This session will briefly cover our experiences with setting up and overseeing an academic makerspace at Lawrence University.

First of all, How many attendees here have a makerspace on their campus or in the library? How many here have a role in managing or working with the space? As I’m covering these topics, please feel free to add your experiences. What we’ve done at Lawrence doesn’t encompass all experiences, so it would be beneficial to all of us if more experiences are shared than just mine. If you’re not comfortable chiming in during, I’ll leave some time for sharing at the end.
In this presentation, I’m going to begin by briefly sharing a bit about Lawrence and the Mudd Library, what we have in our makerspace, and some tips I pick up on how to go about getting a makerspace.

After, I will discuss our experiences with the space over the past year that we’ve been open- including some events we hosted, maintaining enthusiasm, equipment maintenance, training, and meeting changing demands.

- Introduction/Background
  - Lawrence University
  - Mudd Library
- Our Makerspace
  - A makerspace in 4 easy steps
  - What’s in our makerspace
- Briefly run through a few projects from our makerspace
- Discuss some of the major challenges we’ve encountered, along with ways we plan to overcome them
- I’m then going to talk about some other lessons learned
- Questions and I’d like to have some time for everyone to share obstacles and ways they’ve overcome them
Lawrence University is a residential undergraduate liberal arts college and conservatory of music with about 1500 students, located in Appleton, WI.

The Mudd Library was built in 1976. It houses around 500,000 books, periodicals, scores, audiovisual materials as well as the university Archives. In addition to the library collections and people, it houses the campus Information Technology Services department and the director of the Instructional Technology Department.

My role in the Mudd Library is to provide reference assistance at the desk, in classes, and in reference appointments. I also manage the library’s website, co-manage the social media, serve on committees, and as something that was sort of an afterthought to my position when I first got it, oversee the library’s media center- a space with digital conversion equipment that used to have with it a director of media services. We were not able to get approval to replace him after he retired. But, now the media center has now become the media center and makerspace.
I’m going to begin talking about makerspaces by giving some background on how we went about getting our space. For fun, I broke the process into just “4 Easy Steps!”
1. Organize faculty and staff
   - First of all, we got some friends.
   - A chemistry professor, who had a very early 3D printer outside his office and I had talked about finding a way to make 3D printing more available on campus. We were able to get a bunch of tech-minded faculty and staff on board to either attend makerspace planning meetings, or allow us to add their names to proposals.
   - Even having support just by name is helpful, as it can allow you to have representation from a wide variety of disciplines. This can be helpful with internal proposals and pleas to the administration as well as external grant proposals.
   - We also, and perhaps most importantly, had support from the library director and the other members of the library staff.

2. Did some research
   - Look at resources such as Make magazine, MakeSchools website, makerspace Facebook groups, library makerspace websites, and, of course, search the databases to discover what other academic makerspaces are doing.
   - Reach out to learn how those on your campus would like to use this type of space and equipment. This is a time when it’s particularly useful to have support from those around campus, as this can increase the conversation and bring about some great ideas.
3. Wrote a grant proposal
   • First we tried for an internal grant, but our proposal wasn’t seen to have been fully formed and thought out- though it was acknowledged to be a cool idea.
   • For our successful proposal, we were able get a lot of support from a member of the campus grants department. They will not write a grant proposal for you, but they can help you write one well. Anna was crucial in helping to write a great proposal.

4. Identify and set up a space
   • Library is already a central gathering place where all on campus are made to feel welcome. The old 3D printer on campus was in the Chemistry department, so while it was available for all to use, many felt weird traipsing into someone else’s department offices.
   • We converted an underutilized media workroom into our makerspace. The media workroom, equipment, and a 10 hour a week student assistant were the things that were tacked on to my job when I was hired into this position. When converting the space, we were able to reuse most of the furnishings, including cabinetry, carpet squares (luckily there was a box of extras to patch spots), and chairs. The Provost did chip in some money to take down a wall an rehang cabinetry.
   • Look for any other campus spaces that can be set up with card or key access. It doesn’t need to always be monitored by a person, but the card/key access is pretty important for our setup. There is also a security camera in the space.
• Writing a grant proposal takes a lot of time and getting funding isn’t always guaranteed.
  • Writing a good grant proposal takes so much time. Writing a grant proposal really made me admire those who do this professionally. Has anyone here written one?
  • There was only so much that could be done by the whole group, so I ended up taking on a bulk of the work- along with Anna from the Grants office (who is now a close friend).
• Setup of the space took a lot of time and thought and decision-making. Of course, with it being summer, many of the members of the planning group were away doing research or teaching in Europe or just traveling.
• Other duties- the summer we received the funding, we signed on to do a 10 week migration to Primo and Alma- which was WAY more work than advertised. Being the web services librarian, I received the task of customizing the UI- which is very complex.
• Life- When I found out we got the grant, I was 6 months pregnant and looking forward to maternity leave. So there was a race against nature to get the space up and running before the baby.
• Tech problems- Old version of Cura, 3D printers finicky
So, that was kind of a quick overview of the makerspace. I’m going to go into a little more detail what’s in the space as well as talk a tiny bit about the grant.
Our makerspace contains, Two Ultimaker 2 3D printers (1 extended and one standard size, $5,664.00 (one $2500, on $3,000)
Two 3D scanners
The Fuel3D brand Scanify Handheld 3D scanner $1,500
The Matter & Form Desktop 3D scanner for $550
We had many suggestions for a laser cutter, but the designated space didn’t have proper ventilation for one, and we couldn’t afford both the equipment and construction costs, so this was the next best thing.

