Making Sense: Can Makerspaces Work in Academic Libraries?

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Introduction

Makerspaces are a growing service area for many libraries in school, public, and academic settings. Participants, or makers, can create digital and physical items in common working spaces using shared equipment and resources. The essential makerspace elements of makers, tools, space, and shared expertise are also often joined by a spirit of individual exploration and discovery through creative activities.

One area of balance in makerspaces is in providing group training on specific creative activities while also offering open lab times in the makerspace for individuals to work independently or in small collaborative groups on their projects. This is particularly acute in the academic environment, where lab spaces (whether for computers, biology, chemistry, engineering, or nursing) are often imagined for use by classes of students working on an assignment or project. Can an open, self-directed approach work in an environment where much learning is encapsulated in semester-long courses and student learning is assessed by assignments with relatively rigid timelines and criteria? The alternative, maker-focused mindset would allow for tinkering and play to be utilized by makers as they create and learn.

Makerspaces can be a mechanism for encouraging students to experiment and learn beyond the classroom and outside of the normal structure of their assignments. Students are encouraged to examine new means of creation and in doing so they strengthen and apply more broadly the learning they experience in their courses. The following paper presents a positive case for pursuing an academic library makerspace and helpful steps to pursue.

The Rise of Library Makerspaces

Makerspaces have existed in various forms as long as people have been making items and have needed places to work with tools and equipment. The rise of makerspaces as a concept began around 2005 with the beginning of *Make:* magazine and its promotion of creative projects and methods for making. The magazine's publisher also began offering a series of "maker faires" around the United States and internationally that showcased the efforts of makers.[1] In the years that followed, libraries began to host making activities in their programming options and to establish dedicated makerspaces. Librarians also began to recast some of the creative activities and devices already present in their buildings as making activities, such as video and audio capture, large format printing, art-related workshops, music recording spaces, and so forth. With an international network of makers already present and sharing their projects, techniques, and technologies, library staff members could build on their initial inspirations and develop larger makerspace programs.

A 2013 survey of library makerspaces by the author sheds some further light on the state of library makerspaces.[2] 109 librarians responded to a Web-based survey, indicating that their libraries either currently hosted makerspaces or were close to launching makerspaces. Respondents answered 14 questions about their makerspaces, including their location, what type of library they worked in, how long their makerspace had been in place, and what types of making technologies and activities they offer. Respondents represented libraries from 30 U.S. states and seven other countries. The majority of respondents

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came from public libraries (51%), with the next largest group working in academic libraries (36%). Nearly half of the respondents' makerspaces were less than one year old (46%), but 11% had been in place for more than two full years. The most commonly represented making activities and technologies are shown in table 1.[3] Digital technologies such as video and image editing, computer programming, and animation are very common among library makerspaces, but activities ending in physical products like 3D printing or arts and crafts were also well represented. The last item in the list, tinkering, may point toward the presence of independent experimentation with products and items to see how they work and to learn through troubleshooting them.

TABLE 1
The 15 Most Common Technologies and Activities in Library Makerspaces

Technology or Activity	# Libraries	% of All Respondents
Computer workstations	73	67%
3D printing	50	46%
Photo editing	49	45%
Video editing	47	43%
Computer programming/software	43	39%
Art and crafts	40	37%
Scanning photos to digital	39	36%
Creating a website or online portfolio	37	34%
Digital music recording	36	33%
3D modeling	34	31%
Arduino/Raspberry Pi	33	30%
Other	33	30%
Animation	31	28%
High quality scanner	31	28%
Tinkering	28	26%

Making Activities and Technologies in Library Makerspaces

The application of makerspaces in academic, public, and school libraries has been primarily guided by the environments in which these three types of libraries operate. While there are common elements to every makerspace, those in academic libraries do exhibit some differences. When academic library responses were isolated from the author's survey, they illustrate something of a different focus. Table 2 shows a list of the most common technologies and activities from academic library makerspaces. There are stronger showings for creative activities resulting in digital products, such as websites, digital photos, programs, apps, and games. Arts and crafts, tinkering, and the well-represented category of "Other" have dropped from the list entirely. The contents of that "Other" list tended to include more physical making activities (such as button making, hand tool collections, and LEGOs), and may further point to an academic library makerspace tilt toward digital creation.

