Establishing a maker culture beyond the makerspace

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Abstract

Purpose – The purpose of this paper is to describe the process of fostering a maker culture in a liberal arts university. It explores the impact of making on student learning and engagement, as well as the role of the library's maker program.

Design/methodology/approach – This paper is a case study that presents the tools and activities used in an academic library's maker program. Structured interviews were conducted with faculty, staff and students to review the program and maker culture influence on campus.

Findings – Findings highlight the library's role in supporting maker culture on a liberal arts campus and address ways making contributes to student engagement and learning. Interviewees also recommend strategies to increase awareness and market the library's maker program to engage a wider community.

Originality/value – Though there are many articles written about the maker movement and libraries, this study contributes to the growing body of research on makerspaces in higher education, with particular focus on a library at a liberal arts university.

Keywords Academic libraries, Higher education, Programming, Case studies, Makerspaces, Maker culture

Paper type Case study

Introduction

The maker movement has gained popularity in academic spaces in recent years, and has been referred to as "the third industrial revolution" (Anderson, 2013). Existing literature has compellingly demonstrated that interdisciplinary education, teamwork and hands-on learning can strategically enhance learning outcomes (Cooper *et al.*, 2001; Salas and Cannon-Bowers, 2001). These findings are consistent with the impetus behind the maker movement, which is by nature interdisciplinary, hands-on and team-based (Sheridan *et al.*, 2014). More and more schools and libraries have embraced the maker movement and many have created makerspaces to engage students and community members. For some institutions it may prove difficult to fund a makerspace, however there are still ways to support making without a dedicated space and even support maker culture beyond it.

This paper will talk about how a mid-sized liberal arts university began to establish a maker culture before having a dedicated space for making, as well as how the university continues to foster a culture of making beyond the makerspace. The authors will describe the variety of activities within the library's maker program and how the program has evolved over the course of a few years. The University of La Verne Wilson Library opened a makerspace two years after starting the program, and the library found that the work done to build a maker community on campus was a significant factor to the program's formation and success. This paper will also provide a review of the library's maker programming through structured interviews conducted with faculty, staff and students. The results highlight the library's role in supporting maker culture on campus and how making contributes to student engagement and learning. Other institutions can provide similar activities discussed in the paper to their community members in order to support maker culture if they are limited in space and funds.

Literature review

Public and school libraries have led the way on establishing makerspaces, but academic institutions have increasingly incorporated making and makerspaces into

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their teaching and learning. A 2015 survey by the Association of Research Libraries revealed that 64 percent of responding libraries in North America are engaged in providing, planning or piloting makerspace services (Altman *et al.*, 2015). Additionally, Patrons as Creators was identified as one of the six key trends in the NMC Horizon Report: 2017 Library Edition, signifying the continued growth and need for support of patron creation and innovation in academic and research libraries (Adams Becker *et al.*, 2017). Makerspaces have been created in a variety of units on campus. Disciplinary departments, technology units and libraries have all taken leadership in initiating and developing makerspaces (Lotts, 2016a; Forest *et al.*, 2014; Morocz *et al.*, 2015). Many makerspaces in higher education focus on specific disciplines like science and engineering, art and education (Dousay, 2017; Herron and Kaneshiro, 2017; Lotts, 2016b, 2017). Others bring people from many disciplines together to pursue common goals, including entrepreneurship and innovation (Delphenich and Broz, 2015; van Holm, 2015, 2017; Kitts and Mahacek, 2017; Nichols *et al.*, 2017). Most of the literature documents maker activity in large research universities; there is very little written on making and makerspaces in smaller institutions (Gierdowski and Reis, 2015; Burke, 2015). This paper provides some ideas for how a small to mid-sized library can develop a maker program for a liberal arts campus.

Background

University of La Verne is a private, four-year, primarily nonresidential university in Southern California with an enrollment of roughly 4,900 undergraduate students and 2,200 graduate students. Approximately 52 percent of undergraduate students major in the College of Arts and Sciences, 35 percent major in the College of Business and Public Management and 13 percent in the LaFetra College of Education. The majority of graduate and doctoral students are enrolled either in the College of Business & Public Management or LaFetra College of Education (Moore, 2018). Though there is no engineering program at La Verne, a dual degree engineering program in partnership with Washington University in St Louis is offered; students receive a physics degree from University of La Verne and an engineering degree from Washington University.

Along with the central campus in La Verne, CA, the university also has eight regional campuses located throughout Southern California, as well as an online program. In total, 65 percent of students are enrolled in main campus programs with 35 percent in regional or online campuses. The Wilson Library supports all locations and is housed within 29,172 square feet on the main campus. Library instruction takes place in all locations including online. The average number of students reached each year through library instruction is roughly 3,600. The library remains busy throughout the fall and spring semesters with an average door count of approximately 1,100 visits per day.

The Wilson Library maker program developed organically. Spurred by faculty interest and led by the technology librarian, the program initially grew to support the use of emerging maker technology without a dedicated space. Once a makerspace was opened, library faculty sought to create a space recognized as an innovation lab open to all on campus, encouraging experimentation and play while integrating its offerings with curricular, co-curricular and personal activities. The maker program is an extension of the university library and shares its vision to be recognized as an innovative and outstanding academic unit enhancing the learning, teaching and scholarship of the La Verne community.

