

# Guiding Principles for Designing an Accessible, Inclusive, and Diverse Library Makerspace

ISAM  
2018  
Paper No.:  
07

Fang Yi<sup>1</sup> and Melinda Baumann<sup>2</sup>

<sup>1</sup>Fang Yi; Dept. of Teaching and Learning, University of Virginia Library; e-mail: fy5g@virginia.edu

<sup>2</sup>Melinda Baumann; Dept. of User Experience, University of Virginia Library; e-mail: baumann@virginia.edu

## INTRODUCTION

After the most controversial election in recent US history, one that has left many members of marginalized communities angry, scared, and vulnerable, the Association of Research Libraries (ARL) reaffirmed its longstanding commitment to diversity, inclusion, equity, and social justice [1]. ARL also pointed out that, ensuring open and equitable access to information, expertise, services, tools, and spaces is now more important than ever. After all, accessibility, inclusion, and diversity are at the very core of what libraries are all about [2]. Library makerspaces, as part of library spaces, should also fully embrace these core values and should be designed to reflect a commitment to accessibility, inclusion, and diversity. There have been several papers presented at previous ISAM conferences that have proposed a variety of solutions to making academic makerspaces more accessible, inclusive, and diverse. These approaches focus mostly on events, programming, workshops, outreach, and policies [3]-[8]. However, few papers have discussed how the design of the physical makerspace affects its accessibility, inclusiveness, and diversity. In addition, academic institutions often define what makerspaces should look like from the perspective of the staff and administration. Rarely are students asked what their ideal makerspace should look like, whether they embrace the same values as we do, and how they define accessibility, inclusion, and diversity. For large academic institutions in particular, soliciting feedback from students can often be limited to quantitative research using surveys. The results, while helpful in establishing a general sense of how students use makerspaces, can be limited by their inability to yield deeper insights that might lead to solutions.

As the design thinking framework points out, the first and most important step to take when designing a space or a service is to empathize with our target users [9]. We need to take the time and effort to understand what our users' physical and emotional needs are, and what is truly meaningful to them. In contrast to numerical surveys, qualitative analysis of how students use makerspaces are well-suited for developing deeper insight into the emotional and physical needs of users. In this paper, we will share our findings from small focus group interviews of students' perceptions and preferences towards a new library makerspace, as well as their understandings of and expectations for accessibility, inclusion, and diversity. Building on our findings from qualitative research at the University of Virginia (UVA) Library's Robertson Media Center (RMC) and an interview with staff members from the UVA Student Disability Center, we also propose a number of important guiding principles for designing a library makerspace that reflects these core values. Other discussions of this work have been previously published in [10].

## BACKGROUND

### A. ROBERTSON MEDIA CENTER

The Robertson Media Center was founded in 1998 as a state-of-the-art multimedia facility to provide students and faculty access to various media collections and 21<sup>st</sup> Century technologies. It comprises the whole third floor of Clemons Library, one of UVA's twelve libraries. The RMC has evolved significantly over the past 20 years to continuously meet the emerging needs of the technological landscape on campus. As of Summer 2016, the RMC is a 14,500 square foot facility with a variety of media production technologies and spaces including camera/audio recorders, video/audio studios, media classrooms, and group collaboration stations that are open to all students, faculty, and staff at UVA. Recently, with the increasing popularity of and discussion around academic library makerspaces as well as the rapidly changing technologies in research and learning, both the administrators and staff at the RMC started to reimagine what its mission should be and what its future should look like. Even though the RMC was not considered a makerspace in the past, it is a place centered heavily in making and production. The current technologies offered at the RMC have not, however, reflected the rising popularity of new media technologies such as 3D printers, 3D scanning, and virtual reality (VR) technologies. Therefore, in the summer of 2016, we established a RMC reboot committee to rethink the future of the RMC with the hope that we might transform the current facility into a new makerspace that not only would provide access to new, cutting-edge technologies, but also grant students more autonomy and involvement.

### B. BACKGROUND ON THE FOCUS GROUPS

Our team agreed that the future RMC should be a makerspace for students that would, hopefully, be run by students. Therefore, instead of solely relying on administrators' and staff's vision for a new makerspace, which had been the previous approach, we solicited our target users' input from the very beginning of our planning. Previous studies that surveyed students' perception of the makerspace qualitatively have suggested that there are several possible barriers in terms of accessibility [11]. As a member institution of the ARL, we wanted to ensure that the design of the new makerspace reflected our commitment to accessibility, inclusion, and diversity. Therefore, we sought to gain a deeper understanding of our students' perception and preferences for the new makerspace. As the new space would be designed to meet the needs of undergraduate students, the planning committee collaborated with the library's User Experience (UX) team to survey UVA undergraduate students' ideas and suggestions for the new makerspace through focus group in-

interviews. We chose focus groups as our main research method because, according to [12], “the group-based nature of the discussions enables the participants to build on the responses and ideas of others, thus increasing the richness of the information gained.” In other words, the focus group method is very useful for gaining impressions and perceptions of existing or proposed services as well as stimulating new ideas and concepts.

