "maker spaces in libraries are the latest step in the evolving debate over what public libraries' core mission is or should be".

Makerspaces and lifelong learning

One of the fundamental aspects of the mission of libraries is to promote and facilitate information literacy and life-long learning which, as the Alexandria Proclamation of 2005 states, "is a basic human right in a digital world and promotes social inclusion in all nations". (UNESCO, 2016). Lifelong learning can be understood in many ways; within libraries it can be about providing opportunities, personal development and community wellbeing for anyone, at any age. It is also about advancing a fair and just society and promoting respect for every citizen, encouraging community participation, strengthening community wellbeing, reducing

causes of disadvantage and improving quality of life. A recent study has highlighted the benefits of lifelong learning on supporting "educational, social and economic benefits" for communities (Barry, 2014; Wheeler et al, 2013).

An important area of lifelong learning is the development of the skills, knowledge and experience required for the 21st century. Today's information rich world requires the capacity to comprehend, process and use knowledge in order to participate effectively in society. Foundational skills of reading and writing aid in processing this vast amount of information, however the traditional definition of literacy has expanded to move beyond the ability to read and write. Increasing technological development means that other types of related literacies have emerged, such as digital/computer/technology literacies (Garcia, 2013). Amalgamated, these literacies encompass using technology effectively and applying cognitive thinking in a digital environment.

According to Malloy (Google Australia, 2014, p.9), there has been a considerable decline in students commencing computing science at university level, with less than 2% of graduates projected to hold a computer science degree. This outlook is further confirmed by Greythorn's IT market report which identifies that the number of new graduates entering the profession is a concern (2014, p.4). This can perhaps be attributed to a changing view of ICT, where technology is something to be used (or 'consumed') rather than something that can be contributed to (or 'created'), and where computational thinking is not yet part of the National Curriculum, causing school leavers to struggle understanding the syllabus should they enrol in an IT related course. Yet, as Malloy emphasises, technology drives the economy, with the Australian Communications and Media Authority stating that over 13 million Australians used a smartphone in 2015, a 7% increase from 2014 and over 15 million had internet access in the home, an increase of 3% from 2014. Demand for these skills is reflected in the estimated creation of 10 000 technology based jobs in the previous decade, however the low numbers entering the profession is starkly at odds with this information when considering this is a generation constantly immersed in technology.

There have been educational developments in recent years to address the problem of declining interest, not only in computing science but STEM (Science, Technology, Engineering and Maths) subjects in general, which is to blend it with the Arts, thus changing the acronym from STEM to STE[A]M. Proponents of STEAM education argue that art provides a different way of understanding the world, and a means to infuse creativity and innovation into the work of scientists and engineers. Conversely, science and engineering concepts can fruitfully be applied to the arts, enabling students who have no particular interest in engineering or science to apply those concepts to other fields of endeavour (Daugherty). Library makerspaces have taken a lead in supporting their communities within this technologically changing and diverse landscape. Librarians, like Diana Rendina of Renovated Learning, have led the way in demonstrating how STEAM activities are ideally placed within library makerspaces (Rendina, 2016).

Indeed, library makerspaces are well placed to facilitate the development of STE[A]M activities, as the following examples illustrate. The Edge, an initiative of the State Library of Queensland, provides opportunities for creation and discovery across the areas of science, technology, arts and enterprise. The space provides an extensive calendar of events and programs, as well as access to a digital media lab, fabrication lab and recording studio. Within each individual space, there is access to related tools and resources, such as Macs, 3D

printers, sewing machines and a CNC machine. Again, Victoria Park Library in Perth, Western Australia, provided maker based library programs including soldering and electronic circuitry, use of open source software, and 3D printing (Kelly, 2013) Likewise, Westport Public Library, in the United States, has established a strong program of presentations and participatory workshops on topics such as robotics, programming, intellectual property rights for inventors, arts and crafts. Auckland Public Libraries in New Zealand also run a number of different makerspaces and makerlabs with activities like robotics, apps, digital music, 3D printing and minecraft. (….)

Makerspaces in academic learning environments also make an important contribution to the development of critical thinking and problem solving skills, which are invaluable for students who, as graduates, will be faced with the challenge of solving real-world problems with innovative solutions. In a recent study of makerspaces in Australian universities, makerspaces are noted as present on 12 of 43 Australian universities websites. Typically, these makerspaces employ specialist staff, contain 3D printers and laser cutters and offer facilities to conduct coursework, personal and collaborative projects. Of these 12 universities, however, only two - Curtin University and University of Southern Queensland - are located in academic libraries (Wong & Partridge) despite the fact that academic libraries are ideal locations for makerspaces by being discipline-neutral, thus providing opportunity for makers across different disciplines to learn new skills, share expertise and explore new possibilities. (Fisher, 2012).