The starting point: 3D printing

The University of La Verne Wilson Library maker program began with a 3D printer. 3D printing technology is considered one of the most innovative services recently brought into the library (Letnikova and Xu, 2017). With the growing number of academic institutions

rethinking library services and implementing programs supporting innovative tools and techniques, the Wilson Library also began to offer a 3D printing pilot service in Fall 2014, using a borrowed 3D printer from the university's physics department.

The printer was placed in the most visible space in the building, beside the exit gate. With one public exit in the library, all students, staff and faculty pass through this single door. Initially, the 3D printer was used to spark interest and run small jobs so passersby would see it in action. The hope was that faculty and students would see the possible connections between 3D printing and their classes or personal interests. Very soon, the first request came in from a humanities faculty member who wanted to 3D print a structure depicting a Mayan temple. From there, the library began receiving requests from other faculty on campus from a variety of disciplines such as anthropology, math, biology and psychology.

From the initial interest, library faculty knew 3D printing would be a useful service to provide to the campus and that the library was an excellent space to host a 3D printer due to its central location. Since the printer was highly visible, many faculty and students made requests, spurring the growth of the library's maker program.

Makers interest group

As the use and interest of the 3D printer grew, library faculty saw an opportunity to further support not only 3D printing and manufacturing in the library, but also to promote maker culture in general on campus. Faculty interested in the maker movement would often stop by the library to chat with the technology librarian. As a result, the forming of the La Verne Makers Interest Group came naturally. Initially, there were 5 faculty members from math, physics, biology and theatre. Seeing the library as an independent unit separate from the colleges, as well as having the largest service population on campus, the faculty asked if the library would be able to form a grassroots committee to engage community members from various disciplines interested in maker activities. No official announcement was made out to the community, however word-of-mouth communication helped to spread the news. Library faculty including the University Librarian publicized the interest group at various committee and administrative meetings on campus.

The library began hosting monthly one-hour meetings for faculty and staff interested in the maker movement in January 2015. In total, 30 campus community members expressed interest, and approximately ten members attended any given meeting. Similar to committee meetings, the library technology librarian gathered topics from various faculty members to add to the agenda. Initial topics included the areas of making in each unit and touring lab spaces, such as the physics laboratory and theatre department's woodshop. Other topics discussed included research and curriculum linked to making, grant applications to expand the library maker program, as well as advising on maker services in the library.

One of the benefits of the group was that it allowed faculty members from different departments to meet and discuss interdisciplinary work and interests. Inherently, making can be linked to any discipline; therefore, it naturally drove interest on campus as a place for faculty to learn what other departments and colleagues were making. The Makers Interest Group met for approximately one year. This was an important growing period of the maker program in which library faculty helped to promote and raise faculty awareness of maker activities on campus. At this point, the library supported two 3D printers with no dedicated makerspace.

Engaging administration

Library faculty also wanted to spread awareness of maker culture and its connection to student learning to administration. In order to gain administrative support and to secure funding, library faculty reached out to university administration including the

President's University Management Council which includes the CFO, CIO and college department heads. Library faculty also met with the Provost Council which includes college deans and academic support unit directors. Faculty from the arts and sciences, as well as student representatives were asked to present alongside library faculty to the various administrative groups in Fall 2015. Reaching out to administration enabled the library to promote and showcase how the maker movement fit into the curriculum, as well as La Verne student life.

Pop-up activities

Finals week activities have become increasingly popular in academic libraries (Meyers-Martin and Borchard, 2015; Jalongo and McDevitt, 2015; Flynn, 2017) and in alignment with the trend, Wilson Library decided to provide stress relief programing during finals. The new program began in Fall 2015 and included therapy dog visits, meditation sessions and an arts and crafts table. The arts and crafts table was added as studies have shown the therapeutic process of artistic expression and creation (Collier and Von Károlyi, 2014; Lyshak-Stelzer *et al.*, 2007). The library wanted to allow students to not only express themselves through hands-on activities and making, but saw the opportunity to also showcase maker technology such as the 3D printing pen.

The arts and crafts table ran for one hour, three to four times the week before and the week during finals that first semester. The scheduled times were chosen based on when students are most likely to come into the library. These times fell within the university's community hour, a time in which no classes are scheduled (Mondays and Wednesdays from 11:45 a.m. to 1:10 p.m.), as well as evening hours and Sunday nights. Student workers directed the activities which included origami, coloring and using a 3D printing pen. Many of the activities are low cost and a great way to encourage making to students.

The tables were set up at the front of the library, with the most foot traffic, and the high visibility helped to draw students in during their study breaks. The library initially ran the table for one hour, but due to feedback of students wanting more time to finish projects, the table now runs for two hours. In addition, pop-up activities are hosted at the front of the library throughout the semester. These include arts and crafts workshops and virtual reality demonstrations. These fun technology demonstrations allow students to experience emerging technology available at the library and be a part of makerspace activities in a low pressure environment.