Unfortunately, the survey did not allow for a fuller exploration of this distinction in academic library makerspaces. It is possible that, at least among the surveyed libraries, academic makerspaces tend to be focused more on discipline-related projects that involve product modeling and prototyping for engineering, design, or marketing. That might account for the higher ranking of those activities. It might further indicate that academic library makerspaces tend to be created to meet curricular goals at an institution rather than as venues for independent discovery and creation activities. This is purely speculation, though, and this divide between assignment-dependent and –independent use of makerspaces will be explored further in the makerspace profiles that follow.

Profiles of Academic Library Makerspaces

The following profiles of existing academic library makerspaces demonstrate what this concept looks like within actual libraries. They represent different methods for creating and using makerspaces in higher education.

TABLE 2
The 16 Most Common Technologies and Activities in Academic Library Makerspaces

Technology or Activity	# Libraries	% of All Respondents
Computer workstations	25	67%
Photo editing	20	54%
3D printing	18	49%
Creating a website or online portfolio	18	49%
Video editing	18	49%
Scanning photos to digital	15	41%
3D modeling	14	38%
High quality scanner	13	36%
Computer programming/software	12	33%
Digital music recording	11	31%
Animation	8	23%
Creating apps	7	21%
Game creation	7	21%
Prototyping	7	21%
VHS conversion equipment	7	21%
Electronic music programming	7	21%

Valdosta State University is a public university located in Valdosta, Georgia. Staff at the Odom Library created a makerspace by repurposing an unused room to give students a place to work on digital media projects. Library staff members were able to equip the makerspaces by repurposing surplus equipment from the campus' IT department, surplus furniture from elsewhere in the university, and by gaining internal grants to buy 3D printers. The space is meant to be scheduled and used by interested students as they complete projects with only minimal library staff time investment in maintaining the equipment. In addition, library staff members offer regular workshops to teach students how to use the technologies or complete their projects independently. The focus at Valdosta has been to give new purpose to unused library space while also making new technologies available to students.[4]

At the College of San Mateo, a community college in San Mateo, California, the library makerspace began as an attempt to serve students in a new way. That involved building a community of makers by asking students what they were interested in making and reaching out to faculty and staff to teach workshops. This led to a more student-driven plan for choosing making activities to offer and technologies to purchase. It also meant that an open call for workshop leaders brought to light hobbies and talents that are not used in the regular duties of those faculty and staff members. The library staff members were able to collaborate with the engineering, art, and fashion clubs on campus, and the library was awarded a grant for innovative programs offered by the institution's president to fund additional activities. They have offered jewelry making, terrarium-building, 3D printing, and soldering workshops. They hope to see faculty members add hands-on making activities in their classes.[5]

Ferrum College is a private, four-year institution in Ferrum, Virginia. The Stanley Library's director decided to create a digital media center in the library by first hiring a librarian into a new position: systems and emerging technologies librarian. They began by purchasing a green screen kit, some digital cameras, and image editing software. They were later able to expand into a larger dedicated space as part of a library renovation. The makerspace now contains a 3D printer, some small circuit kits, and a large format printer. It has become a popular stop on campus tours, and the technologies present there have nearly marketed themselves, helped along by word-of-mouth marketing by the library's student assistants. The goals for the makerspace include both giving individual students the opportunity to create apps outside of their class assignments, and by connecting makerspace items, like Raspberry Pis, with networking and computer science classes. Another forthcoming development: turning the makerspace mobile. The systems and emerging technologies librarian hopes to take some

equipment, like the 3D printer, out of the makerspace and into the classroom.[6]

The campus library at Kent State University-Tuscarawas, a public two-year regional campus in New Philadelphia, Ohio, is starting a makerspace with small businesses in mind. The library makerspace, funded in part through a Library Services and Technology Act (LSTA) grant, will feature 3D printing, electronics and robotics kits, a vinyl cutter, and other technologies. Through a partnership with the Ohio Small Business Development Center and a small business incubator, the makerspace will also feature workshops on starting a business, securing funding, marketing, and other topics of interest to potential entrepreneurs. The effort is strongly focused on aiding economic development in the community around the campus as well as educating and aiding students to turn their ideas into businesses.[7]

How Makerspaces Connect to Learning in Higher Education

The hands-on nature of makerspaces, whether focused on digital or physical creation, does contribute to individuals learning skills, software, and the processes involved. But is making a useful activity in the higher educational setting?