About $200 (purchased with library media money)
Added because of student demand for a sewing machine not tied to the costume shop on campus and efforts to avoid gendering the makerspace. I had been talking to someone who was a member of a community makerspace who mentioned that fiber arts were looked down upon by many other members of a different local makerspace, which made me realize that we needed to make sure the space wasn’t gendered.

Just under $100- library media
PAINTING AND COLLAGE STATION

Added by demand of an art professor with old magazines he brought in- necessity for such a space outside of an art class

Probably about $20 worth of supplies (including stuff I found around the library that wasn’t being used)
Students often asked for these things- so we wanted to make them always available.

(By the way, we just completed an equipment and tool list that’s posted to our website. It includes things that are in the space, so not the coloring station.)
• FaCE grant ACM- The funding was meant to go toward enhancing methods of teaching for faculty- so our grant proposal had to be heavily written for faculty and what we called “maker pedagogies.”
• This meant our space had to be geared toward faculty- the outreach, programming, and methods of usage.
• The grant total awarded was $23,377.
  • This included $11,199 for technology and equipment, $2,700 for consultants and facilitators, $2,500 for space setup and consumables, and $6,978 for an ACM maker pedagogy workshop. The reasoning for the workshop is that the ACM didn’t want to give money to just benefit one school, but through the workshop, we could share what we’ve learned with many ACM schools.
  • If you’d like to learn more about the grant proposal, take a look at our website, blogs.lawrence.edu/makerspace. We’ve linked to the page where the proposal is mostly written out on the about page.
  • Speaking of the website and grant, please, feel free to use those as inspiration if you’re planning your own makerspace. We have assignment ideas, downloadable documentation, and a bunch of potentially useful stuff on the site.
• Library technology assistant Matt Sonnenberg came to campus to tell about his experiences with using 3D printers in the UW Stevens Point library as part of the consultants and facilitators line of the grant budget. We invited him to come as part of the grant opening of the space in the winter of 2016.
  • There were about 7 people in attendance, and three of us had planned the event.
  • Luckily, we did get a recording of Matt’s talk. See blogs.Lawrence.edu/makerspace for a recording
• As I mentioned, the grant also included funding for a maker pedagogy workshop, focusing mostly on 3D printing.
  • The workshop drew 15 out of town guests from ACM schools as well as keynote speaker futurist Bryan Alexander (who participated in the conference as well)
  • Bryan talked about 3D printers in liberal arts technology (see lux) His slides are in our IR, see our website for a link. There is a recording, but sadly, I set up the camera in a terrible spot, so he’s actually out of the frame for a while. It is linked on the website as well, however.
  • I talked about management of a makerspace
  • We had some hands-on workshops with 3D design
  • Had some good discussions about uses of 3D printing
  • Sadly, only 4 Lawrence faculty who were not among the 3 of us who planned the
conference attended. We did budget for 30 ACM guests and 25 Lawrence guests (faculty and staff).
PROJECTS FROM OUR MAKERSPACE
Fluorometer for Instrumental analysis class- just one of the things that students found in the *Journal of Chemical Education* and printed in the makerspace.
Students from the New Media in Art have used the 3D printers and the electronic cutter in the space. This student’s project consisted of putting words in removable adhesive vinyl and 3D printed letters around campus and collect reactions from the students from a Tumblr account. http://luwordart.tumblr.com/)
Pictured here are Tahnee (a psychology major) and Emmi (a spanish/math double major and my new media assistant). These students, given their majors, may not have had the opportunity to do 3D design and work with 3D printers if not for the makerspace. Emmi will be doing an independent study in advanced 3D design, and another student will be doing a tutorial in 3D design and printing to complement his computer science senior capstone in which he’ll create a program for a small electronic car.
Cello bow holder-