Mini maker fair and Shark Tank style contest

Maker fairs and mini maker fairs have been held across the maker community, including one hosted at the White House in 2014 (Halverson and Sheridan, 2014; Peppler and Bender, 2013). Fairs bring makers together to share knowledge and showcase their projects, and can also increase awareness of maker tools and activity in a campus community. Wilson Library held its first mini maker fair in April 2016. The fair provided an opportunity for faculty, staff, students, and members of the community to showcase a range of projects using maker technology and crafts. There were multiple goals for the fair including bringing different library and university constituents together, raising awareness of the maker movement to a wider university community, and demonstrating some of the maker tools available in the library.

The event took place during a time of the day when no classes were scheduled. Participants signed up through the library website and each individual or group was provided with one table and two chairs for their project. In order to boost attendance and encourage exhibitors to promote their projects, the committee offered a $500 audience prize for the most popular table at the fair. Upon entering the exhibit space, attendees were given three tickets which they were free to distribute among ballot boxes on each exhibitors' table,

to vote for their favorite. The planning committee originally planned to hold the fair in the park just outside of the library, however, due to weather, the event was moved indoors.

In total, 36 participants, working alone and in groups, displayed 23 maker projects. Some of the technical projects included a ping-pong ball vacuum cannon, a gumball machine powered by a hand knock, a re-engineered retro commodore computer and a rebuilt motorcycle. Art projects included repurposed jewelry, glass bottle designs, a lap loom and paper crafts. Groups of students also exhibited projects related to their coursework. Professors and staff from math, biology, chemistry and business departments exhibited alongside their students, and students from a math + theatre course displayed four class projects. The library also used several tables to showcase maker resources available in the library. Student library workers were stationed at each table using resources like the 3D printing pen and displayed objects made using the 3D printer. Attendees also played games using bananas and a Makey Makey, a device that creates a physical interface to computers using everyday objects (Peppler *et al.*, 2016).

Seven exhibitors signed up to compete in a Shark Tank style contest that took place during the second half of the maker fair. In a format loosely based on the popular television program, participants pitched their projects in front of an audience of attendees and judges. The event gave exhibitors an opportunity to formally present their ideas and innovations, get feedback from a panel made up of faculty and board members and compete for prize money. Competitions, like the Shark Tank style contest, promote entrepreneurship and innovation which are values central to maker culture (Carlson, 2015; van Holm, 2015).

The committee solicited feedback about the maker fair and shark tank style event both formally, through surveys distributed to exhibitors, and informally, by talking with attendees. In general, exhibitors said they appreciated the opportunity to share their projects and talk with other makers. However, many complained that the library was too small to give adequate space to everyone. Attendees also generally agreed that seeing the range of projects on display was enjoyable. Feedback about the shark tank style contest, however, was varied and sometimes conflicting. Many exhibitors enjoyed the contest even if they did not win prizes; however, some faculty felt that the competition was antithetical to the spirit of community, collaboration and sharing at the heart of the maker movement (Foster *et al.*, 2014). Even the faculty and staff who saw no problem with competition, could not agree on the criteria that should be used to judge the pitches and projects. After much deliberation and debate, the planning committee decided not to hold Shark Tank style competitions in future fairs.

Opening of the makerspace

In July 2016, the Wilson Library was able to open its first iteration of a makerspace in a small, 335 square foot room that was previously used as a quiet study room. The technology in the room was limited due to space as well as budget. Students, faculty and staff were able to access the room and technology only by appointment. This was due to staff availability as well as to ensure that all visitors to the makerspace were properly trained to operate the equipment safely and correctly. In July 2017, the makerspace relocated to a 550 square foot room as a result of expanding services, new equipment and ventilation needs for a laser cutter. At this point, the makerspace began to offer regular open hours, weekdays between 9 a.m. to 6 p.m. and opened only by appointment on weekends. The 3D printer was also moved out of the lobby area and into the space.

Located on a liberal arts campus, the makerspace was designed to attract all disciplines, catering to those interested in not only science and technology but also the arts and humanities. The largest constraint of the makerspace is the limited room. Large equipment cannot fit in the current space. Equipment purchased for the space include 3D printers, a laser cutter, microcontroller kits and a virtual reality set. Crafting tools are also offered

such as a Cricut die-cutting machine and sewing machine. Makerspace staff develop a wish list each year based on trends of emerging technologies. Budget is a key factor in the procurement process. Faculty input is also taken into consideration. For example, an English professor suggested the purchase of a button maker, which has since become one of the more popular items in the makerspace, used in pop-up activities and borrowed by student clubs on campus.

Operation of the makerspace

The makerspace is primarily staffed by student workers who are paid from Federal Work-Study and the library budget. Students are supervised by one full-time library staff member. The technology librarian is not involved in daily operations, but works closely with the staff supervisor to develop programs and events.

Student employees demonstrate a high degree of skill with technology, research, problem solving, and customer service. Some student staff are studying STEM fields, but many are from other disciplines including history, business and English literature. No prior experience with maker technology is required. Instead, the library looks for students who demonstrate an aptitude for troubleshooting and a strong customer service orientation. Since they will be working with emerging technologies, students will often get a variety of questions they do not know the answers to. Therefore, it is important that they have an inclination to research in order to solve problems, and have the willingness to ensure that makerspace users get all the help that they need.

