Competencies for Information Professionals in Learning Labs and Makerspaces

Kyungwon Koh
School of Library and Information Studies, The University of Oklahoma, Email: kkoh@ou.edu

June Abbas
School of Library and Information Studies, The University of Oklahoma, Email: jmabbas@ou.edu

An increasing number of libraries and museums provide transformative learning spaces, often called "Learning Labs" and "Makerspaces." These spaces invite users to explore traditional and digital media, interact with mentors and peers, and engage in creative projects. For these spaces and programs to be sustainable, it is essential that they are staffed by qualified professionals and support staff. This research study investigated the competencies required for the successful performance of professionals in library and museum learning spaces. Researchers conducted in-depth interviews with professionals working in leading learning spaces in the U.S. The findings include top competencies (e.g., ability to learn, adapt to new situations, collaborate, serve as an advocate, and serve diverse people) and skills (e.g., management, program development, grant writing, technology, and facilitating learning) required for professionals, as well as relevance of higher education to prepare them for their current positions. The study generated curricular design implications for LIS educators with an emphasis on teaching and learning with technologies.

Introduction

Transformative learning spaces have burgeoned in libraries and museums over the past few years. These are often referred to as Learning Labs and Makerspaces. Learning Labs are places where youth explore both traditional and digital media, interact with mentors and peers, and engage in expressive and creative projects (Dresang, 2013; Association of Science-Technology Centers & Urban Libraries Council, 2014). In 2009 YOUmedia at the Harold Washington Library in Chicago launched a youth-centered, interest-driven learning space (http://youmedia.org/). Inspired by YOUmedia, the Institute of Museum and Library Services [IMLS] and the John D. and Catherine T. MacArthur Foundation supported the planning and designing of 24 Learning Labs in libraries and museums in 2012 and 2013. These spaces are designed to promote libraries and museums as hubs for innovative community learning centers (IMLS, n.d.). The soundness of the Learning Labs is supported by research-based frameworks such as HOMAGO—Hanging Out, Messing Around, and Geeking Out, the stages of self-directed learning that youth progress through with digital media (Ito *et al.*, 2009). Learning Labs also represent the principles of Connected Learning, "learning that is socially connected, interest-driven, and oriented toward educational, economic, or political opportunity" (Ito *et al.*, 2013, p. 4). Learning Labs provide different youth-driven programs that involve the use of digital media and technologies, such as creating an online teen literary magazine or gaming podcasts, open mic performances, or digital storytelling. The outcomes of Learning Labs includes the development of a supportive and safe environment for youth that allows them to cultivate their interests and expertise, exposing them to a breadth and depth of interests, and connecting their interests to

J. of Education for Library and Information Science, Vol. 56, No. 2—(Spring) April 2015
ISSN: 0748-5786
doi:10.12783/issn.2328-2967/56/2/3

career and academic opportunities in the real, wider world (Larson *et al.*, 2013).

Makerspaces offer access to equipment and cutting-edge fabrication technologies, which allow people "to not only design their ideas digitally, but to turn those ideas into real objects" (Maker Media, n.d.). Led by Maker Media, the Maker Movement inspired a growing community of makers who bring a DIY (Do-it-yourself) mindset to technology and development of Makerspaces in libraries, museums, community centers, and schools. Makerspaces provide a range of tools and materials, including but not limited to electronics (Arduino, Raspberry Pi), power tools (jigsaw, sewing machine, drill), mechanical (screwdriver, hammer, wrench, wire cutters, soldering), and other digital fabrication technologies such as 3D printers and laser cutters. Activities vary from skill building projects, such as soldering, woodworking, and crafting, to independent long-term projects. The Maker program is a type of student-centered, project-based learning that stems from the pedagogical tradition of learning by making and through apprenticeship (Maker Media, 2013). Advocates of the Maker movement suggest "making encourages a deep engagement with content, critical thinking, problem solving, and collaboration while sparking curiosity" (New York Hall of Science, 2013, p. 1). In particular, the Maker movement embodies science, technology, engineering, and mathematics (STEM), as learners seek out STEM knowledge and skills to develop their project.