## METHODOLOGY

In this study, three focus groups were conducted with a total of eleven students. As [9] pointed out, speaking with extreme users can often yield meaningful insights that may not be as evident when engaging with those in the middle of the bell curve. Therefore, when selecting participants, we identified two groups of extreme users, namely the generalists and the experts. The participants of two focus groups – which included seven students – were self-identified as experts and had extensive use of other makerspaces at UVA. The third group’s participants were considered generalists with little or no prior experience with makerspaces. Another important consideration for recruitment was diversity. We worked to ensure that the participants were diverse representatives in terms of gender, major, and year of study. Participants were recruited via several students’ email list serves and were compensated \$15 for their time. The participants’ detailed information is attached in Appendix I. All three focus groups were conducted in-person by two library staff members from the User Experience team. One library staff member served as the moderator to guide and facilitate the discussion, while the other took notes. Each focus group took approximately an hour and fifteen minutes to complete. All focus groups were recorded with an audio recording device and later transcribed for analysis.

A potential limitation to our methodology rests in the small sample size of our focus group interviews, which was partly inevitable due to the timing of the interviews immediately before the summer, a typically challenging time for recruiting. This being said, the ensuing discussions will demonstrate that despite the small sample, the qualitative data is rich and there is strong alignment around the findings.

### A. FOCUS GROUP DESIGN

Since the participants of the generalists group were not familiar with the term “makerspace,” they were first asked to give impressions of the terms “build,” “make,” and “create.” In contrast, the expert groups were first asked about their perceptions of a makerspace, then asked to discuss their past makerspace experiences. All three groups were asked what a library creative space/makerspace should help students do or accomplish, what makes for a good experience in a creative space, and whether it is important for such a space to be student-run (a library stakeholder requirement). All focus groups were shown photos of various types of makerspace equipment—including 3D printers, motion capture suits, virtual reality headsets, 360 video cameras, etc.—and encouraged to think about how training and learning might occur in this new space. Detailed interview questions are attached in Appendix II.

### B. INTERVIEW ANALYSIS

We formed three focus groups to gain insight into the broad experiences, impressions, and opinions of current UVA students. The methodology reflects the overall goal to identify needs and to improve service in an academic library. The notetaker used audio recordings of each focus group to enhance her notes to create a rough transcription, with timestamps, of each session. The facilitator performed a high-level review to identify common themes, patterns, and strong reactions from each of the three groups. The themes were fleshed out with quantified analysis (e.g. “three out of six participants expressed surprise”), analysis of the participants’ lists of important elements of a good space experience, and quotes that provided evidence of the emerging interpretation. The facilitator created actionable recommendations and crafted a User Experience (UX) Rreport based on her analysis. We then performed a secondary analysis around how our students understood the concepts of accessibility, inclusion, and diversity. This was done by applying a similar approach as described above.

## FINDINGS

To our surprise, students expressed stronger opinions about the design of the space than what equipment and services the space might provide. In this section, we first list several significant findings from the UX report as general takeaways from the focus groups. These key findings have helped guide our planning and decision making. The focus in this section is to share our further analysis of both the report and recordings to understand students’ definition of accessibility, inclusiveness, diversity in a library makerspace.

### A. KEY FINDINGS FROM THE UX REPORT

- 1) **All students highly value accessibility, inclusion, and diversity in a creative space.** Such a space should be “open to all” students, regardless of their major, year of study, or level of technical expertise. Some described it as “interdisciplinary” and others said it should be “inviting,” but the intent was clear: this space should be for all students and the Library should strive to make all feel welcomed in the space. Participants also prioritized the need to make the space accessible to people with disabilities. This finding means that students embrace the same core values as the Library.
- 2) **Students use the term “comfortable” and “neutral” to describe an ideal makerspace.** All student groups expressed that the design of the space should support productivity and comfort. A “comfortable” space was described as “non-academic” and “relaxed.” Neutrality means that the space is not affiliated with any academic department or disciplines. Students expressed that the Library is uniquely positioned to function as that neutral and welcoming space.
- 3) **Too much high-end technology is “a turn-off” to inexperienced students who prefer a creative space with “simple stuff.”** “Intimidating” was a term used more than once by the generalist focus group to describe technology spaces. Some participants also identified a need for material-based tools such as markers, paper, and scissors that are “more relatable than high-tech.”

4) **Training and instruction should serve a variety of learning styles.** All three groups wanted a variety of training and instruction styles, such as online tutorials, instructions accompanying equipment, and some expert-led workshops and short courses.

