chapter 24*

Structuring the Unstructured:

Plan Your Library Makerspace with Instructional Design

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As makerspaces continue to spread to academic, public, and school libraries nationwide, many librarians wonder how to start and successfully maintain such a project. Deciding to create a makerspace can raise many questions and challenges regarding equipment, training, staffing, and so on. Although the style of learning that takes place in makerspaces is intentionally less structured than in a formal classroom setting, instructional design principles can still be invaluable in developing and sustaining a maker learning environment.

Institutional Setting

The State University of New York at Oswego (SUNY Oswego) is a public institution with nearly 8,000 students, the majority of them enrolled in undergraduate degree programs. The school has six master's degree programs and does not issue any doctoral degrees. In Fall 2015, the percentage of enrolled

students from New York State was 95.8 percent, with 32.2 percent of those hailing from central New York, where Oswego itself is located.[1] Penfield Library serves the campus community with about sixteen full-time librarians and an assortment of library staff and part-time adjunct librarians. The library operates out of a single, centrally-located building.

Penfield Library's strategic three-year plan, aligned with the college's strategic Tomorrow Plan, is broken down into five impact statements or overarching goals. The second of these states, "Our education ecosystem is highly collaborative and engaged,"[2] in line with the Tomorrow Plan's goal of a "unique education ecosystem…driven by devoted, passionate, diverse, and talented faculty and staff who work collaboratively, resourcefully, and creatively."[3] Fostering a collaborative community is an essential piece of the library's mission, along with "provid[ing] emerging technologies and information resources appropriate to current student learning environments" and "equip[ping] students with critical literacies for lifelong learning."[4]

Problem to Be Addressed

When I took over the position of Learning Technologies Librarian in June 2015, Penfield Library was home to two 3D printers, a 3D scanner, and a variety of tools for creating multimedia projects (cameras, microphones, digital voice recorders, two small rooms with video and audio editing software installed, etc.). Midway through the fall semester, an instructor in the Art Department approached the library about the possibility of creating a makerspace. We decided to apply for a grant offered by the university intended for acquiring technology that will improve or enhance student learning, planning to use these funds for our initial equipment purchases. With this decision, we began to lay down plans for our library makerspace.

Although makerspaces do not focus on instruction in a strict, traditional sense, learning is still an important and central aspect of making. The interest-driven, collaborative, and creative learning that occurs in makerspaces bears many similarities to the model of connected learning.[5] As such, it can be helpful to approach makerspace planning as one might approach the development and design of other types of more formalized instruction.

The widely-used ADDIE model breaks down instructional design into five steps: Analysis, Design, Development, Implementation, and Evaluation.[6] Backward design, another approach for designing curriculum, emphasizes setting goals and determining desired results before deciding on an instructional method or approach.[7] Both methods require instructors to pose and answer a number of questions about their students, their objectives, and their circumstances to help inform the design of their curriculum. In a similar way,

librarians can benefit from carrying out information gathering and analysis prior to making concrete plans for a library makerspace. Some useful questions to begin with include:

- What is my goal in creating a makerspace? What am I setting out to achieve?
- How will I know if I have been successful?
- Why does it make sense for the makerspace to be in the library? What allowances would a library location afford that other spaces on campus would not?
- Who else on campus is involved in making and maker activities (whether they use that term or not)?
- What needs are currently being met by the on-campus maker activities and equipment? What needs are not being met?
- What interests or objectives might students on campus have when it comes to making? For example, students on a campus with a strong agricultural program may have different maker interests than those at a school more heavily focused on computer science.

At a public library, simply replace "campus" with "local community" and the same questions can be used as guidance. A K-12 school might want to think about the combination of the school's resources and the local community or partner schools.

At Oswego, our first step was to begin information gathering by exploring what resources were already available on campus. We discovered existing maker learning and supplies within the Art Department, the Technology Education Department, and the Computer Science department (especially Human-Computer Interaction). We identified key players in charge of the various labs that contained maker equipment, as well as student organizations whose interests might align with ours. In order to collect more details and answer more of the questions listed above, we convened a series of focus groups, inviting members of these groups to speak with us about the current state of making on campus. We also toured the Technology Education Lab to see some of their equipment.