A cello professor wanted a guide for a cello bow custom made for one of her students. After telling her we really don’t do that, but being interested enough by the challenge, Arno decided to take this on. It turned out pretty well, but took him many tries to work with the nuances of the Flex PLA.
Comp sci, brain wave thingie

This student reverse engineered a brain wave scanning program he had found on GitHub and 3D printed the headset for the detector. It made one of our Communications department’s Lawrence minute videos. Linked on our website.
I&E Band aid dispenser https://twitter.com/LUMakerspace/status/798544119135993858

Students in this class were tasked with coming up with a solution to a problem, creating a prototype of the solution- if it was an object, and creating a business model around it. These students made a band-aid dispenser for hiking.

See more projects on our website (click)
Now I’m going to talk about some of the challenges we’ve encountered over this past year since we officially opened the makerspace.

You may have noticed that a few themes have already come up- the lack of participation from faculty to our grant-funded events and the initial challenges for example, but I’m going to focus on a few big ones, and provide some solutions we’ve implemented as well as some that we really should implement but we/I just haven’t had time for.
MAINTAINING ENTHUSIASM
• As I had mentioned, the grant proposal was written in a way that the use of the makerspace was to be for faculty to enhance their teaching. So it was up to them to bring in students and work with together on fun, hands-on assignments.
  • Our original group I had mentioned in step 1 of the 4 easy steps consisted of about 20 faculty and staff from 12 different disciplines and departments on campus
  • A few faculty did follow up on this.
  • From fall term of 2015 (before the space was officially open) to winter term of 2017, we have had 6 departments bring their classes in, and this represents 6 faculty, some of whom have brought their classes back in subsequent offerings of the class.
So, what have we done to try to improve these numbers?
• We’ve held open houses during breaks,
• as well as a coffeehouse, in which I talked about makerspaces and the maker movement- and also had an open house after
• We’ve held meetings for interested faculty and staff to discuss uses of the makerspace with their coursework
• We’ve expanded our social media to include Instagram, So, within the past few weeks, I’ve been adding to the makerspace Instagram with the stockpile of photos I’ve accumulated on Flickr and my work iPad over the year.
  • I’ve been using a few social media tactics to try to engage more faculty such as posting targeted things like bones from the Lucy skeleton, and knowing that an anthro professor follows us, and tagging other department accounts in posts.
• Stay on the radar
  • If your campus has a hashtag or aggregator, use that.
  • Post frequently and try to be timely.
While there were only 6 departments represented in the classes that were brought to the space, the students who came to the space on their own represented a much more academically diverse group. We had many individual students come to us for makerspace training to work on senior experience projects, honors projects, or had a cool way to integrate the 3D printers into a class assignment.

- If a student indicated multiple interests, such as Physics and general use, they were added to both.
- I’ve also kept faculty/staff on this, as those indicated the faculty and staff who came to training outside of bringing in a class.
- The faculty participation chart did look really dismal, but if I look at this, and if I look over the stuff students have made in the space, there’s so much cool stuff.

While writing the grant proposal and doing initial planning, the faculty centered goal made a lot of sense and had a lot of support. As time went on, and many faculty talked about how cool it is and how they hoped other faculty were using the space with their classes, it became clear that the goal needed to change. In the beginning, lots of students were told that the space was primarily for educational use, but I suppose they could do cool stuff if they didn’t do too much and made sure to check with me first.

But as fewer faculty were showing interest in the makerspace, and as this chart shows, more individual students asked about gaining access, we realized that maybe this should
become a more student-led space. The grant follow-up paperwork was already submitted, and I was able to show the ACM that it was beneficial for its intended initial use for a while.

• Speaking of the grant, I lifted this from our proposal, “Students need the opportunity to move from passive receivers of information, to producers and creators. To do this, they would need a safe place to experiment, try out ideas, learn from mistakes, and to be hands on” and to “prepare students for life after college by equipping them with the confidence and knowledge to work with new technologies.” Students don’t need to come to the space with a professor to meet this goal.
We’ve decided to change the focus of the space to make it more student-centered.
• The first step to making this happen was to drop the hint to the most interested students that if they created a makerspace club, they could print all the Tardises, Pokemon, and Iron Thrones they want.
  • What I’ve learned from being more accommodating with the Pokémon, TARDISes, and Iron Thrones, is that many students will show a curiosity about using the space and equipment, tinker with it, then come back later with an idea for a class assignment, independent study, or senior capstone idea.
  • A club has been formed and is working on getting a budget from the student council.
  • The club is going to provide funding for materials and equipment.
  • I’ve already trained 4 students from the club to be able to be official makerspace trainers
• Making the space more student-friendly is going to help us in that we won’t feel badly about advertising the space all over campus, rather than just sticking to faculty and staff email lists and speaking at faculty meetings.
  • Students will spread the word through word of mouth
  • We can advertise in the school paper
  • We can hold open house events when the students are on campus

