MAKER LITERACIES FOR ACADEMIC LIBRARIES

INTEGRATION INTO CURRICULUM

EDITED BY KATIE MUSICK PEERY

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PREFACE

As makerspaces become increasingly ubiquitous, many librarians have questioned the value these technologies bring to the library setting—is this just a fad to entice new users, or does engaging with these tools offer a true educational advantage? Even those librarians who believe in the benefits of makerspaces often then wonder, "What role could I possibly have in contributing to the success of such a space?"

Throughout the initial ideation, creation, and expansion of the Maker Literacies program, the University of Texas at Arlington (UTA) Libraries and FabLab staff consistently encountered these same questions, both for themselves and among makerspace staff at other university libraries. From the outset, we wanted to quantify the impact that academic library makerspaces were having on student learning, underscoring the anecdotal success stories we all hear with data which justified the programs and spaces that so many have worked to create. How best to accomplish that goal, as well as how best to share and encourage the adoption of such practices at other institutions, has been as experimental as any project that is created within the makerspace itself.

We set about our task by first drafting a rough set of maker-based competencies—transferable skills we believed students were gleaning by designing, fabricating, failing, and iterating in our collaborative, non–discipline-specific space. Internally, several faculty members partnered with us to pair selected competencies with their courses' learning outcomes, which we then assessed through pre- and post-assessments and faculty feedback. Although course integration of makerspaces occurs at many institutions, those programs often exist outside the library, are discipline-specific, or do not focus on assessment of the learning taking place. As this program evolved, we also wanted to specifically highlight the significant role librarians play in bridging the gap between the subject-based content students acquire in their courses and the interdisciplinary knowledge they can gain through making.

Thanks to external funding from the Institute of Museum and Library Services (IMLS), we have been able to continue to test and grow this program at other diverse institutions across the nation. More information about the origins of this program, accounts by all our partner institutions from the initial IMLS grant—Boise State University; the University of Massachusetts Amherst (UMass Amherst); the University of Nevada, Reno (UNR); and the University of North Carolina at Chapel Hill (UNC-Chapel Hill)—and the perspective of a faculty member are included within this book.

Through this work we have discovered that many librarians and makerspace staff members desire to establish a program like Maker Literacies at their institutions but are underprepared to partner with faculty in the curriculum development process; teaching and instructional design skills are often not emphasized in the traditional library school program, putting librarians at a disadvantage when working with faculty members who are also subject matter experts in their field. In other cases, space, staffing, or material constraints, or a lack of administrative support, impede progress or limit how courses can operate within a space.

Maker Literacies for Academic Libraries: Integration into Curriculum is written to inspire, encourage, educate, and empower librarians, makerspace staff, and faculty who are interested in integrating their makerspace into curriculum but have encountered difficulties such as those just noted or just aren't sure how to get started. The accounts within this book are presented by libraries serving a wide variety of user demographics, partnering with courses from a range of subjects, and all offering disparate equipment selections—no two are exactly alike, and each encountered its own unique challenges and successes in bringing this program to reality.

Collectively, UTA and our four partner academic library makerspaces from the first IMLS grant project have successfully refined and expanded the list of maker competencies to inclusively cover the broad scope of transferable skills that students obtain through maker-based course assignments. As a continuation of that work, UTA, UNR, and UMass Amherst are now partnered with seven other institutions, including UNC-Chapel Hill, to revise and improve standardized rubrics for each of those competencies to better assess student learning outcomes. We will also develop and host an immersion program for academic librarians and makerspace staff to impart best practices learned through this grant work, allowing participants to become curriculum design and assessment leaders within their local spheres of influence.

The future outcomes of the Maker Literacies team will continue to be shared broadly and openly for others to adopt and adapt. The assessment tools, immersion curricula, and analyses of student learning data will join the lesson plans and other resources currently found on the Maker Literacies website (library.uta.edu/makerliteracies) as they are developed and finalized. Our hope is that this book, along with these resources, will serve as an enduring, evolving, and impactful resource for librarians engaging in the maker movement for years to come!