A pair of theories about learning has been identified in the maker literature to explain the impact of producing items on students' understanding of related concepts and the value of making to the strengthening and diversity of this understanding. The learning theory of constructionism, developed by Seymour Papert, suggests that problem-based learning exercises are an excellent way for students to build and reinforce their knowledge. As learners encounter a problem to solve, they are driven to create an answer. This creation may be just a mental model that helps the learner understand the subject matter, but if it is a physical or virtual creation it makes a stronger impact on the learner.[8] Makerspaces provide resources that students can use to solve problems through creation, and also offer guidance and examples of products to inspire the learner to deeper understanding.

Henry Jenkins' concept of participatory culture allows students to play multiple roles in the creative process, gaining understanding from each perspective. The idea is to move students from serving only the role of consumers of information or media, and into the role of creators.[9] Not only does this provide students with the freedom to shape their own visions into products, but it also allows them to grow in their skills at their own pace, and to have guidance from and collaboration with more experienced creators. The learner can become the teacher, and grow in understanding through explaining what they know to others. There is power in having an environment where students can see and share the work of their own hands.

Makerspaces can also be a venue for learning specific types of skills relevant to fields of study in higher education. They can be practical laboratories to learn concepts related to STEM (science, technology, engineering, and mathematics) fields. Several colleges and universities have built makerspaces with equipment aimed at prototyping architectural or engineering designs. In other cases, students in biomedical engineering or other scientific fields have created items to use in simulating body functions or treating medical conditions.[10] In a more interdisciplinary vein, other schools are opening makerspaces for the purpose of stimulating innovation and developing students' skills as entrepreneurs.[11] Students may develop a marketable product in the space, or may set forth on a new career or area of research thanks to an interest they discovered.

Motivations for Creating a Makerspace

Beyond the impact of makerspaces on learning, there are some other reasons that library staff members have decided to pursue makerspaces. The philosophy behind the larger Maker Movement, as expressed in the Maker Movement Manifesto, has been influential.[12] The tenets of that document can be summarized by the following provisions of makerspaces:

- They exist to bring individual makers into a space with shared resources.

- They are spaces in which experienced makers can teaching skills and guide the progress of newer makers.
- They allow for the sharing ideas and designs not just within the makerspace, but outward to the larger world of makers.
- They enable individuals to collaborate on projects and bring multiple perspectives and skill sets together.
- They encourage individuals to experiment and discover through tinkering with technologies and products and to approach making with a spirit of play.

Library staff members have found motivations to pursue makerspaces within these aspects, perhaps because the aspects and practices of makerspaces connect very well with those of libraries. Like makerspaces, libraries have a mission to provide patrons with access to resources and technologies they may not be able to afford on their own. Libraries are already makerspaces of a sort, or at least maker-friendly, partly because of the technology that they offer and partly because of the "how-to" resources their collections may include. As makerspaces offer a shared space for makers, libraries provide a community space to bring diverse individuals together with the opportunity to collaborate. Libraries are also educational institutions, and are often connected to institutions (schools, colleges and universities) with an interest in promoting STEM knowledge and activities. There are enough areas of correlation to cause library staff members to consider the creation of makerspaces.

The author's survey of library makerspaces included a question on what respondents tell people who ask why their library has a makerspace.[13] An examination of those responses illustrates what librarians and library staff members consider the strongest arguments for adding a makerspace. 90 of the 109 respondents to the survey answered this question, some at great length and others with just a sentence or two. Each of the responses was coded into a set of categories that best matched the thoughts expressed. The categories were then tallied to see which ones were most often cited. After the entire set of responses was tallied, the responses were then divided by type of library.