We do plan to continue to reach out to faculty as well Makerspace meetings
Follow through with this- and give plenty of notice.
Advertise in multiple locations- Moodle, Facebook, email, send letters to those who’ve indicated interest and/or to department offices & break rooms.
Infiltrate other meetings
  Faculty meetings, all-staff meetings
  Curriculum meeting?
  Speak at departmental meetings
• Ask me! Email signature in on campus emails- maybe dorky, but it’s worth a try
Another challenge we’ve encountered is equipment maintenance, repair, and the demand for new stuff.
In regard to equipment maintenance, repair, and upgrades:

- **Warranty**
  - Be well aware of your equipment warranty. We had to have our handheld 3D scanner replaced twice and many parts for our 3D printers replaced, one even sent back to Tennessee for a full tune-up, free of charge because they were still under warranty.

- **Customer support**
  - While checking forums and websites can be helpful don’t be afraid to contact customer support.

- **Upgrade when possible**
  - An upgrade kit for the Ultimaker 2 was made available just months after we purchased ours.
    - It was helpful to be able to upgrade, as the kit did solve some of the problems we were having with the machines.
    - We also learned that it’s important to upgrade software and firmware.
      - The version of Cura, the Ultimaker slicing program that makes 3D object files readable for a 3D printer, that we had initially installed on the makerspace computers was pulled shortly after we downloaded it. Paying closer attention to the version notes would have saved us, and our students, many problems.
      - It’s also important to make sure, for the Ultimaker 3D printers at least,
that the firmware on the 3D printers is updated whenever Cura is updated.

- Part supplier - have one you trust
  - Look for educational discounts, such as that offered by 3D Universe
- Have regularly scheduled maintenance
  - With a manual to keep record
- And finally, plan ahead
  - Our grant funding also included an allotment for 2 computers to use in the space. We had asked for them to have a little extra memory and SD card slots, but that was all. Turns out, a lot more processing power is needed for computers to successfully be able to do 3D design.
    - The computers in the space have since been upgraded by our IT department to have solid state hard drives, dedicated memory cards, and many times the RAM as the original computers.
    - If I had properly planned ahead and researched what the software requirements for the 3D design programs, and for even slicing very large 3D object files, we wouldn’t have had to upgrade our computers so soon.
- We also realized after we purchased the handheld scanner that it would have been very useful to have a Windows tablet to make it more portable. If we had planned ahead, we could have written this into the proposal.
Keep an eye out for needs not met elsewhere on campus, and alternatively, when people request equipment, find out if that would be duplicating something already available on campus.

- Substitute when possible Electronic cutter in place of a laser cutter
- Sewing machine
  - Some makerspaces gendered male/shun traditionally female forms of making
  - Students wanting to sew outside of the costume shop
- Professor requested painting and collage table for students no longer enrolled in an art class who still wanted to paint and collage
- Simple creativity and making- as a study break or de-stressor- Students asking for coloring books and supplies and more wellness initiatives in the library
- We now have a large scale CNC machine on campus, but still no laser cutter...
  - Glowforge. We may be able to use the remaining funds from the grant, along with money from various accounts, on a Glowforge. It’s pitched as a more user-friendly desktop laser cutter. They haven’t been mass released yet, so the trick is convincing the director of IT to take on a piece of equipment like that.
- Remember that the Initial makerspace grew out of a demand for a communal space on campus for 3D printing and making- so keeping the idea of meeting unmet needs in mind is important.
TRAINING
Here’s a chart of the number of students we’ve trained over the time we’ve had the makerspace. Our training sessions last about 45 minutes. We try to group as many students together as possible when it is outside of a class session. We’re on a trimester system at Lawrence.
• Time-consuming
  • Up until recently, all of the training has been done by Arno Damerow, instructional technologist, and myself. With my office being in the library, a large portion of the training sessions have fallen on me.
  • Arno and I have been trying to tackle this problem by each taking a day during the week in which we can do training- like a standing meeting time. Last term, students could come in on Monday at 3 or Thursday at 3. Since our classes are MWF or TR, we figured offering a session on a M and one on a R would help us to be available to many students. We’re going to continue this next term and see what happens.
  • The makerspace club is also doing to do a training session during their meeting that falls on the first Wednesday of the month. This has been especially helpful, as it encourages students who are interested in tinkering in the space to interact with other students who share the same interest, and funnels the fun uses to other students.
• Documentation printed in advanced, and kept updated
  • Google docs helpful
  • Have folders in the space
• Work with the space
  • Extra monitor, folding chairs and table
• Plan a training session all trainers will follow
• Find others to help with sessions
• Schedule training sessions during set times
  • Easier to do when weekly times are designated
• Meet with classes- try to plan these over breaks when professors are creating syllabi
  • Plant the seed over break
Those have been our major challenges. Here are some lessons we’ve learned.
MORE CHALLENGES (AND SOLUTIONS)