—KATIE MUSICK PEERY

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Teaching and Learning through Making

Gretchen Trkay and Rebecca Bichel

At the turn of the millennium, many people were pondering the future of academic libraries. *Library as place* had become a catchphrase as learning commons became ubiquitous in university libraries, but was there a future for libraries as providers of individual work and collaborative spaces? Some thinkers in the profession saw special collections and archives as the future of academic libraries, claiming that a library's value rested in its unique holdings and the access it created to that content. And a few of us had begun to consider the opportunities presented by the freedom of not being anchored to the role of collection caregiver. Could we become entrepreneurs, with our product being services and programming that strengthen students' expertise in and confidence with using cutting-edge tools to create and problem solve? The FabLab at the University of Texas at Arlington (UTA) Libraries represents one outcome of such a venture.

This chapter will explore, from two different perspectives, how UTA Libraries became a hub for making and maker-based education over the past six years. Specifically, Rebecca Bichel, the dean of UTA Libraries, will discuss the inception of our unique take on a makerspace and the intended goals at its creation, and Gretchen Trkay, our department head for Experiential Learning and Outreach, will explain how we approached actualizing a strategy for integrating making into curricula.

INSPIRATION AND INNOVATION IN LIBRARIES

BY REBECCA BICHEL

In 2012 UTA Libraries began an almost wholesale rethinking of what a library can be and, more specifically, what our library should be. Inspired by library thought leaders urging the profession to be bold, we began with a comprehensive data dive to uncover hidden needs and opportunities. We looked to qualitative and quantitative data that reflected university growth, enrollment, and library use but made certain to couple this research with bold ideas as well as best practices.

In the past decade, makerspaces in libraries have moved from exceptional to expected. Visionary Lauren Smedley created the first makerspace in a library in the United States at Fayetteville Free Library in New York State in spring 2011. In summer 2012, as UTA Libraries began planning for a pilot makerspace on the first floor of its Central Library, the DeLaMare Science and Engineering Library at the University of Nevada, Reno became the first academic library in the United States to make the leap to offering 3D services, including printing and scanning, to all students. Tod Colegrove, then director of the DeLaMare Library, noted that the maker service "takes the library's support of the learning and research missions of the University to a new level—beyond simple information exchange and consumption into knowledge-driven creation."[1]

A visitor to these makerspaces would find as much unique as shared, but what resonated most powerfully with me was a bold vision for technology as a tool to enable library users to move from consumers to creators. Dr. David Lankes, whose scholarship focuses on new librarianship, gave a revolutionary speech in October 2011 inciting librarians to act—to look to the future and not the past. His stated task was to "radicalize librarians." Lankes demanded we throw away the notion that we are in the "book business" in favor of the more noble goal of facilitating the creation of knowledge.[2] This vision inspired UTA Libraries to advantage neither the present nor the past in our thinking about how to empower our students to create.

This call for action was echoed by library influencer Brian Mathews in his 2012 white paper exhorting librarians to abandon a fixation on incremental enhancements to existing services, which he labeled as the quest for ever "better vacuum cleaners," in favor of bold ideas, transformative change, and attention to the user's real needs.[3] He noted, "Our jobs are shifting from doing what we've always done very well, to always being on the lookout for new opportunities to advance teaching, learning, service, and research." This perception resonated with UTA Libraries as we sought to integrate ourselves broadly in the university's ambitious new strategic plan rather than identify with a library-only mission. Both the university's and the Libraries' strategic plans prioritized enabling students as creators. From that strategic-level priority, a series of actions were planned, beginning with the creation of a cross-disciplinary makerspace, to be called the UTA FabLab, and retooling our instructional programs toward hands-on learning.

Creation of the FabLab

The UTA FabLab opened in 2014 and was the first MIT-affiliated FabLab in a university in Texas. The vision was that graduates with experience in the UTA FabLab would have a competitive advantage in the marketplace through their development of a rich toolkit of professional, creative, and technological skills.

In developing the UTA FabLab, we visited about thirty makerspaces across the country, some in libraries, but most not. Some on college campuses, some membership-based, and some open to the community. Our focus was not on what technology or tools to include but on best practices in developing a customer base, sustainability models, and the service model for each space.

A common phenomenon we saw in academic libraries was makerspaces housed in rooms with minimal hours and little, if any, dedicated staffing. These spaces sometimes seemed to exist more for the function of checking off an "Innovative Spaces in Libraries" bucket list item than for serving local needs. In addition, we saw many examples of the mini-me phenomenon—a space that was a mimicry of another makerspace or based on a published how-to list with no local conversation or data gathering.