#### B. STUDENTS' PERCEPTIONS OF ACCESSIBILITY, INCLUSION, AND DIVERSITY

Our UX report has confirmed that students also highly value accessibility, inclusion, and diversity in a makerspace. To further understand what these terms mean for students, we conducted a secondary analysis of the UX report and interview recordings, which revealed students' perception and definition of accessibility, inclusion, and diversity in a library makerspace.

##### 1) Accessibility

From students' perspectives, accessibility means both physical accessibility and virtual accessibility.

- a) *Physical accessibility.* Physical accessibility can be further divided into three sub categories. The first one is the traditional notion of accessibility for people with disabilities. All three focus groups prioritized the need to make the space accessible to people with disabilities. The second meaning of physical accessibility entails accessibility to essential facilities such as food, water, and bathrooms. The third notion of physical accessibility means the proximity of its location. A major factor that determines whether students will come to a particular makerspace is based on its proximity to their dorms and classrooms. The first definition of physical accessibility is usually the one that libraries focus on the most when designing space. However, the second and third notion of physical accessibility are aspects we often overlook but are certainly important to our students.
- b) *Virtual accessibility.* Nearly all participants indicated that online accessibility to information about the makerspace is crucial. This information should include the location, types of equipment, hours, service model, tutorials, etc. Therefore, virtual accessibility refers to the ability to search and find relevant makerspace information online. In addition to focus on the design of the physical space, it is important to pay attention to the design of our online space to ensure critical information is accessible for all.

##### 2) Inclusion

According to [1], "Inclusive librarians ensure that their library's facilities, services, programs, collections, and technology are designed in ways in which all people, regardless of their ability, have an opportunity to participate in and use them." However, merely providing an opportunity for all people to participate is far from enough based on our focus group results. To our students, an inclusive makerspace needs to be not only open, but also welcoming.

- a) *Openness.* Openness means being open to all students, regardless of their major, year of study, or level of technical expertise. This aspect is most highly valued by all focus groups. In addition, openness also means that we don't prioritize one group over another. Rather, we

should treat all students equally. For example, in the past, the RMC has been contacted by the UVA Media Studies Department to discuss the possibilities of reserving certain equipment and computers for their students. Even though we hope to support Media Studies students' learning, we decided not to reserve equipment for their classes as an effort to be fair to all library users.

- b) *Welcoming.* The words "welcoming" or "not welcomed" were brought up frequently during all focus group interviews. At the very minimum, a welcoming space should not discourage any target users from participating. Based on the three focus groups, we summarized a list of key factors that may discourage participation. They are location of the makerspace, naming of the makerspace, and the location of the front desk. According to the focus groups, when the makerspace is housed within a specific department, students will immediately feel that the space only belongs to certain disciplines and will, in turn, feel unwelcome if they are not from those disciplines. This also reaffirms the necessity of having a makerspace within a central library because of its neutrality. In addition, when presented with the map of various makerspaces at UVA, both expert and generalist groups pointed out how the naming of the space is either exclusive or intimidating. For example, even for the Robertson Media Center, one participant argued that the word "media" made her feel insecure, as if implying that she should not use the space if she is unknowledgeable about media. Finally, one group pointed out that the location of the RMC front desk makes them feel intimidated and unwelcomed because it looks like a security check-point as opposed to a space where they may freely explore.

Even though it is important to make sure we do not discourage our target users in any way, a truly welcoming space should be both comfortable and attractive. The focus groups considered factors such as comfort, modern design, and safety to be important considerations for making the space more attractive and welcoming.

##### 3) Diversity

Diversity for makerspaces is often defined as having a group of users from a variety of disciplines use the space for various purposes. For example, in [4], diversity in makerspaces is defined as "students representing a wide cross section of disciplines [that] are utilizing our space for various purposes (not just academic purposes)". However, based on our focus groups, students' definitions of diversity are more complicated than we initially assumed and can be categorized with the following aspects.

- a) *Diverse populations of users.* As discussed in the previous section on inclusion, all three focus groups highly value inclusiveness in a makerspace. More specifically, students think that the space should be "open to all," regardless of major, year of study, or level of technical expertise. Therefore, simply making the makerspace interdisciplinary is not enough. A diverse makerspace should also target both experienced and inexperienced users.