When students are hired, they are trained on approximately ten frequently asked questions and software issues. During the orientation process, staff members pay attention to students' interests and aptitudes so that later they can be supported to further develop particular expertise (Burke and Kroski, 2018). All student workers are trained to provide basic help in makerspace technology, but also specialize in one or two particular areas, such as video production, sewing, coding or 3D modeling.

The makerspace trains and develops student workers using a collaborative, peer-to-peer model that enriches learning and allows students to maximize their talents and experiences (Elliott *et al.*, 2018). Junior student workers shadow senior student workers for at least six months while building their skills. In the past, student workers within libraries have been looked on as a low skill resource; however this is changing, as libraries are now seeking to hire students who can bring a variety of skills and capabilities to workflows and projects (Logan, 2012). In addition, peer-to-peer learning can enhance students' college experiences by providing community and support, connecting students to one another and the university community at large (Mitchell and Soini, 2014).

The makerspace in the curriculum

The makerspace is used by faculty for teaching and learning in several ways. Many request 3D printing of instructional objects for use in the classroom. A psychology professor passes around a 3D printout of Phineas Gage's head injury to help students identify regions of the brain and its impact on behavior. A humanities faculty member supplements his lectures with architecture models because he values how touch adds to visual and auditory modes of learning. Also, an anthropology professor uses 3D reproductions of new fossil finds to illustrate properties that cannot be seen in two dimensional photos.

Several faculty members encourage their students to incorporate making into their academic work. An English professor brings students to the makerspace for a tour to introduce them to tools they can use to create multimedia. Art faculty have promoted the makerspace as a place to produce senior projects. One art major used the 3D printer to make an avant-garde dress with accessories that is now on display at the library's reference desk.

A few faculty assign makerspace lab time in their courses. Students in an education class can explore tools in the makerspace to fulfill their field work requirement. Over the last four semesters, students in two general physics courses have been able to earn extra credit by signing up to spend one hour per week in the makerspace learning about circuit boards. The physics students begin the semester receiving instruction on microcontrollers from the makerspace student workers, and then go on to design circuit projects that showcase their new knowledge and skills. Over the terms, makerspace staff have noticed that the physics students become absorbed in their work, often spending time beyond the one hour per week required by the professor.

Mini maker fair 2017

A second mini maker fair was held in Spring 2017. The 2017 maker fair was similar to the 2016 fair, but with a few adjustments due to feedback and observations from the first year. In total, 27 participants displayed 16 projects. The event was held outside of the library which provided exhibitors and attendees more space to set up and move around the projects. Holding the event outdoors also increased the fair's visibility and attracted campus passersby who may not have intended to come to the event. The mini maker fair was held during the community hour to attract campus members during their lunch break or between classes.

Exhibitors included a mix of students, faculty and staff. One exhibitor displayed a homemade arcade game. The fair also included several student teams from the physics department that often used the library's makerspace to work on projects. One particular physics class that worked with the technology librarian resulted in several entries in the 2017 Mini Maker Fair.

In the first fair, an audience prize for the most popular exhibit was given; however in the second year, the planning committee decided to offer raffle drawings, rather than a direct prize. This allowed several smaller prizes to be given out which included three $100 gift cards to exhibitors and three $25 Amazon gift cards randomly awarded to attendees who filled out survey forms.

Both attendees and exhibitors were surveyed. The surveys were online and the attendee survey was easily available on iPads during the event. Many exhibitors in the 2017 fair were disappointed that an audience prize was no longer awarded. Exhibitors also wished the library would grow the event more and increase participation from the wider campus community as well as the local area. Attendees were asked how they learned about the event, what they enjoyed the most, how familiar they were with maker culture before the event, and whether the fair made them interested in visiting the library's makerspace. The audience award will likely be offered at the next fair due to exhibitor disappointment. It also seemed that the audience award motivated exhibitors to ask friends to attend, thus increasing fair attendance.

Robotics Summer camps

The library began offering an Introduction to Robotics Summer camp in June 2017. The camp enrolled 7th to 12th grade students in a week-long program during which they learned to build a robot from scratch. The enrollment was capped at 6 in order for students to receive personalized attention. Campers engaged with 3D printing, modeling, coding, and used Arduino Uno. Arduinos are devices that provide a link between hardware, such as light sensors and motors, and the software program that directs the hardware (Burke, 2014). Library student workers assisted in the camps and were able to gain valuable instruction and course design skills in the process. A campus wide e-mail was sent out to the La Verne community. Word-of-mouth marketing also helped to advertise the program. Additionally, a

flyer was posted on the makerspace webpage which enabled other populations to find the posting through web searches.