We also saw incredible makerspaces. Some of our favorites were a makerspace in a public school in which the students had real ownership and there was a vision for equipping the students with life skills; a makerspace in a public library staffed entirely by volunteers but filled with locally grown innovations for local needs (e.g., using a digital studio to host indie music recordings); and a community makerspace in a socioeconomically depressed neighborhood that humbled us with how much the organizers accomplished with scraps and donations.

From these visits we fundamentally learned that if we wanted to build an indispensable makerspace and programming, we needed to be authentic to our students' needs and closely aligned with the core values and goals of our university and libraries. Although we have heard from other libraries about underused makerspaces, that was never the case at UTA. From its soft opening in 2014 as an eight-hundred-square-foot beta space through its expansion into an eight-thousand-square-foot facility, the UTA makerspace has been well used. I believe that this success came as a result of a series of carefully crafted decisions during the planning phases and continued responsiveness to the observed needs of our community.[4]

FabLab Design Strategies

The UTA FabLab space and programming were designed with specific goals that drove decision-making. For example, we wanted to attract a broad cross section of students, rather than a specific discipline or class level. So we strategically located the FabLab on the first floor of our Central Library, highly visible as soon as you enter, and not in a specialized library. We wanted students to feel welcomed, so the space is adjacent to our café, is completely open to the library (no walls), and has a mix of study tables and worktables. We wanted diverse students across disciplines to use the space, so we made a policy decision to aggressively recruit student employees across disciplines, gender identities, and ages, recognizing that this diversity requires a resource investment in building the technical skills of many student employees. Absent this policy, we would likely be staffed almost entirely by male engineering students.

The following strategic decisions governed design:

1. *The development of the UTA FabLab was one outcome of a broad strategic goal related to creation.* The FabLab was never a one-off or just a space. It was developed as a distinct public services department with associated staffing and services. The department was later partnered with

another new department, now called Experiential Learning and Outreach, responsible for developing course-integrated and independent learning opportunities grounded in a philosophy of experiential learning (discussed later in this chapter).

2. *The UTA FabLab would be available for any student.*

    No class-only limits. Because there was a shortage of learning labs, we heard strong faculty advocacy that the FabLab be limited to classes only and curricular use, excluding walk-in students or recreational projects. We instead advocated to stakeholders the value of a makerspace open to all students across majors. We want students in the makerspace anytime, exploring and applying their creativity. We design pop-up programming to encourage this aspect.

    No limits to majors or class levels. Because there was a shortage at UTA of labs in which engineering and architecture students could work, initially there was an external expectation that those majors would be our target audience. Instead, we aggressively market to all colleges. Knowing that student employees bring their friends and classmates to visit the FabLab, our goal is to have student employees from each college on campus in our long semesters. We also promote the space as STEAHM (Science, Technology, Engineering, Arts, Humanities, and Math), not STEM.

    Value and work for diversity. Because UTA is one of the most diverse universities in the country, we knew we wanted to help overcome the inherent barriers of a perceived STEM space to non-STEM majors and women.[5] Our recruitment strategy for student employees reflects this goal. We recruit faculty across disciplines to engage with their students in the FabLab. This outreach has included disabilities studies, English, art, math, education, modern languages, engineering, architecture, biology, philosophy, theater, broadcast communication, and history. I am proud that though leadership for discipline-specific fabrication labs is overwhelmingly male, our director is a woman and a librarian.[6] This key position sets the tone for our commitment to diversity.

3. *Embrace risk-taking and play.* Much of the equipment is not heavily mediated. Rules are limited, such as those for safety. Like the rest of the library,

we want the students to feel ownership of the FabLab. They are *not* our guests. This is their home. That means they have spaces to relax, explore, and experiment. Skilled technicians and student employees help students craft solutions for complex class assignments as well as make fantastical figures for tabletop games. At the same time, although mentors are available, we celebrate failure as an inherent, valuable learning experience. Another way we enable risk-taking and play is by subsidizing costs significantly. Students pay for the consumables we provide (comparable to paying to print or photocopy) but not for use of the equipment.