- b) *Diverse purposes for usage.* Similar to how [4] argued that a diverse makerspace should not limit the use of its equipment and spaces only to academic purposes, students in our focus groups also suggested a range of usages for a makerspace. Students value the use of makerspaces for personal projects. For example, when asked about the most memorable making experience, one participant responded that, “something can be taken home, something you own versus hand it to a class.” In addition, for the generalists focus group, a makerspace is also considered a place for meeting and exchanging new ideas with other people. For example, a generalist offered that a makerspace should be “a place to prototype, meet up with people, and get your creative juices going.” Some also suggested that we open the makerspace up for students’ groups to host presentations, events, and other programming. While these non-academic uses may not appear to be directly fulfilling academic needs, it is often through these non-academic experiences that students become more proficient in the use of makerspaces. The educational value that comes with increased general exposure to makerspaces is that students will more readily use these spaces – and be familiar with the tools – when the opportunity arises to complete an academic assignment or project. Less additional training will be needed, and students can dive right into the project itself.
- c) *Diverse tools and supplies.* When it comes to selecting tools and supplies for a makerspace, staff and administrators tend to make decisions for students based on new trends. We often assume the latest technologies, such as 3D printers and VR equipment, are attractive to our users. However, when presented with a list of popular equipment in a makerspace, we learned from our generalist focus group that these technologies are often considered to be intimidating rather than inviting. One student commented, “When I think of creativity I think of a more materials-based creativity.” Generalists recommend having scissors, paper, and protractors available, which are “more relatable than high-tech” equipment. Thus, to become a diverse makerspace that satisfies the needs of a diverse group of users, staff and administrators should also consider providing a variety of low-tech tools and supplies including prototyping and material-based tools instead of only supplying high-tech equipment.
- d) *Diverse training and instruction style.* To attract and serve a diverse population of users with different learning styles, it is also important to offer diversity in training and instruction. When asked how learning and training could take place in this space, one participant argued that hands-on and project-based learning is the best way for her to learn. Another participant suggested offering general instruction for users who have no idea of what to make, then moving on to project-based learning once the general instruction was completed. Another participant suggested having both online and in-person training – similar to what the RMC currently uses for high-end equipment training.

## GUIDING PRINCIPLES

From the above analysis, it is apparent that both students and libraries value accessibility, inclusion, and diversity. Further, students’ definition of accessibility, inclusion, and diversity is far more demanding and specific than we previously assumed. In this section, we offer a list of guiding principles to assist library and other makerspaces that share similar values. These guidelines and suggestions are based on our focus group interviews as well as an interview with two full-time staff from UVA’s Student Disability Access Center. Good design models are the ones that pay attention to details. Elements as seemingly trivial as the length of the desk are important to ensure an accessible and comfortable environment.

- 1) **The Design of the Physical Space.** According to the focus group results, first impressions of the physical space will significantly impact users’ decisions to return to the space for future use. Thus, when designing the physical space, the following aspects need to be taken into consideration.
  - a) *Location of the space.* **The location of the makerspace should be accessible and neutral.** Accessibility means that all target users are relatively close to the physical space. Neutrality dictates that it is not affiliated with any department or departmental libraries.
  - b) *Overall design.* **The overall design should look modern, flexible, and non-academic.** A modern design signals creativity and students feel more drawn to the space with the idea that they will be inspired when working within. The makerspace also needs to be flexible so that it can evolve over time to satisfy diverse and changing needs. Finally, students are more attracted to places that look different from the other academic buildings that they often see on campus. For example, most of UVA’s architecture is constructed in the Southern Plantation style which students associate with the seriousness and rigor of academia. In our findings at our institute, students preferred a design that is more contemporary.
  - c) *Furniture.* **Select furniture that has high accessibility, flexibility, and comfort level.** Desks need to be at least 36 inches long (42 inches is ideal) to accommodate a single wheel chair. Motorized standing desks are ideal because their height can be adjusted for comfort and accessibility. Chairs need to have adjustable arms for people who need support to stand up, but also have adjustable height for comfort. Flexible furniture, such as movable tables, chairs, and whiteboards can not only accommodate students with different abilities, but also satisfy different learning styles.
  - d) *Color of the paint.* **Choose non-academic, light, and modern colors that also signal the functionality of the spaces when selecting the color scheme for rooms and walls.** Colors clearly affect emotions. For example, intense colors, such as red and yellow, might distract people from focusing, making lighter and neutral colors preferable. Be-

cause colors can be used to concentrate our attention in different ways, students also suggested using different colors for different rooms. For example, we chose a blue and green color scheme for our 3D printing studio and VR space, respectively.