Curtin Library Makerspace and community engagement

While the missions of public libraries are clearly focused on serving the broader community, the role of the academic library in public engagement is not as clear, as its primary commitment is to serve its own university community. However, most universities see community engagement as part of their mission and have demonstrated its value (Leong, 2013; (Scheider, p. 204). In particular, academic libraries engage with different sectors of the community by providing access to collections, information literacy, exhibitions and scholarly events, and special projects in collaboration or partnership with industry groups (Leong, 2013; Dunne, 2009; Courtney, 2008). More recently, makerspaces in academic libraries have offered a new means of engaging with the community.

This is well exemplified in the experience of Curtin University Library, which states that: “Engagement with the broader community, regional, national and international will form part of our activities in support of our vision”. That vision is to be an “international leader in information management: building connections, building communities and building places.” Curtin Library does many things to publicly engage, and the makerspace plays a key role in this aspect of its mission, specifically in relation to fostering lifelong learning and digital literacy.

The Curtin Library Makerspace was established in 2015 as a learning space to encourage the development of skills such as digital literacies, critical thinking, complex problem solving, creative and iterative design and collaborative learning. It invites hands-on exploration of emerging technologies to cultivate expertise for the future workplace. It has peer learning, active participatory learning and self-directed learning and creation at its core and aims to encourage this learning, not only by providing a creative space for people to use for their own maker projects, but by coordinating and facilitating workshops, drop-in sessions, collaborative projects and events.

The physical ‘hub’ of the Library makerspace is within the Robertson Library at the Bentley campus, and is currently located in a converted group study room, storing an array of tools and equipment with a small workspace. It is available for booking and regular drop-in sessions are promoted to staff and students. Users can make specialised materials through use of Makerspace equipment and Library staff deliver, or coordinate presenters for a series of maker workshops of interest to its community. Since it was established, the makerspace has facilitated a number of activities, some of which have been focused on engagement with the wider community. One successful way in which it engaged with the community to foster STEAM skills was by running a National Science Week event called Light Makers.

Light makers @ the Library

One example which illustrates in more detail engagement with the public as participants, as well as with other external organisations - is the makerspace’s involvement in National Science Week when it ran a week long event in August 2014 called ‘Light Makers’ consisting of a series of workshops and events that were designed around the theme of light. With an interest in fostering a cross-disciplinary approach to the development of the makerspace, the emphasis was on celebrating the relationship between science and art through hands on activities providing a STE[a]M (science, technology, engineering, art and math) experience to both the Curtin and wider community, The aim was to provide a STEAM experience to a wide range of community members through participation in a range of hands on maker activities focused on the theme of light, run throughout National Science week. By engaging in the activities provided, participants would develop a range of different skills and new knowledge while exploring scientific concepts in a fun, playful and engaging way.

The event was kickstarted by the Library’s successful application for a small grant from National Science Week of $2000 which funded some equipment, consumables and promotional material. From the outset the event was a collaborative enterprise as the Library partnered with Enkel, a Fremantle based community collective which facilitates and hosts the discovery, development and implementation of innovative ideas and Thornlie Public Library. Within Curtin University itself, the Makerspace team worked with Curtin Teaching and Learning, Curtin Science and Engineering Outreach and Curtin AHEAD (Addressing Higher Education Access Disadvantage).

Over the five days of National Science Week, 17 – 21 September, we facilitated nine hands-on maker workshops, three events, and two school visits, involving over 40 Curtin staff volunteers and over 300 participants. The workshops included creating illuminated origami flowers, inventing with Makey Makeys, exploring sewable electronics, virtual reality (with Google Cardboard) light painting with mobile apps, and lighting images with paper circuitry. We had workshops on Arduino using neo-pixel shields, a soldering/craft workshop making ‘bright bunnies’; and a mini-hack exploring the Trove API.

The ‘Bright Bunnies’ workshop is a good example to illustrate the collaborative and cross-disciplinary nature of STEAM activities. A two hour workshop which involved soldering a circuit board and then sewing a felt bunny to enclose the circuit board. A magnet in a felt carrot turns on a switch when the carrot is near the bunny’s mouth, causing its tummy to light up. Andrew Kelly represented the public library sector, drawing on and sharing his previous experiences in running a similar workshop at Victoria Park Library. The Curtin Engineering team created the circuit boards, hosted the soldering session and provided student mentors to assist. The

Library makerspace hosted the event, purchased the necessary equipment and compiled the kits.