4. *Build a full-time staff with technical expertise.* Most library makerspaces are staffed by student employees or volunteers or one staff member, often with other assignments. The UTA FabLab has five full-time staff in addition to our student employees. The two technicians were recruited for their deep technical expertise, and an artist with an advanced degree (MFA), experience creating with maker technologies, and curriculum development and teaching experience but without an MLS was hired as a FabLab librarian. The Libraries received zero new positions for the FabLab, so we repurposed empty lines from other roles.

5. *Minimize barriers to access.* We want students to see the FabLab immediately upon entering the Central Library and to feel welcomed to enter and explore. The space has a casual, industrial design—cement floors, tables hand-crafted from pipe and wood, and colorful balls with retractable electrical cords suspended from the ceiling. There are no walls enclosing the space other than clear glass doors to contain the shop room, and study tables and computer-use tables are purposely integrated to encourage a mix of uses. The space includes a large sectional and other soft seating, as well as oversized bar-height tables. We selected a furniture style inspired by community co-working spaces to encourage collaboration and entrepreneurship. The UTA FabLab is adjacent to our café, and food and drink are welcome anywhere in the makerspace, with the exception of our shop room where they would pose a safety risk.

The goal for UTA was never simply to build a makerspace. We knew we needed to build a dynamic space to support our strategic goal of supporting creation, but we also needed paired services, programming, and outreach that integrated making within the curriculum as one of the university strategies to enhance student academic and professional success.

The UTA FabLab is unique as a library makerspace because it was conceptualized as an integrated space with a broad vision of what a modern, twenty-first-century research library should be. We made a decision to offer campus leadership focused on student creativity, innovation, and entrepreneurship; developed a strategy to advance that leadership goal; and created a makerspace as one element of that mission. Our next step was to redesign our instructional program to draw upon the tools and expertise offered via the FabLab to transform our teaching from active to experiential learning.

INNOVATION IN TEACHING AND LEARNING PRACTICE

BY GRETCHEN TRKAY

In direct response to our strategic imperative to be a hub for experiential learning and creation, the Libraries built the UTA FabLab, a space in which students could engage in both self-directed and guided inquiry and creation. This strategic imperative promised the UTA community access to "a transformative environment that fosters learning through reflection, design, creativity, experimentation, and innovation."[7] The FabLab provided that space and service model, and students quickly began to engage in self-directed learning, but we struggled to identify a sustainable strategy for curricular integration and programming. Although FabLab staff worked with faculty to devise new course assignments, the original strategy to partner in this work with the Libraries' subject liaisons failed.

In 2013 UTA Libraries initiated a comprehensive reorganization. Until that point, subject librarians had been asked to do what subject librarians had always done—consult with students and faculty, provide bibliographic instruction, give input about collections, and occasionally work the reference desk. The new vision included the creation of an outreach and scholarship department. Members of this department would continue to have responsibility for traditional subject librarian activities but would add new layers of expertise, with an emphasis on scholarly communication and hands-on learning.

As is not uncommon in a perpetual beta environment, sometimes you try things and they just don't work. Our library staff had a mixed reaction to focusing on creation as a primary library function. A few staff members were excited about the makerspace and became early evangelists. Some were open but concerned about sustainability with limited resources and how staff would develop technical skills. And some rejected the concept of a library role beyond information access and preservation. Many of our subject librarians were overwhelmed with the substantive shift in what they were being asked to achieve.