- e) **Flooring. In addition to having a unique and impressionable design, flooring needs to display high contrast in color and texture for those who experience color blindness.** This will allow blind users to feel the difference when navigating the space with their canes. For example, we used an area rug in the VR space to help users with varied abilities to know the boundary of the VR space when wearing the headsets. Unique and impressionable designs are also important, as demonstrated by how one of the participants in our focus group had shared that the checkerboard flooring of another makerspace in the library, the Scholars' Lab, is so unique that it draws him back into the space.
- f) **Front desk. The location of the front desk needs to be both approachable and accessible.** If it is at the entrance of the makerspace, consider putting it on the side so it doesn't appear as a security checkpoint. Also, make sure the staff at the front desk are approachable and helpful. The front desk also needs to be accessible for wheelchairs or for people who are less-than-average height.
- g) **Tools and supplies. Make a variety of tools and supplies accessible to support different learning styles and different usages of the makerspace.** For example, material-based craft tools such as paper, scissors, glues, and whiteboards are valuable to have available for prototyping and brainstorming. When designing storage for tools and supplies, make sure that it is easily reachable for people with varied abilities. Students also suggested making rented storage available for the housing of long-term or unwieldy projects.
- h) **Display of technologies. Make tools and technologies visible and easily reachable for all users, including those with physical disabilities.** Students often complain that they do not know these equipment and resources are available because, often times, these tools and technologies are stored behind closed doors without windows. Choosing a visible location for displaying your technologies will help market your tools and space. For example, our VR space was originally in a closed lab, a place students rarely know about or access. After putting two VR stations out on the main floor, the stations received significant increase in usage.
- i) **Noise isolation. Design separate group working areas and individual working areas to minimize noise interference.** Some technologies can be quite noisy and unpleasant to be around when operating. Therefore, when designing the overall layout for different technologies or spaces, consider ways to minimize the interference and noise. For example,

we used to position our computer lab (which also doubles as a teaching space) in the middle of the floor next to the group study stations. After discovering how noisy it was for staff who were attempting to teach, we moved the entire space to the far end of the floor so that it could be surrounded by two walls. We also used partition walls to help isolate the noise. Ideally, we would like to install glass walls to make the classroom both functional *and* visible.

- j) **Ventilation. Design a space with sufficient ventilation.** Tools in makerspaces can emit dangerous or odorous gas or particles. Ventilation is essential not only for safety concerns, but also for comfort. Students complain that it is uncomfortable to work for long periods of time in poorly ventilated makerspaces.
- 2) **The presentation of information.** Not only does the design of the physical space matter to students, but the way in which information about the makerspaces is disseminated and displayed is also crucial. The following are important factors to consider.
- a) **Naming of the space. The name of the space should be neutral for accessibility while not being intimidating for inclusion.** The term neutrality refers to how a space should not be limited to a specific discipline. For instance, a makerspace with the name "Drama Scene Shop" sounds as if it excludes all majors outside of the Drama School. At UVA, a few facilities' names, such as 1515, Open Grounds, and HackCville have all been identified as appropriate, neutral names. In short, a space that is not meant to be intimidating should not have a name that sounds overly technical.
  - b) **Online information. Have a welcoming online presence for your makerspace as it serves as the most easily accessible channel by which users may find out more information.** Be explicit about who your target users are. If this space is intended for all, then be sure to highlight to your users that this space is open to all, regardless of major, year of study, and level of technical skills. Even if your space is not intended for all users, ensure your target users feel welcomed through your website and signs. Also, try to provide as much information as possible, including hours, location, rules and policies, types of equipment and spaces available, and contact information. In addition, the information should be written in a friendly and welcoming tone meant to encourage further inquiries.
  - c) **Rules and policies. Accommodate for diverse uses of the space instead of limiting it strictly to academic uses only.** If budget and resources are available, consider opening the space up to as many groups as possible. Further, to make your space more welcoming and accessible, endorse an open-door policy for rooms that have equipment without any physical hazards. Our new 3D printing studio has adopted the open-door policy during its

operation hours to allow for exploration and experimentation.

- d) *Training and instruction. Take different learning styles and users' prior experience into consideration when designing training and instruction for the space.* Have guided instruction for beginners and more independent projects for advanced users. Combine both online and in-person trainings to make it more convenient and efficient for users. In addition, the staff who conduct the instruction and training should be approachable in order to cultivate a culture that embraces learning through experimentation and, at times, failure.
- e) *Events and Programming. Cater events and programming specifically to groups with different levels of expertise.* Also, the events need to be relatable to all users' majors and interests, instead of only focusing on STEM-related themes. When promoting the events and programming, explicitly tell users what level of experience is necessary—if any—to successfully take part in the session.

### CONCLUSION

Through three focus groups, we confirmed that not only do academic libraries value accessibility, inclusion, and diversity, but our students also share similar values. In addition, we realized that students' understanding of these three terms are more complicated and far more demanding than what we initially assumed. Therefore, in this paper, we proposed a number of guiding principles to ensure that our design reflects our commitment to accessibility, inclusion, and diversity. These guiding principles are not only useful for planning a new library makerspace, but they are also helpful for making sure that existing makerspaces meet students' expectations. Even though the research is conducted in a library context and will be most applicable to academic library makerspaces, we believe our findings and guiding principles can yield insights for other makerspaces which also embrace the same core values of accessibility, inclusion, and diversity.