During focus groups, we first asked participants to fill out a questionnaire, including a few basic demographic questions. They were then asked to rank their interest and involvement with the following activities: robotics, electronics, 3D printing, coding/programming, multimedia creation (video, photography, audio), arts and crafts (e.g., knitting, sewing, textile arts, papercraft, painting), food/cooking, gardening, other. Finally, we posed the following questions, allowing the conversations to shape themselves as participants freely interacted with each other:

- Do you currently maintain or use a lab that is designed for making and creating?

- What technologies do you usually teach with or use for your class?
- What library-provided technologies or resources/services are you aware of? Which ones have you used or recommend to students to use to complete a class assignment or other projects?
- What type of tools, technologies, devices, etc. might you incorporate into your teaching or want to use in the next five years?
- Are there other resources, technologies, or services that you wish the library had to extend your classroom experiences, and to create or collaborate?
- Do you wish there was a space to build and experiment with technology? If so, what devices would you like to have access to there?
- Do you have any other advice for us?

As our library is part of a university, most of our questions were focused around the ways in which we might benefit students and faculty academically. Other libraries would, of course, want to alter their questions to be appropriate to their patrons and circumstances.

As a result of the data we collected, we were able to engage in the goal-setting and analysis required by the instructional design methods mentioned previously. We were provided with a clearer picture of the existing maker community on campus. We began to understand that we did not want to duplicate what others were doing successfully, but that many students and faculty felt the current equipment was siloed and accessible only to those within specific departments. Much of the equipment was only available to students if they were enrolled in a particular class, and then only for working on class projects. Much of the equipment was also fairly advanced, enough that students with a casual interest or unsure if they might be interested would not be given the chance to experiment and explore freely.

Our analysis led easily into the next steps of design and development. The library, centrally situated and open to everyone on campus, would provide a good home for something intended to be widely accessible. As part of our existing strategic plan, we were already offering campus-wide access to important emerging technologies. Also—in alignment with our goal of teaching critical literacies—instead of specializing in any type of technology or creation, thus duplicating another department's efforts, we would aim for offering the opportunity to explore and build new interests, which could then be pursued further and at a more advanced level by approaching a specific department. For example, rather than purchasing a large, industrial-quality 3D printer, like the Technology Education Department did, we would need only consumer-grade desktop 3D printers. Rather than stocking up on soldering tools, we might want to explore simple circuitry kits for beginners. One of our goals would be to allow students to discover new passions that they would be

able to follow further by taking a class, adopting a minor or a major, taking on an internship, and so on. To address the issue repeatedly raised during our focus groups of equipment and knowledge being siloed, we would also set out not just to create a makerspace, but to facilitate a campus maker community that encouraged interdisciplinary collaboration.

Engaging in this type of instructional design process is especially helpful in determining an appropriate makerspace model for a library. Many people think of makerspaces as dedicated physical locations with high-tech equipment and heavy machinery; however, in reality, there are a number of effective models and approaches. Mobile makerspaces or maker carts consist of maker equipment that is easily portable and can be moved from place to place. The mobile maker cart used at Vanderbilt University's Monroe Carrell Jr. Children's Hospital is an excellent example, allowing for the makerspace to travel to patients who are isolated and confined to their rooms.[8] Maker kits provide similar benefits, plus the ability to allow patrons to check them out from the library as they would books, movies, or any other library resources.[9] Pop-up makerspaces, or event-based makerspaces, are designed to exist for a limited period of time, then be cleaned up and put away until the next event or the next time they "pop up"; this model also dovetails nicely with maker carts and kits. Of course, it is possible to create any amalgam of approaches that makes sense, such as having a dedicated physical location that also includes circulating maker kits, or having a workshop-based makerspace that travels with a maker cart. At Penfield Library, we would have to find an appropriate model to help overcome the issue of siloed equipment and knowledge and that could help us work toward the type of collaborative learning community or "educational ecosystem" that is important to SUNY Oswego.

Description of the Project

With our data gathered and our goals set, we were ready to follow the design and development stages into implementation. We lacked access to a space we could dedicate full time to being a makerspace—nor did we have the staff capacity to service a space full time—but, according to our design, our purchases would be mainly smaller, easily portable supplies. As such, we planned for an event-based model that would incorporate themed workshops (i.e., Circuits 101, Crochet 101) and pop-up open makerspaces.