The Summer camps were developed for several reasons. Staff and student workers had an interest in robotics. It was also a way to generate revenue to balance the cost of the makerspace during the Summer. In order to accommodate classes and research through the Summer, the makerspace remains open despite low usage. Summer is also a time for training student workers. With the makerspace less busy, students are able to practice their skills as well as engage in more in-depth projects to build specialized skills. Furthermore, the camp aligns with one of the core values of the University of La Verne, the commitment to improve and enhance local communities. The makerspace concept in the community is emerging and the library wanted to promote maker technology to the wider community especially to local middle school and high school students.

Four week-long camps were offered through the Summer months. The camps were designed to host students aged 12 to 18, for four hours a day for five days. Three student workers and one staff member ran the program. Each student worker was responsible for one instruction portion of the program such as 3D printing and design or coding and design. Preparation for the Summer camp began approximately six months prior to the start of the camp. Robot kits were researched; safety, assembly difficulty and robustness of wheels were taken into account. Once a robot kit was chosen, it was purchased and prepared along with other items such as wires and pre-printed parts in order to save time. Campers would then be able to focus more on experimentation and design.

Assessment

As these activities took place on campus, some forming organically, others through careful planning, a maker culture started to take shape. The maker program evolved to include curriculum support, arts and crafts workshops, game nights and virtual reality demonstrations. Maker fairs and robotics camps are also held annually. Evaluations are collected from participants after many individual maker events, but the library decided to assess the program as a whole. The authors conducted interviews to determine how the library fits within the maker community on campus, how making can contribute to student learning and engagement, and what the library can do to expand its support services.

Methodology

Between June and September of 2017, 11 interviewees consisting of faculty, staff and students at the University of La Verne were interviewed using a questionnaire. Interviews with current members of the makerspace community were chosen as the assessment method because open-ended questions are recognized as a valuable way to gather detailed information on how users think and feel about programs and services (Radcliff *et al.*, 2007). The authors developed questions and optimized them after conducting a pilot interview. Each interview was approximately 30 min in length. Ten of the interviews were conducted in person, and one was conducted by telephone.

Potential interviewees were recruited from a community of core users. Examples of some of the making done by participants include creating 3D prints, developing a digital display using a microcontroller and constructing an LED cape. The participants were selected to represent a variety of disciplines in business, education, arts and sciences, as well as university statuses, from faculty to staff to students. Volunteers were recruited via e-mail. For each interview, an audio recording was made and used to create a written transcript of the session. Though participants ranged in background, many viewed maker culture in similar ways. Coded data summarizing the sessions were gathered across interviews to derive common themes. This served as the basis for the analysis below.

Interview questions

Interviews were conducted by two interviewers, which allowed for dialogue as well as requests for clarification and elaboration. Every interview included the following questions:

(1) Please state your ULV status (faculty/staff/student) and college/department; and tell us how familiar you are with maker culture and making.

(2) How do you see maker culture contributing to student learning and student engagement at La Verne, which is specifically known as a liberal arts, HSI, non-engineering institution?

(3) Can you share an experience where you [or your students] used maker technology in the library and what you learned?

- What was valuable about it?
- Were there any challenges?
- Did you work individually or collaboratively using maker technology?

(4) What do you see as the role of the library in establishing and supporting a maker culture?

(5) What can the library do to increase interest in the makerspace and making culture on campus?

(6) How could the library support the integration of maker culture and making into your courses (and curriculum)?

(7) Is there anything else you would like to say about the library makerspace and/or maker culture on campus?

The library's role

Interviewees were asked what they believed to be the role of the library in creating and supporting a maker culture on campus. Participants generally saw the library as occupying an important role, both because of its physical location on campus and how it is perceived by the university community. Notably, many answers commented on the value of the library as a whole, not limited to the makerspace and equipment.

Several participants talked about the library's central placement on campus. The library is visible and adjacent to a campus park, where many university events are held. One staff member observed, "I think the library is a hub for the entire campus since it's in a centralized location." Staff and faculty also noted that it is a space that is separate from disciplinary departments and is thus seen as a neutral space (Harris and Cooper, 2015). The library was described as a communal space, where people from different disciplines can come together. Collaboration across disciplines was described as central to making culture and the library was seen as a natural space for people to gather.

Participants also discussed the library's perception in the community. Comments by staff like, "It's a space that is just open to everybody and feels open to everybody. It's a space that serves all disciplines on campus" and "It's a place where any student from any major can come in" were typical. Participants also described the library as a welcoming space. It was talked about as a good place for students to experiment and take chances through making because it's a place where people know they can get help and are comfortable asking questions and making mistakes. Many described the library as a place for learning and one student noted "the makerspace is definitely a room for learning." In addition, participants recognized the range of technology resources the library has offered for a long time and saw that makerspaces and making equipment were a natural extension of library services and resources.

Student learning and engagement

Additionally, participants were asked how they saw maker culture contributing to student learning and student engagement. Interviewees, particularly the students and staff, remarked how maker culture has the ability to spark imagination and resourcefulness. One staff member noted that maker culture is about "finding ways to be creative" when working on and executing projects. Another staff member mentioned how making "provides a way for students to express their creativity." A student also shared how maker culture encourages "out-of-the box thinking." They discussed how there are no strict rules to making, so they are free to create and make up their own rules using any and all resources available to them.