- Usage stats
- Roles established
- Space organization
- Usage stats
- Designate time to work in the makerspace
- Be flexible
- Documenting usage
- 3D design is hard
- Money!

• Roles established-Delegate responsibilities- may make it easier to keep people involved
  • Certain person do ordering, outreach, training, website/blog/social media
  • The responsibility of the space has mostly fallen to me, but also with the help of Arno Damerow from Instructional Technology and my media student assistant (though she has other tasks relating to the media equipment and digitization requests)
  • I have submitted a request to have a student who specifically helps with the makerspace and will work in the evenings and weekends, when I’m usually not there.

• Space organization. In multi-user, non-monitored spaces, it’s very important to make sure everything is everything has a place and is well organized.
  • Label. Everything.
  • Have printed instructions available
    • In binders and on the wall near the equipment
  • Keep an inventory
    • Tool list
  • Workstation model
    • Place for 3d printing, 3d scanning, painting...
• Usage stats- Start these early, and update often
  • Stats have been kept since the space started, and even more since I came back from maternity leave, but I hadn’t compiled them in Excel until a few weeks ago. That took a while.
  • Types of stats we keep,
    • usage logs for 3d printers, electronic cutter, and now the sewing machine
    • Forms available on the website
    • Everyone trained- I recently added a spot on the training agreement form for students to describe how they plan to use the space- super helpful
    • Classes brought in
  • Designate time to work in the makerspace
    • This can help improve skills with the equipment and programs, keep the space regularly tidy, and make it so it’s not a constant worry
    • This doesn’t work, however, when there’s a student with a serious filament jam
  • Be flexible- May need to refocus your efforts, maybe your initial impressions on the demand were incorrect.
  • Documenting usage logs and getting photos and or reports about things people are printing
    • Ensuring the campus community knows about the space
    • Remind students that the more stuff I know about and my boss knows about, the more cool stuff we can get/keep it open
  • 3D design is hard
    • Tinkercad saved the day on this one. Tinkercad is a free web-based 3D design program that was designed for beginners, including children, so it’s very intuitive. It’s a great program for editing files one might find on Thingiverse, and for creating fairly complex designs from a combination of simple shapes.
    • AutoDesk, makers of Tinkercad, offer free licenses for education for many of their CAD programs http://www.autodesk.com/education/free-software/all, including Maya (3D design including animation) and 123D design, which will soon be replaced with Fusion 360
  • Money-
    • This is the last challenge I’m going to talk about, but probably the first thing on everyone’s mind.
    • It takes a fair amount of money to purchase equipment- which we handled with a grant.
      • Like I did, try to get assistance from your grants department
      • Or, look at grant resources online. We have a research guide with some free places to search for grants, as well as a grants database that everyone is welcome to use in our library (part of the contract) http://guides.lib.lawrence.edu/funding
        • Look up the Funding Information Network to find a Foundation Center library near you.
    • For the initial purchases and ongoing costs, try to work with departments to contribute. We were able to get our art department to willingly chip in for a Mac
version of a software program, and some professors have suggested that they are willing to use some department funds to chip in for filament costs.

- Right now, we have money from the grant for this, as well as some money in the library media center budget.
- The makerspace club will also help with this in covering some costs.
So, I feel like I’ve been complaining for [minutes]. I felt it was important to share the challenges we’ve encountered, and hopefully, I’ve also succeeded in sharing our solutions. So, is running a makerspace in an academic library worth it? I think so. To know that I’m one of the people on campus who has worked to provide students with the skills and confidence to work with new technologies and to explore and tinker, and to give them an alternative method for doing their classwork, is pretty great. Although it isn’t the traditional type of resources librarians provide to our patrons, library makerspaces allow us to equalize access to new technologies, and give them to those who normally wouldn’t have had experience with these tools the opportunity to use them.
QUESTIONS & SHARE YOUR TIPS