Two important considerations when putting together a makerspace are staffing and training. As community-building on campus was among our goals both for this project and on a library-wide level, we planned to address these challenges by reaching out to form collaborations with the key players on campus we had already met. Rather than requiring the librarians to be-

come experts on every tool, we could bring in players with existing expertise to lend a hand and share their knowledge during events; this would also break down barriers and open the door to a campus-wide maker culture.

We planned approximately three events per month throughout the spring semester in order to keep momentum going and give people enough opportunities to explore the tools. Our first event (3D Printing 101) was planned around our existing equipment to help grab people's interest, while our second event (a pop-up makerspace) was planned concurrently with the library's annual Valentine's Day event, Penfield Loves You Day. To ensure visibility and to capture attention, events throughout the semester were held in a first-floor library classroom with many activities, especially anything that was exciting and noisy, flowing out into the lobby (the library's first floor is not a designated quiet floor).

Most of the maker events tended to be very unstructured and exploratory: all the equipment was brought out and I ensured there would be at least a couple people on hand who could provide some basic guidance. This also became easier as the semester went on and people began to pick up skills they could share with others. People were free to come and go as they wished during the scheduled time for the event, and I arranged a few large rolling whiteboards to point patrons toward the event if they happened to be passing through the library. A typical scene at these events might be a few people sitting around a table learning to crochet, while someone at another table draws with a 3D printing pen. Students may be in the lobby just outside the classroom gathering around a 3D printer, while someone else taps out a tune on a musical littleBits keyboard. Attendees might be folding origami as they refer to YouTube how-to videos or building up structures with a hot glue gun and popsicle sticks. Though I would often move among the attendees to check in on what people were making and to see if they needed help, it was common to see people helping each other, even across age and status barriers (students, teaching faculty, and so on).

Lessons Learned

Instructional design works best as an iterative process informed by assessment and evaluation, which are essential for makerspaces, as well. Like a library collection or lesson plans for one-shot workshops, makerspaces should constantly evolve to fit the changing needs of patrons and the goals of the library. Equipment will need replacement, technology will need updating, and training is an ongoing process. Especially at an academic library, where students are constantly enrolling, transferring, and graduating, the population of library patrons can change significantly over time.

Effective instructional design employs two separate types of assessment: formative and summative. Formative assessment "is conducted during the life of a program (or performance) with the purpose of providing feedback that can be used to modify, shape, and improve the program (or performance)."[10] In my situation, I was able to conduct formative assessment during the semester by informally taking headcounts during events, gathering names of people interested in being on an event mailing list, speaking with event attendees, and generally observing how my plans played out. I recorded stories of important, interesting, or inspiring moments that occurred, and I made sure to ask people how they were finding out about the events. The stories I took down will help me further articulate the value of the library's maker events, as well as help me understand what people have responded to well so I can make plans for the future.

Summative assessment differs from formative, as it is "conducted after a program has been in operation for a while, or at its conclusion, to make judgments about its quality or worth compared to previously defined standards for performance."[11] I am currently conducting maker events, so have not completed much of my summative assessment; however, as part of our initial design, we set up a "frequent maker program" to help us judge engagement. Participants in this program can earn "points" or punches on their Frequent Maker Cards for completing challenges during maker events; as an example, "make something that lights up" would be worth one point, while "teach someone how to do a new crochet stitch" might be worth two points. Filling up a card is rewarded with a small prize, such as a free 3D print. At the request of students, I have also been involved in starting an official student organization, the SUNY Oswego Maker Club. I anticipate this club being useful in conducting summative assessment as I am able to look back on its progress and resulting projects over time.

The lessons I have learned so far have been very useful. Headcounts have helped me judge what time of day generally works best (evenings, usually starting around 6 p.m.), as well as which times of the semester allow for more student engagement (students seem to have more time on their hands in February than in April, for example). I have been able to note which supplies and types of making get the most attention (3D printing, crochet, Arduino, papercraft). As a result of feedback and heavy use, I opted to purchase an additional 3D printing pen part of the way through the semester. There has been a noticeable spike in the number of people contacting me about our 3D printing services (which run all the time, not just during events). I have also been able to make note of important information about which types of activities draw which types of populations. For example, the participants in our Crochet 101 event were mostly female and many were faculty and staff, while Circuitry 101 participants were more likely to be male graduate students. All this information about demographics will serve me well as I prepare to run maker events again in the fall semester.