Since each higher education institute services a unique body of students and faculty, we understand that some of the findings and guiding principles might not apply to your school's context. For example, students' desire for a makerspace with a non-academic architectural style is most likely unique to UVA as we are a UNESCO Heritage Site, which prevents us from having contemporary styled buildings. Therefore, we highly recommend other makerspaces to conduct similar focus group research at your location in order to ascertain the unique preferences of your students. We learned that it is especially important to conduct user research at the very beginning of the planning stages and that it is vital to continue seeking users' input throughout the entire project. Last but not least, further quantitative research of surveys and usage statistics is needed to determine whether findings through the focus groups truly resonate more broadly with the user communities at large.

### REFERENCE

- [1] Chris Bourg. (2016 Nov). *Research Libraries and Archives Stand Committed to Diversity, Inclusion, Equity, social Justice*. [Online] Available: <http://www.arl.org/news/arl-news/4154#.WrEfMpPwah2> . [Accessed: 31-Mar-2018]
- [2] A.S. Rogers, "The Librarian's Role in Academic Makerspaces," in Proceedings of the 1<sup>st</sup> International Symposium on Academic Makerspaces, Cambridge, MA, 2016, p.124.
- [3] A.C. Rutherford et al., "Moving Towards a Diverse University Maker Culture," in Proceedings of the 2<sup>nd</sup> International Symposium on Academic Makerspaces, Cleveland, Ohio, 2017, No. 36.
- [4] J. Grayburn and A. Shepherd, "Beyond the Page: Outreach and research in Academic Library Makerspaces," in Proceedings of the 2<sup>nd</sup> International Symposium on Academic Makerspaces, Cleveland, Ohio, 2017, No.87.
- [5] M.R. Hickman, "Overcoming Barriers to Establishing Academic Makerspaces and "Tinkering Culture"," in Proceedings of the 1<sup>st</sup> International Symposium on Academic Makerspaces, Cambridge, MA, 2016, p.215.
- [6] J. Whyte and C. Misquith, "By Invitation Only: The Role of Personal relationship in Creating an Inclusive Makerspace Environment," in Proceedings of the 2<sup>nd</sup> International Symposium on Academic Makerspaces, Cleveland, Ohio, 2017, No.102.
- [7] K.E. Aidala et al., "Empowering the Liberal Arts Student: Tech for All," in Proceedings of the 2<sup>nd</sup> International Symposium on Academic Makerspaces, Cleveland, Ohio, 2017, No.67.
- [8] A. Noel et al., "Sustaining a Diverse and Inclusive Culture in a Student Run Makerspace," in Proceedings of the 1<sup>st</sup> International Symposium on Academic Makerspaces, Cambridge, MA, 2016, p.14.
- [9] Institute of Design at Stanford. *An Introduction to Design Thinking PROCESS GUIDE*. [Online] Available: <https://dschool-old.stanford.edu/sandbox/groups/designresources/wiki/36873/attachments/74b3d/ModeGuideBOOTCAMP2010L.pdf>. [Accessed: 3-April-2018]
- [10] M. Baumann, "Focus Group Insights," *Library Journal*, vol. 142, no. 16, p. 20, 2017.
- [11] M.L. Culpepper, "Types of Academic Design/Build Spaces", in 1<sup>st</sup> International Symposium on Academic Makerspaces, Cambridge, MA, 2016, p.7.
- [12] J. Langford and D. McDonagh. (2003). *Focus Groups: Supporting Effective Product Development*. New York: Taylor & Francis, p.2.

## APPENDIX I

*Table 1: Personal Background Information for Focus Group Participants*

Gender	Year of Study	Major
Female	4th year	History and Religious Studies
Female	4th year	Nursing
Female	3rd year	Urban & Environmental Planning
Female	4th year	Economics
Female	4th year	Neuroscience & Biology
Female	3rd year	Computer Science
Male	2nd year	History
Male	4th year	Drama
Female	3rd year	Computer science
Male	1st year	Engineering
Female	4th year	Engineering