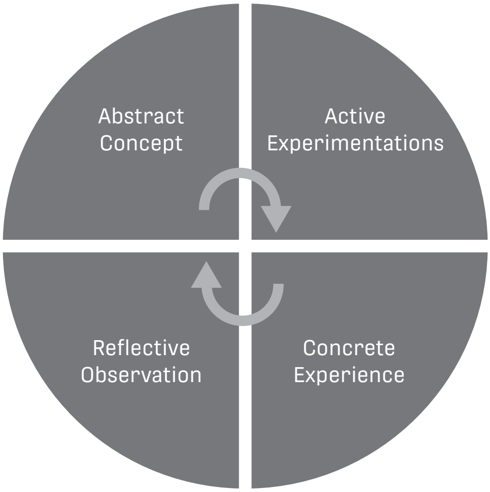
The reality of working within the context of a makerspace is that it requires a set of competencies different from what many librarians have been trained to do.[8] Rather than emphasizing mastery of academic subjects, information retrieval, and evaluation, those librarians engaged in makerspaces require dispositions that embrace collaboration, adaptability, and learning on the fly, along with such hard skills as program development, grant writing, technology literacy, and a deep grounding in the application of learning theory. The Libraries had not effectively laid the foundation for all our liaison librarians to engage in this new type of librarianship. The closest correlation to the dispositions and skills just listed was found in our librarians who had been heavily involved in teaching and learning and in undergraduate student engagement activities. One of these librarians, who had been initially hired as a first-year-experience librarian and then transitioned into a position as an interim codirector for the FabLab (and who also happens to be the editor of this book), was hired as the full-time director of the FabLab. Within a year of that hire, I, a former information literacy librarian, was tasked with creating a new department for which integrating making into curricula would be among its primary responsibilities. My approach to accomplishing this task was to take what I knew and find a way to apply this knowledge and experience in support of empowering students as creators.

Experiential Learning as a Pedagogical Frame

Experiential learning is an educational model predicated on students learning by reflecting on doing.[9] The experiential education ecosystem includes high-impact practices such as project-based learning, problem-based learning, service learning, undergraduate research, and study abroad.[10] Experiential curricula make it possible for students to pair and apply subject-based learning with transferable skills. Essential to these curricula are reflective exercises during which students are encouraged to synthesize their experiences with

FIGURE 1.1

Kolb's experiential learning cycle



Source: Derived from David A. Kolb, *Experiential Learning: Experience as the Source of Learning and Development* (Englewood Cliffs, NJ: Prentice-Hall, 1984).

prior knowledge, draw conclusions from the experience, and connect new knowledge with potential future applications (figure 1.1).

Our new department, Experiential Learning and Undergraduate Research (later changed to Experiential Learning and Outreach), embraced experiential learning as its preferred mode for teaching and learning because that model is student-centered and student-specific. Grounded in students' experiences and their individualized reflection, experiential learning allows for those with differing initial knowledge bases to achieve similar growth trajectories, even if they do not ultimately land in the same place. The reflective nature of experiential learning also makes room for the inclusion of instructional strategies that support transferability. Kuglitsch illustrates this feature in her discussion of low and high road transfer within the context of information literacy.[11] Specifically, library educators can develop instruction during which students start by exploring a technique or idea (active experimentation and concrete experience) followed by connecting this exploration to other concepts and contexts (reflection and abstract conception), techniques Kuglitsch refers to as "hugging" and "bridging."

Maker-Based Competencies

Experiential learning is broader than making alone, but the first goal for the Experiential Learning and Undergraduate Research Department was to develop structure and programming for curricular integration of making and low barrier to entry opportunities for guided exploration. Creating a concept for how the department would hire and train librarians and staff, engage with faculty, collaborate with our partners in the Libraries' FabLab, and develop curricula that bridge subject-based learning and transferable skills was our first task. The most profound experience that I had as a librarian was attending the Information Literacy Immersion program presented in 2005 by the Association of College and Research Libraries (ACRL) and the subsequent application of what I had learned to my teaching and learning practice. I had successfully fostered collaborations with faculty by using the ACRL's *Information Literacy Competency Standards for Higher Education* as a tool for mapping what the Libraries could provide to faculty members' goals for students' disciplinary learning. Just as information and digital literacies bolster libraries' position as a hub for teaching transferable and transdisciplinary skills, my thought was that by defining maker literacy as a concept, the Libraries would be able to more easily talk to faculty about the applicability of making outside STEAM disciplines. I made the decision that the Libraries would develop competencies that helped define the transferable skills students could gain via making. Before we even began trying this approach as a strategy, I had dreams of creating a national immersion program that would provide librarians engaged with making what information literacy immersion had provided me.