A number of interviewees also discussed interdisciplinary collaboration. Some noted the different majors and disciplines drawn to maker culture. The maker community has the ability to foster ideas from a diverse set of thinkers and encourages sharing and collaboration. One student noted, "I am an English major. I've seen other students who are Art majors really take to this. It's not just for STEM." A faculty member also remarked that problem-solving is essential in many disciplines and maker culture supports every student.

In addition, interviewees shared how maker culture can increase student motivation and participation. One student explained how a great aspect of maker culture is that "it gets at what people are interested in." A faculty member noted, "I find it helps them inhibit their feelings about the pitfalls of making a mistake." Even if a student made a mistake, it wouldn't be seen as too bad; they can go back and correct. A staff member also observed how students from different majors are able to learn from each other. Students are not afraid to take on unfamiliar projects or subject matters since they're able to reach out to other students. This further supports the view that makerspaces encourage exploration and collaboration, allowing the chance for students to embrace failure as a positive part of learning and even seek out challenges beyond their comfort zone (Lotts, 2017; Fleming, 2015).

Having support available to students through the library was also highly valued. One faculty member noted that support is absolutely necessary, and that students may not know what to do or might be intimidated by unfamiliar technology. Support was also valued in terms of time management and in regards to learning and working on complex projects. One staff member shared how he would rather "use time wisely, which would mean having a guide that would help me so I wouldn't have to make all the mistakes I would normally have to make to become an expert at something." Therefore, having someone available to provide training and assistance becomes crucial to their process.

Having a maker culture thrive on a university campus facilitates collaboration across disciplines and fosters creativity. Having the support while working on projects also helps to motivate students to learn unfamiliar technology and can inspire them to pursue their interests. Whether students engage in maker activities in the classroom, at the library or at home, it is clear that making provides students with many benefits in support of their education.

Expanding the program across campus

The authors also wanted to learn how the library could improve and expand its maker program across the La Verne campus. In general respondents gave the program high marks. The support provided by the library was highly regarded, though a number of interviewees believed the program should focus on marketing more to boost awareness. Also, curriculum integration was highlighted as a way to reach more students on campus.

Interviewees emphasized increasing awareness of the makerspace and one faculty member even noted, "People don't know its existence." Interviewees made a number of marketing suggestions such as publicizing student makerspace projects in the library, having booths at student centered events on campus, and getting more clubs involved in

maker activities. Since clubs on campus draw from a wide swath of students, outreach from the library would be beneficial. Diversifying the types of events through the makerspace was also suggested by faculty and students, such as inviting more speakers and incorporating more arts and crafts to show that the makerspace is not just focused on technology. Visibility on campus and offering maker programs are key to expanding knowledge and use of the makerspace (Willingham *et al.*, 2018). Due to the lack of awareness, there has been difficulty introducing new users to the space and the tools and resources available to them.

Integrating making into more courses was also considered by many interviewees as an important way to expand the maker program. One faculty noted, "I have a couple maker assignments in my class," but to make it easier for faculty, suggested that the library help by providing ideas of maker activities or modules for courses. A faculty member also suggested that librarians invite themselves into classes to give guest lectures on the topic of making and maker culture.

Conclusion and recommendations

Based on the combined efforts of the library, the participating faculty, staff and the student workers of the makerspace, the authors derived the following conclusions and recommendations for others looking to establish a maker culture at similar institutions. Wilson Library started with a single 3D printer in a visible location of the library, sparking new ideas and creative possibilities in the curriculum. Place emerging technology in visible locations to allow people to see how it works, instead of placing it in closed off areas.

Next, engage the campus community through a variety of channels. The Wilson Library's maker program would not have grown without the support of faculty, administration and students. The library reaches out to faculty to collaborate, offers class tours, purchases equipment based on faculty recommendations, and provides tools and technology that faculty use in their research and teaching. Students are engaged throughout the year with fun activities like pop-up workshops and demonstrations in the library. The maker fair engages student makers as well as students in the larger community who attend the fair. In addition, library faculty made a point to reach out to administration in order to showcase the impact of making on students. These steps helped to establish a maker culture in the community and continues to support it. Many of these activities occurred outside of the makerspace. Without a dedicated space, a maker culture can still be supported through targeted programming.

The authors also recommend identifying one or two very engaged faculty to work with closely. These star faculty can provide the opportunity to show others what can be done with making and maker tools. The Wilson Library technology librarian works with several physics faculty and uses their classes and projects as examples to show other faculty the possibilities of using maker technology in courses.

Also, be aware that small steps can lead to larger outcomes. Small arts and crafts pop-up events expose students to the larger activities of the makerspace. It also allows student workers in the makerspace to take on larger roles, such as planning and leading pop-up activities, interacting with attendees during the event, helping them to grow a variety of non-technical skills. These small, low cost events also provide a large amount of goodwill and positive feedback for the library and maker program.

The Wilson Library makerspace would not function without the exceptional work of its student workers. The library takes care to invest in training time and allows student workers to follow their interests. Hire students who are creative problem-solvers and do not focus solely on technical skills, as these can always be acquired on the job. Support the interests of student workers and staff; it can help to create unique opportunities such as the robotics Summer camp.