## APPENDIX II: Focus Group Questions

### A. MAKERSPACE FOCUS GROUP – GENERALIST QUESTIONS

Question	Rationale/Notes
1. Please tell us your name and what made you decide to come to UVA.	<ul style="list-style-type: none"> <li>• Warm-up question: to establish a sense of community</li> <li>• Should be factual and answerable in 30 seconds</li> </ul>
2. Have any of you been in a focus group before?	<ul style="list-style-type: none"> <li>• Assess familiarity with process</li> <li>• Go over ground rules</li> </ul>
3. I'd like to start by asking you what these terms mean to you: <b>build, make, create</b> . What do these terms bring to mind?	<ul style="list-style-type: none"> <li>• Probe on answers</li> <li>• Suggest more terms to broaden scope: <b>edit, experiment, design, prototype, tinker, innovate</b></li> </ul>
4. <b>Hand out color copies of UVA Makers Map:</b> There are more than a dozen labs and shops on Grounds that support student creativity and innovation. The Library is considering how we might contribute space to this effort. What should a Library creative space help students do or accomplish?	<ul style="list-style-type: none"> <li>• Introduce term, 'makerspace'</li> <li>• Reference other UVA makerspaces</li> <li>• Probe for how a Clemons makerspace might fit into the UVA maker landscape</li> <li>• Can Library fill a gap, meet needs?</li> </ul>
5. <b>Hand out equipment list:</b> Please review this list, which has equipment that might be in a makerspace. What do you think about the items on this list? Do you think these items would help students accomplish the tasks you've just identified?	<ul style="list-style-type: none"> <li>• Gain insight on equipment/materials in relation to answers to question 4</li> <li>• Probe for what's missing</li> </ul>
6. What are your experiences using the equipment on this list in classes or to complete assignments?	<ul style="list-style-type: none"> <li>• Determine how students are asked to use technology/equipment relating to coursework</li> <li>• Follow-up: how often are you required to use this type of equipment?</li> </ul>
7. Imagine that undergraduate students are managing and operating this space. What are the most important values, rules, and operational practices you'd like to see?	<ul style="list-style-type: none"> <li>• Prompts: diversity, accessible, egalitarian, student-run, 24-hour, pay or free, coursework/personal/research</li> </ul>
8. How could training and learning occur in this space?	<ul style="list-style-type: none"> <li>• Probe on how training and learning could occur on equipment, software, values, rules, operational practices</li> <li>• Probe on peer mentors/trainers vs. expert staff</li> <li>• What are the ways you prefer to learn?</li> </ul>
9. What are some important elements of creating the best experience for students in this space? How would you describe a good experience here?	<ul style="list-style-type: none"> <li>• To provide details to inform space and service development</li> <li>• List descriptors on whiteboard/easel as they are identified [welcoming, professional, friendly, experimental...]</li> </ul>
10. What makes a space [welcoming, professional...] to you?	<ul style="list-style-type: none"> <li>• Prompt them to think about how to translate ideas from question 8 into the physical space</li> <li>• Follow-up: what would be the biggest obstacle?</li> </ul>
11. Suppose you were trying to convince a friend to use this new makerspace. What would you say?	<ul style="list-style-type: none"> <li>• Insight into how to attract students to a new lab/service</li> <li>• Effective marketing</li> <li>• Different response if trying to convince a group instead of an individual?</li> <li>• Possible follow-up: what would be the biggest obstacle?</li> </ul>
12. Of all the needs we've discussed today, which ones are most important to you? What do you most want us to remember?	<ul style="list-style-type: none"> <li>• To assign weight to opinions</li> <li>• To interpret conflicting comments</li> </ul>
<b>Summary:</b> Facilitator gives 2-3 minute summary of outcomes of session	<ul style="list-style-type: none"> <li>• Start with most important findings</li> <li>• Tie to the purpose of the focus group</li> <li>• Cite common themes and also differing points of view</li> <li>• Cite key phrases to demonstrate careful listening</li> </ul>
13. How well does my summary capture what was said here today?	<ul style="list-style-type: none"> <li>• To ensure highlights are captured</li> </ul>
14. Is there anything we should have talked about but didn't?	<ul style="list-style-type: none"> <li>• To ensure nothing important is left out</li> </ul>



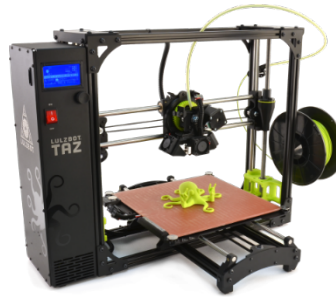
**B. MAKERSPACE FOCUS GROUP – EXPERT QUESTIONS**