Other sessions included an “Ideas Clash”, facilitated by Enkel, where people presented innovative ideas around lighting collaborative spaces followed by the group brainstorming and discussing innovative ideas. There was a visit from students and staff from Curtin’s Department of Information Studies to discuss the role of makerspaces in libraries and their contribution to STEM learning and awareness. A further two-hour drop-in session enabled the Curtin community to tinker and engage with the range of activities covered in the workshops. Finally, two schools visited and students engaged with a range of maker activities, including makey makeys, making a hologram viewer, creating spiders with eyes that lit up, illuminated origami, and augmented reality.

Although initially the workshops were aimed at Curtin staff and students, registration was open to anyone and promoted on the National Science Week website, quickly attracting the attention of the wider community. Participants were representative of a large range of age groups and areas of the community, with 70% of participants being school age children and adults from the general community and the remaining 30% from the Curtin community. All the activities were well attended, with the more popular workshops being those that involved electronics. The home school community was well represented at the workshops, due to the promotion on the National Science Week website (and from there through the home-school network). There were also participants from community organisations who joined in to learn, experience and formulate ideas to take back to their organisations. Comments about the activities were overwhelmingly positive, with 94% of respondents saying they enjoyed the activity, 85% indicating they learned something new. The most common descriptive words provided in the feedback were “fun”, “cool”, “interesting”, “amazing”, “awesome” and “exciting”. One participant commented that the activities were “challenging and made you think, which is what I liked about it”, while another wrote that: “one hour felt like 15 minutes it was so enjoyable.”

Running the National Science Week event was a valuable experience for those involved. The makerspace team developed relationships with individuals and groups on campus, as well as the external partners/ collaborators with the public library and community sector, which in turn strengthened the growing maker community at Curtin. There was a valuable exchange of knowledge, experience and learning in a new area, enabling significant steps toward contributing to the development of lifelong learning skills. Finally, for library staff, designing, developing and implementing the varied workshops meant they learned new skills and gained valuable experience.

While the benefits of the Light Makers event were evident and celebrated, it nonetheless raised the question of how much the limited makerspace resources, including staff time, should be diverted away from the university’s primary clients (students and staff) toward the wider community. Despite such concerns, the benefits of community engagement are clear: they make libraries relevant to their local communities, connecting people, resources and knowledge; attracting and recruiting new members, students and scholars; and raising funds through collaborative partnerships (Leong, 2013). Moreover, there are significant benefits in community-oriented projects for those within the academic community as well, including students, teaching staff and researchers.

One of the aims of the makerspace is to incorporate maker activities into the curriculum, and community engagement offers a way to do that. Supported by the makerspace, students could be involved in designing and running makerspace sessions for community groups, working alongside experts and collaborating with community organisations such as pubic libraries to design and implement projects. For example, library and information studies students could collaborate with a public library to develop a makerspace learning program for home school families, or cultural heritage/ visualisation students could work with GLAM (Galleries, Libraries, Archives and Museums) industry groups to develop educational interactive learning activities using games technology, augmented or virtual reality. As the “community informatics” model of experiential learning demonstrates students would be involved in community based projects in collaboration with community partners, thus responding creatively and contributing to solving real world problems in response to needs and opportunities (Wolske et al, 2014).

The projects, the process of making and the tools created or used can become subjects of research. There is also scope for research into the process of making itself using the emerging body of theory and practice around ’critical making’, defined as "a mode of materially productive engagement that is intended to bridge the gap between creative physical and conceptual exploration” (Ratto, 2011). There are many opportunities for community engagement through grant-funded partnerships with community organisations, and the development of a “digital scholarship” network or community of practice of which the makerspace is a core component.

Conclusion

Both public and academic libraries have role to play in community engagement through makerspaces, and improving multiple literacies via STEAM activities. Partnerships between both sectors and with government agencies and local schools lead to better knowledge sharing which in turn leads to better and stronger community engagement.

Although spaces within libraries still continue to be dominated by physical collections, the ubiquity of the internet has changed the way communities interact with their libraries as a primary source of information. Embracing a future where users are able to interact with information, technology, space as well as with each other means libraries become the intersection point of technology and learning with the provision of information, bringing together the best of the search for knowledge as well as the creation of knowledge.

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