For all libraries, the six most popular motivational categories for library makerspace creators were: (1) supporting learning, (2) encouraging collaboration, (3) providing access, (4) expanding library services, (5) following the library's mission, and (6) providing opportunities for individual creation. All of these were discussed by between 15 and 34 of the respondents. When looking at just the 34 responses from academic library respondents, there were four highly ranked categories: (1) supporting learning, (2) providing access, (3) encouraging collaboration, and (4) following the library's mission. Public library respondents' responses did not deviate from the results for all libraries, but school library respondents included (1) support of tinkering, (2) offering cross-curricular experiences, and (3) providing STEM-related opportunities among their top six categories, in addition to choices already mentioned.

It is interesting to imagine how these small differences in expressed motivations might be explained among the library types. Academic library staff may not have needed to stress that their makerspaces were an expansion of library services as much as public library respondents did, perhaps because there are more creative options already in place in academic libraries. School library respondents may have a clearer goal than those from academic libraries in expressing support for STEM or reaching students with projects that crossed subject boundaries in keeping with larger district or statewide expectations. But the expressions of motivations can also reflect respondents' personal expectations for the makerspace, and not imply wide differences in motivational focus by types of libraries. Nonetheless, the results of that question on the survey do provide insight on how makerspace creators from different types of libraries describe the purpose of their spaces.

Some Considerations When Planning a Makerspace

There are some decision points related to providing making opportunities that can help guide the plan-

ning process. These issues represent both initial starting points and later transitions that the library staff can choose to make with the makerspace. Some are fairly binary options, and others should be seen as a sliding scale.

- Will it be clean or dirty? Or both? The makerspace can feature making that is primarily low-impact in terms of messes made (such as digital image or audio production), or it can involve carpentry or laser cutting, with many scraps left on the floor. Or, with the right space, it could involve both types of activities.
- Will it be an open lab, or just for classes and workshops? There might be time set aside for anyone to come into the space and work on a project, and then times where the makerspace is reserved for a class project or a workshop. This is a balance between the norms of the environment that the makerspace is serving (for instance, if there is a high interest in having classes meet in the makerspace) and the Maker Movement freedom of letting makers tinker and try projects on their own (with support).
- Will it be regularly staffed, or checked/maintained as needed? Depending on the type of equipment available, or the level of expertise needed to use it there may be a need to only open up the makerspace when it can be staffed. On the other hand, perhaps it can be open more often without staff on hand, which makes the operation of the makerspace less of a drain on the human resources of the library.
- Will it be noisy? Noise can come from equipment or from enthusiastically collaborating makers, but it is something to consider when choosing space and noting its proximity to areas using for quiet contemplation.
- Will there be a dedicated space, or mobile making? Perhaps the makerspace will be a room or corner of the library that is clearly demarcated, with equipment, furniture, and resources situated and ready to use. An alternative arrangement would be to have maker activities and gear packed up and ready to pull out for workshops, or to take on the road to classrooms or other locations on campus.
- Will all making be done in-house, or will technologies circulate? Academic libraries may already circulate a lot of creative equipment, from cameras to laptops to video and audio recording devices. There could be more maker-focused equipment that circulates, from hand tools to 3D scanners.
- Will it be funded entirely by the library, or from fees for services, or with start-up grants, etc.? Funding and budgeting for a makerspace is a key part of an implementation plan. The sources of funding may change over time, but it is crucial to know what will be possible in the space given the funds available.

In addition to making these decisions, planners can also follow an approach toward implementing the makerspaces in stages. Burke provides a summary of several implementation methods.[14] Good suggests a set of five stages, moving from "one-off activities" to "dirty labs" over time.[15] A helpful chart by FutureMakers expands on Good's work and gives more detailed information.[16]

The Justification for an Academic Library Makerspace

A compelling rationale can be constructed for adding a makerspace to an academic library. The following lists of arguments should be helpful to librarians who are assembling their own justifications. They are presented in two groups. The first speaks to needs that campuses are facing and draws on some of the previous material covered on the connection between learning and making. The makerspace can provide opportunities for:

- Hands-on learning: Students can built objects and both learn and practice creative skills with various technologies and media.
- Co-working: Students can work collaboratively with their peers and with more ex-

perienced makers to create works together, learning valuable group participation skills and benefiting from the input and insights of others.
- Self-directed learning: Students can use the materials in the makerspace to follow up on questions or explore and review concepts at their own pace.
- STEM education: Students can create and practice with elements related to the STEM fields and the makerspace can support teaching and learning in these disciplines.
- Prototyping: Students can create product models that they design and then rapidly test, alter, and enhance their prototypes using tools in the makerspace.
- Tinkering: Students can explore how devices or objects work and delve into troubleshooting them or creating new variations.
- Open culture: Students can experience an open design and sharing environment in the makerspace, where they can learn how maker culture is dependent on the free exchange of ideas and information.

The second group are drawn from additional interviews that the author conducted with 17 makerspace creators in the survey of library makerspaces. The interviewees recounted how their makerspaces began and noted factors important to that process. The factors were sorted into summary statements in an attempt to form a list that can guide others. Each statement is presented as an affirmative statement, which may vary in accuracy or strength depending on the setting. If enough of the statements are true in a given library environment, though, they make strong arguments for considering creating a makerspace.

- The formation of the makerspace is in keeping with the library's mission, or adding making activities is a reasonable extension of that mission.
- There are demonstrated needs in the community served by the library for learning and collaboration through making activities.
- The makerspace is a method for the library to provide access to services, materials, and skills that patrons may not be able to obtain on their own.
- The library has potential sources for funding a makerspace.
- The library administration supports the idea of forming a makerspace (or has supported similar undertakings in the past).
- The library can form a makerspace in cooperation with other partners on campus or within the larger community of the campus.

The library staff is interested and/or experienced in making activities.

Conclusion

If an academic library can commit time, space, and a little money, and serves a campus community that is interested in exploring experiential learning, a makerspace and making programs can be built and can thrive. It is crucial for libraries to consider whether makerspaces are a possible fit. Given the interdisciplinary nature of most academic libraries, they remain open to the whole campus community. It can be argued that they are the best place to have a makerspace on campus.[17]

Notes

1. Chris Anderson, *Makers: The New Industrial Revolution* (London: Random House Business Books, 2012), 20.
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3. Ibid, 6.
4. Caitlin A. Bagley, *Makerspaces: Top Trailblazing Projects* (Chicago: ALA TechSource, 2014), 93-102.
5. John Burke, *Makerspaces: A Practical Guide for Librarians* (Lanham (MD): Rowman & Littlefield, 2014), 90-92.
6. Ibid, 28-31.
7. "Kent State Tuscarawas Library's Innovative 'Makerspace' to Provide Entrepreneurs with Tools, Resources." *OhioLINK*, accessed February 13, 2015, https://www.ohiolink.edu/press/kent_state_tuscarawas_library%E2%80%99s_innovative_%E2%80%98makerspace%E2%80%99_provide_entrepreneurs_tools_resources
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9. Henry Jenkins, *Confronting the Challenges of Participatory Culture: Media Education for the 21st Century* (Cambridge,

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10. Larry Johnson, Samantha Adams Becker, Victoria Estrada, and Alex Freeman. *NMC Horizon Report: 2015 Higher Education Edition* (Austin, Texas: The New Media Consortium, 2015), accessed February 13, 2015, http://cdn.nmc.org/media/2015-nmc-horizon-report-HE-EN.pdf, 40-41.
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15. Travis Good, "Making Makerspace Libraries." ILEADUSA2013. YouTube. March 28, 2013, accessed January 9, 2015, http://www.youtube.com/watch?v=WV_Eu5Kz1cA&feature=youtu.be.
16. FutureMakers, "What Is Your Readiness for a Makerspace?" 2012, accessed December 19, 2014, http://kidsmakethingsbetter.com/wp-content/uploads/2013/11/What-is-your-level-of-makerspace-readiness.pdf.
17. Audrey Watters, "The Case for a Campus Makerspace." *Hack Education,* February 6, 2013, accessed December 9, 2014, http://hackeducation.com/2013/02/06/the-case-for-a-campus-makerspace/.

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