Question	Rationale/Notes
1. Please tell us your name and what made you decide to come to UVA.	<ul style="list-style-type: none"> <li>• Warm-up question: to establish a sense of community</li> <li>• Should be factual and answerable in 30 seconds</li> </ul>
2. Have any of you been in a focus group before?	<ul style="list-style-type: none"> <li>• Assess familiarity with process.</li> <li>• Go over ground rules.</li> </ul>
3. When you hear the word “Makerspace” what comes to mind?	<ul style="list-style-type: none"> <li>• Intro question to reflect on experiences and connection to the topic</li> <li>• Note variations on definitions</li> </ul>
4. What motivated you to use a Makerspace for the first time?	<ul style="list-style-type: none"> <li>• “First experience” is the starting point</li> <li>• Grounds discussion in past experiences, not projecting forward in time</li> <li>• Probe on likes/dislikes</li> <li>• Probe on obstacles/barriers</li> </ul>
5. <b>Hand out color copies of UVA Makers Map:</b> The Library is considering how we might contribute to the UVA Makerspace effort. What should a Library Makerspace help students do or accomplish?	<ul style="list-style-type: none"> <li>• Reference other UVA makerspaces</li> <li>• Probe for how a Clemons makerspace might fit into the UVA maker landscape</li> <li>• Library should fill what gap; meet what needs?</li> </ul>
6. <b>Hand out equipment list:</b> Please review this list, which has equipment that might be in a makerspace. How would these items help students accomplish the tasks you’ve just identified?	<ul style="list-style-type: none"> <li>• Gain insight on equipment/materials in relation to answers to question 5</li> </ul>
7. What would you do with the equipment on this list? What’s missing from this list?	<ul style="list-style-type: none"> <li>• Feedback on what is useful, interesting, missing</li> <li>• Probe to address media as well as fabrication</li> </ul>
8. What is your most memorable making experience?	<ul style="list-style-type: none"> <li>• “Most memorable” highlights key, influential experiences</li> </ul>
9. Imagine that undergraduate students are managing and operating this space. What are the most important values, rules, and operational practices you’d like to see?	<ul style="list-style-type: none"> <li>• To think about how to translate experiences from question 8 into practices, values, policies</li> <li>• Prompts if needed: diversity, accessible, egalitarian, student-run, 24-hour, pay or free, coursework/personal/research</li> </ul>
10. How should training and learning occur in this space?	<ul style="list-style-type: none"> <li>• Probe on how training and learning could occur on equipment, software, values, rules, operational practices</li> <li>• Probe on peer mentors/trainers vs. expert staff</li> <li>• What are the ways you prefer to learn?</li> </ul>
11. What are some important elements of creating the best experience for students in this space? How would you describe a good experience here?	<ul style="list-style-type: none"> <li>• To provide details to inform space and service development</li> <li>• List descriptors on whiteboard/easel as they are identified [welcoming, professional, friendly, experimental...]</li> </ul>
12. What makes a space [welcoming, professional...] to you?	<ul style="list-style-type: none"> <li>• Prompt them to think about how to translate ideas from question 11 into the physical space</li> <li>• Follow-up: What would be the biggest obstacles?</li> </ul>
13. Suppose you were trying to convince a friend to use this new makerspace. What would you say?	<ul style="list-style-type: none"> <li>• Insight into how to attract students to a new lab/service</li> <li>• Effective marketing</li> <li>• Different response if trying to convince a group instead of an individual?</li> <li>• Possible follow-up: what would be the biggest obstacle?</li> </ul>
14. Of all the things we’ve discussed today, which ones are most important to you? What do you most want us to remember?	<ul style="list-style-type: none"> <li>• To assign weight to opinions</li> <li>• To interpret conflicting comments</li> </ul>
<b>Summary:</b> Facilitator gives 2-3 minute summary of outcomes of session	<ul style="list-style-type: none"> <li>• Start with most important findings</li> <li>• Tie to the purpose of the focus group</li> <li>• Cite common themes and also differing points of view</li> <li>• Cite key phrases to demonstrate careful listening</li> </ul>
15. How well does my summary capture what was said here today?	<ul style="list-style-type: none"> <li>• To ensure highlights are captured</li> </ul>
16. Is there anything we should have talked about but didn’t?	<ul style="list-style-type: none"> <li>• To ensure nothing important is left out</li> </ul>

## APPENDIX III: Makerspace Equipment

### 3D Printers

- Makebot replicator +
- Ultimaker 3 and Ultimaker 3 extended
- Lulzbot Taz 6



2 Lulzbot 3D printer



1 MantisVision 3D scanner

### 3D Scanners

- MantisVision PocketScan3D

### Virtual Reality Systems

- HTC Vives and Hololens
- Egg chair with Oculus rift
- Motion capture suit



4 HTC Vives VR system



3 Motion capture suit

### Cameras

- Canon Vixia Zoom
- Canon XF300
- Canon C100
- Gopro Omni 360
- Bloggie Cameras



6 Gopro Omni 360 video camera



5 Canon Vixia Zoom camcorder

### Optima & Casio Projector

### Audio Equipment

- Marantz recorder
- Tascam Stick recorders
- MIDI Instruments in audio studio
- Snowball and Yeti USB microphones
- Wired and wireless Lav mics
- Shure 58 mics



8 Snowball USB microphone



7 Sewing machine

### Sewing Machines

### Computers

- iMacs in G-lab
- iMacs and Dell desktops for the 3D printers
- MSI laptops for HTC Vives

### Studio Rooms

- Video studio
- Audio studio
- One button studio
- VizLounge and Vizwall



9 One button studio

APPENDIX IV: UVA Makerspace Map