Simultaneous with this decision, ACRL approved the *Framework for Information Literacy for Higher Education,* an effective argument that information literacy, rather than being a set of transdisciplinary skills, had theoretical significance outside disciplinary contexts. This shift in how academic libraries were thinking about information literacy gave me pause about whether maker-based competencies were the right approach to creating structure for our work with faculty. It is fair to argue that reliance on competencies to define concepts such as design thinking, information literacy, and the like can be perceived as reductionist, but what the Libraries needed was a bridge for conversation and collaboration with subject faculty that resulted in incorporating the learning of complex, maker-based transferable skills into subject-based curricula. When thinking about the integration of making into courses, I felt that we needed to reflect on something concrete, something not unlike Kolb's experiential learning cycle (see figure 1.1), before we would be in a place to articulate an abstract concept of making equivalent to ACRL's *Framework*.

An additional consideration was whether pursuing goals that resulted in assessment of student learning in makerspaces was antithetical to fostering a home for maker culture. Many argue that makerspaces should only be used for informal learning and that by applying structures of formal academic environments, student learning will be stymied. It is a fair critique. Our position was that guided, course-integrated making with measurement of student learning was only one of a multitude of ways in which students could engage with iterative design and creation. Additionally, if course assignments, activities, and instruction are carefully structured, there is still room for students to explore, invent, and problem solve as part of their process. Ultimately, we felt that for libraries to be able to meet the expectations of university administrations, we needed to show return on investment through usage statistics and tangible evidence of student learning.

Getting the Work Done

With a path forward in mind, we needed to determine how best to staff a department that would not work specifically for the makerspace but for which one of the primary responsibilities would be integrating making into courses. Due to the nature of our library, our first hire would also be responsible for traditional subject liaison duties. Our strategy was to hire a librarian who was trained in a discipline that would easily pair with design thinking and creation and who demonstrated excitement about the opportunity to develop some foundational competencies and tools for curricular integration of making. Martin Wallace was hired as UTA Libraries' new Maker Literacies librarian and liaison to the College of Engineering. His first task was to pull together a team of subject faculty and FabLab staff to create a beta set of maker competencies that we could use to test course integration and assessment of learning on a local level. This endeavor will be discussed in greater detail in the next chapter, but the team's expected outcome was the development and testing of the competencies so that we would be prepared to apply for a planning grant from the Institute of Museum and Library Services (IMLS)

National Leadership Grants for Libraries program that would fund testing of the competencies at different college and university library makerspaces throughout the country. UTA Libraries was awarded this grant in 2017, and we continue to work with partners nationally to refine and build on our initial work to integrate making into academic coursework.

THE PRESENT AND FUTURE

BY REBECCA BICHEL AND GRETCHEN TRKAY

UTA Libraries' Experiential Learning and Outreach Department continues to expand its work. The trajectory of our work includes curricular integration of both fabrication and digital-based making, pop-up experiential learning opportunities intended for beginning makers, maker-based curriculum and professional development for K–12 audiences, and the development of virtual reality health sciences educational platforms. In partnership with the FabLab, UMass Amherst, and UNR, we received a 2019 IMLS National Leadership Grants for Libraries project grant (LG-17-19-0126-19) to create a national networking and professional development immersion program intended to prepare other librarians to integrate making in courses and assess student learning. Specifically, this grant will fund the development and testing of rubrics for each of the maker literacy competencies discussed in this book. Faculty, librarians, and makerspace staff will be able to apply these rubrics to student artifacts as a direct assessment of student learning and development of maker-based skills. Additionally, the IMLS National Leadership project grant will fund the creation of an immersion program for librarians and library makerspace staff at other institutions. This program will be offered both in person and through an asynchronous, digital platform. All lesson plans, assessments, and course materials created as part of both IMLS grants are available with Creative Commons licenses for reuse and adaptation by others (library.uta.edu/makerliteracies). Our intent is to create an ever-growing repository of curricula as a resource for educators worldwide.

UTA Libraries continues to expand its support for its ultimate goal: to empower students as creators through teaching and learning. The FabLab, the Experiential Learning and Undergraduate Research Department, and the Maker Literacies program were the first expressions of this goal, but the future includes a plan to expand the space available for students to engage in creative activities. The concept is to dedicate the entire first floor of our Central Library to creativity across disciplines. Students will be able to develop mastery using cutting-edge technologies, adding robust digital creation technologies to the fabrication tools currently available in the FabLab. Our vision is to provide an immersive, technology-rich environment in which students, including K–12 students in nearby schools, can engage as creators, facilitated by librarians and staff committed to experiential learning.

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