A few of my discoveries have been surprising and will result in me needing to re-evaluate aspects of my approach. For instance, the frequent maker program has been largely unsuccessful and, in fact, was attempting to serve a need that did not exist. I believed patrons would have difficulty getting started at events and would not feel comfortable jumping in and starting to explore, or that they would need some encouragement to share skills with each other; as a result, I thought the maker challenges would be essential. In reality, people have had no issues leaping right in and have seemed mainly confused by the Frequent Maker Cards. I had also hoped to have some kind of showcase at the conclusion of the semester, during which people could display the maker projects they had completed or were working on. As time went on, however, I began to realize that our event-based model is not ideal for long-term projects, as makers do not know when they will have the opportunity to work with the tools again. This problem, in addition to a number of requests to use the equipment outside of event times, has led me to consider implementing some kind of regularly-scheduled "open maker hours" to provide people with more chances to work on projects.

Part of assessment involves revisiting the original goals to determine if they have been or are being met. In this regard, even though the semester is not over yet, I have been pleased and have been encouraged to make adjustments for the future. Many students attending events have tried out an activity or technology for the first time, or have been excited to work with something in person that they have only seen on TV or online (a 3D printer, for example). One of the students helping me start the Maker Club has been considering buying her own 3D printing pen; she had never used one before attending an event. A few students, after being exposed to our Arduinos, are purchasing their own to use in a final project for a course. It is clear our maker program has been able to serve as a gateway for students who otherwise would not gain experience with certain tools and skills; in this way, we have been working toward the library's goals of teaching critical literacies and providing emerging technologies, especially those that tie in with coursework.

Our success in facilitating a campus maker community has been a bit more mixed; evaluating what has worked and what has not worked has given me additional goals to aim for in the next semester. I was happy to find faculty reaching out to me with an interest in what I was doing, leading to collaborations I did not anticipate, such as an instructor in the Art Department inviting me to visit her class with our Arduinos and Makey Makeys. Many of the maker events have been attended by faculty and staff, and I was able to get a Technology Education graduate student to help lead my Circuits 101 workshop. On the other hand, I realized I need to plan earlier and better if I want more faculty, staff, and students to lend their skills and guidance during events in an official capacity (rather than just happening to show up). Over-

all, reviewing my original goals is useful in making adjustments for the next iteration of my project.

Adapting or Customizing this Idea

The overall instructional design process I used to approach my makerspace planning is easily adaptable to makerspaces in other settings. Though the details and circumstances might be different at other academic libraries, at public libraries, or at school and even special libraries, the path followed can be similar: ask questions, gather important information, set goals, design a clear plan, set things into motion, and assess in order to make changes. The design of your makerspace will vary based on the data you collect and the goals you subsequently set.

A makerspace will never be a one-size-fits-all concept, nor should it be. As with many aspects of the library, so much depends upon the community the library wants to serve. Thus, considering the community up front and translating what you learn into clear goals is essential to creating something that works, rather than simply jumping into a popular trend and ending up with supplies that sit around gathering dust. A similar approach and thought process can be useful not just in makerspace planning, but for developing successful events and programming in general.

Conclusion

Instructional design principles have been an effective guide to our thinking in developing a makerspace and a maker community on campus at SUNY Oswego. Taking our cue from models like ADDIE and backward design, we set out to gather information that informed the clear goals and plan we developed. We aligned our goals with the needs we discovered, with our library's and campus' strategic plans, and with the resources we had to work with. During our pilot semester, we conducted formative assessment, while gathering data for summative assessment to be completed after the end of the semester. This process has helped us put into motion a strong makerspace program in the library.

The library is a place of learning in many different forms, some structured and some less so. Instructional design models and thinking prove beneficial in many areas beyond the one-shot workshop or library information session—a makerspace is just one example. Considering how to creatively apply instructional design to less formal and less structured learning opportunities can be the first step toward developing your library as a place of exceptional learning for all.

Notes

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