Looking back, there were also lessons learned. The Shark Tank style event in the 2016 Mini Maker Fair was discontinued as it did not suit the values the library wanted to convey. The following year, the fair was designed to be more equitable with less focus on monetary prizes. For pop-up events, some activities were too open-ended and unclear, leading to student confusion. As a result, the library focused on more specific activities such as ornament making and button making, leading to increased student attendance and engagement. Also, an assessment of the library's maker program confirmed that maker culture is valued on campus; though it is clear that there are still several challenges in marketing and further curriculum integration that need to be addressed.

Finally, the authors' overall recommendation would be to keep planning and trying new things. Establishing and supporting a maker culture on a university campus can yield many benefits. Even without a dedicated space, libraries can provide activities and engage in conversations that encourage making and support a maker community. Holding an annual mini maker fair has enabled this library to showcase faculty, staff and students' creative works, reinforcing the significance of making to the campus community. Furthermore, offering a robotics Summer camp extends the value beyond the university into the local community. Based on the research and the library faculty's strategic goals, the authors plan to continue to focus on engagement and outreach, not only to the wider campus community but the local community as well.

References

Adams Becker, S., Cummins, M., Davis, A., Freeman, A., Giesinger Hall, C., Ananthanarayanan, V., Langley, K. and Wolfson, N. (2017), "NMC horizon report: 2017 library edition", The New Media Consortium, Austin, TX, available at: www.nmc.org/publication/nmc-horizon-report-2017-library-edition/ (accessed June 26, 2018).

Altman, M., Bernhardt, M., Horowitz, L.R., Lu, W. and Shapiro, R. (2015), *SPEC Kit 348: Rapid Fabrication/Makerspace Services*, Association of Research Libraries, Washington, DC, available at: http://publications.arl.org/Rapid-Fabrication-Makerspace-Services-SPEC-Kit-348/ (accessed June 26, 2018).

Anderson, C. (2013), *Makers: The New Industrial Revolution*, Crown Business, New York, NY.

Burke, J. (2014), *Makerspaces: A Practical Guide for Librarians*, Rowman & Littlefield Publishers, Blue Ridge Summit, PA.

Burke, J. (2015), "Making sense: can makerspaces work in academic libraries?", available at: www.ala.org/acrl/sites/ala.org.acrl/files/content/conferences/confsandpreconfs/2015/Burke.pdf (accessed June 26, 2018).

Burke, J.J. and Kroski, E. (2018), *Makerspaces: a Practical Guide for Librarians*, Rowman & Littlefield Publishers, Washington, DC.

Carlson, S. (2015), "The maker movement goes to college", *Chronicle of Higher Education*, Vol. 61 No. 32, pp. A26-A28.

Collier, A.F. and Von Károlyi, C. (2014), "Rejuvenation in the 'making': lingering mood repair in textile handcrafters", *Psychology of Aesthetics, Creativity, and the Arts*, Vol. 8 No. 4, pp. 475-485.

Cooper, H., Carlisle, C., Gibbs, T. and Watkins, C. (2001), "Developing an evidence base for interdisciplinary learning: a systematic review", *Journal of Advanced Nursing*, Vol. 35 No. 2, pp. 228-237.

Delphenich, P. and Broz, D. (2015), "Garage innovation+ higher education = the academic incubator", *Planning for Higher Education*, Vol. 43 No. 4, pp. 10-12.

Dousay, T.A. (2017), "An evolving makerspace for teacher education", *International Journal of Designs for Learning*, Vol. 8 No. 1, pp. 69-81, available at: https://doi.org/10.14434/ijdl.v8i1.22672 (accessed June 26, 2018).

Elliott, C.R., Vandenbark, R.T. and TeKippe, S. (2018), "An ELITE service model: creating and implementing a peer-to-peer library tech support team", *College & Undergraduate Libraries*, Vol. 25 No. 2, pp. 110-121.

Fleming, L. (2015), *Worlds of Making: Best Practices for Establishing A Makerspace for Your School*, Corwin Press, Thousand Oaks, CA.

Flynn, H. (2017), "Beyond therapy dogs: coordinating large-scale finals week activities", *Public Services Quarterly*, Vol. 13 No. 2, pp. 117-123.

Forest, C.R., Moore, R.A., Jariwala, A.S., Fasse, B.B., Linsey, J., Newstetter, W., Ngo, P. and Quintero, C. (2014), "The invention studio: a university maker space and culture", *Advances in Engineering Education*, Vol. 4 No. 2, pp. 1-32.

Foster, C.H., Lande, M. and Jordan, S.S. (2014), "An ethos of sharing in the maker community", paper presented at the 2014 ASEE Annual Conference and Exposition, June 15-18, Indianapolis, IN, available at: https://peer.asee.org/19892 (accessed June 26, 2018).

Gierdowski, D. and Reis, D. (2015), "The mobile maker: an experiment with a mobile makerspace", *Library Hi Tech*, Vol. 33 No. 4, pp. 480-496.

Halverson, E.R. and Sheridan, K. (2014), "The maker movement in education", *Harvard Educational Review*, Vol. 84 No. 4, pp. 495-504.

Harris, J. and Cooper, C. (2015), "Make room for a makerspace", *Computers in Libraries*, Vol. 35 No. 2, pp. 5-9.

Herron, J. and Kaneshiro, K. (2017), "A university-wide collaborative effort to designing a makerspace at an academic health sciences library", *Medical Reference Services Quarterly*, Vol. 36 No. 1, pp. 1-8.

Jalongo, M.R. and McDevitt, T. (2015), "Therapy dogs in academic libraries: a way to foster student engagement and mitigate self-reported stress during finals", *Public Services Quarterly*, Vol. 11 No. 4, pp. 254-269.

Kitts, C. and Mahacek, A. (2017), "The Santa Clara university maker lab: creating the lab, engaging the community, and promoting entrepreneurial-minded learning", paper presented at the 2017 ASEE Annual Conference and Exposition, June 24-28, Columbus, OH, available at: https://peer.asee.org/29011 (accessed June 26, 2018).

Letnikova, G. and Xu, N. (2017), "Academic library innovation through 3D printing services", *Library Management*, Vol. 38 No. 4, pp. 208-218.

Logan, F. (2012), "Student workers: essential partners in the twenty-first century academic library", *Public Services Quarterly*, Vol. 8 No. 4, pp. 316-325.

Lotts, M. (2016a), "On the road, playing with Legos®, and learning about the library: the Rutgers university art library Lego playing station, part two", *Journal of Library Administration*, Vol. 56 No. 5, pp. 499-525.

Lotts, M. (2016b), "Playing with LEGO®, learning about the library, and 'making' campus connections: the Rutgers university art library Lego playing station, part one", *Journal of Library Administration*, Vol. 56 No. 4, pp. 359-380.

Lotts, M. (2017), "Low-cost high-impact makerspaces at the Rutgers university art library", *Art Documentation: Journal of the Art Libraries Society of North America*, Vol. 36 No. 2, pp. 345-362.

Lyshak-Stelzer, F., Singer, P., Patricia, S.J. and Chemtob, C.M. (2007), "Art therapy for adolescents with posttraumatic stress disorder symptoms: a pilot study", *Art Therapy*, Vol. 24 No. 4, pp. 163-169.

Meyers-Martin, C. and Borchard, L. (2015), "The finals stretch: exams week library outreach surveyed", *Reference Services Review*, Vol. 43 No. 4, pp. 510-532.

Mitchell, J. and Soini, N. (2014), "Student involvement for student success: student staff in the learning commons", *College & Research Libraries*, Vol. 75 No. 4, pp. 590-609.

Moore, L. (2018), "University of La Verne Fact Book 2013-2017", University of La Verne, La Verne, CA, available at: https://laverne.edu/institutional-research/reports-publications/fact-books/ (accessed December 3, 2018).

Morocz, R., Levy, B.D., Forest, C.R., Nagel, R.L., Newstetter, W.C., Talley, K.G. and Linsey, J.S. (2015), "University maker spaces: discovery, optimization and measurement of impacts", paper presented at the 2015 ASEE Annual Conference and Exposition, June 14-17, Seattle, WA, available at: https://peer.asee.org/24967 (accessed June 26, 2018).

Nichols, J., Melo, M.M. and Dewland, J. (2017), "Unifying space and service for makers, entrepreneurs, and digital scholars", *Portal: Libraries and the Academy*, Vol. 17 No. 2, pp. 363-374.

Peppler, K. and Bender, S. (2013), "Maker movement spreads innovation one project at a time", *Phi Delta Kappan*, Vol. 95 No. 3, pp. 22-27.

Peppler, K., Halverson, E. and Kafai, Y.B. (2016), *Makeology: Makerspaces As Learning Environments*, Routledge, New York, NY.

Radcliff, C.J., Jensen, M.L., Salem, J.A. Jr, Burhanna, K.J. and Gedeon, J.A. (2007), *A Practical Guide to Information Literacy Assessment for Academic Librarians*, Libraries Unlimited, Westport, CT.

Salas, E. and Cannon-Bowers, J.A. (2001), "The science of training: a decade of progress", *Annual Review of Psychology*, Vol. 52 No. 1, pp. 471-499.

Sheridan, K.M., Halverson, E.R., Litts, B.K., Brahms, L., Jacobs-Priebe, L. and Owens, T. (2014), "Learning in the making: a comparative case study of three makerspaces", *Harvard Educational Review*, Vol. 84 No. 4, pp. 505-531, 563-565.

van Holm, E.J. (2015), "Makerspaces and contributions to entrepreneurship", *Procedia-Social and Behavioral Sciences*, Vol. 195, pp. 24-31, available at: www.sciencedirect.com/science/article/pii/S1877042815036460

van Holm, E.J. (2017), "Makerspaces and local economic development", *Economic Development Quarterly*, Vol. 31 No. 2, pp. 164-173.

Willingham, T., Stephens, C., Boer, J. and Willingham, S. (2018), *Library Makerspaces: the Complete Guide*, Rowman & Littlefield, Lanham, MD.

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