Besides different origins and sponsoring agencies, Learning Labs and Makerspaces somewhat differ in their focus on digital media (Learning Labs) and the physical objects and engineering approach (Makerspaces). These spaces, however, share several common features in that these are hands-on and mentor-led learning environments that provide access to a range of media and tools for community members who might not otherwise be able to afford these technologies or have access to the mentors' expertise. In addition, learning spaces in libraries and museums may use different names such as Fab Lab, Hackerspace, Studio, or Digital Commons. Even without a dedicated space, a number of libraries and museums offer creative makerspace programming using a range of technologies. These learning spaces and programs demonstrate non-traditional ways in which information professionals engage with users, provide services, and partner with diverse public and private sector collaborators.

In order for these innovative programs and spaces to be sustainable, the authors assert that it is essential these learning spaces are staffed by qualified professionals and support staff. Learning Labs and Makerspaces in libraries and museums may perish without well-trained personnel who will continue to manage, implement, and develop programs and facilities. No research studies, however, have been conducted to identify the necessary skills, knowledge, abilities, or attitudes required for the successful performance of information professionals in Learning Labs and Makerspaces. There are existing lists of competencies for librarians and museum staff, but they do not focus on these emerging and innovative places. Nor has there been a published analysis to revisit the existing competencies to assess their relevance to workers in emerging learning spaces. This fact poses a challenge for Library and Information Science (LIS) educators to update and develop an evidence-based and cutting-edge curriculum. Therefore, the authors conducted a research project informed by the following research question:

> What are the competencies required for information professionals to provide resources and services in library and museum learning spaces such as Learning Labs or Makerspaces?

Identifying competencies desired for information professionals in the digital age is significant in several ways. The findings can

be used to generate specific implications for LIS educators to understand, design, and update LIS curriculum. The results can also be used as a tool to evaluate and improve current services in libraries and museums, as well as provide a research-based framework for staff training.

Literature Review

The literature on Makerspaces and Learning Labs has been proliferating almost as quickly as these new learning spaces themselves. However, the literature focuses mainly on: 1) history and models of Makerspaces and Learning Labs (Abram, 2013; Balas, 2012; Mayo, 2013); 2) case studies or informal reports of how specific libraries or museums developed their Makerspace or Learning Lab (Britton, 2012; Jensen, 2013; Haug, 2014; Larson, 2014; Mayo, 2013); 3) advice and resources for how to start a Makerspace or Learning Lab (American Library Association, 2013; Graves, 2014; Houston, 2014; Jensen, 2013; The Makerspace Team, 2013; McDonald, 2013; Preddy, 2013); and 4) models and technology suggested for use and sample projects (Loertscher, Preddy, & Derry, 2013; The Maker Team, 2013; Steele, 2013). The limited research on these innovative learning environments relates to surveying libraries in the U.S. and seven other countries about the presence of Makerspaces in their organization or their plans to develop one in the future (Burke, 2013). Further Burke explored issues related to funding, programming, and the top technologies used by library Makerspaces. Burke's study, however, did not address competencies needed by information professionals who work in these learning spaces.

Current Competencies for Librarians

While there are ALA core competencies in general librarianship (American Library Association, 2009a), competencies for different types of libraries or library services, and for librarians serving specific populations, e.g. children or young adults (American Library Association, 2009b), and curricular competencies for museum professionals (ICOM, 2009), competencies for professionals in Learning Labs and Makerspaces in libraries and museums have not been identified. However, several of the competencies listed for library professionals who serve either children or young adults could be applied to library professionals who work with these populations in either Learning Labs or Makerspaces. The Discussion section presents a brief comparison of established competencies and how these competencies are related to the findings of the study. The problem still remains, because no set of competencies has been compiled for information professionals who work in these new learning spaces, and as noted above, no research to date has specifically addressed the competencies needed for professionals in Makerspaces and Learning Labs.

A somewhat related study was conducted by Bowler (2014) with the goal of exploring the skills, knowledge and aptitudes librarians need to implement Makerspaces. Her study pilot tested a "maker" experience with LIS students who participated in a design challenge to use robots to interpret a selected work of children's literature. However, while the findings briefly described the students' experiences participating in the Bots challenge, no findings related to competencies were reported. While Bowler's findings do not identify specific competencies, it is encouraging that there is a growing recognition of the significance of identifying competencies, but also for developing an evidence-based and cutting-edge LIS curriculum to support information professionals who work in these innovative learning environments.

New Librarianship

Libraries and museums realize that in

order to remain viable in today's digital, participatory culture, they must continually re-evaluate their core values, missions, and services. The American Library Association has been holding town meetings for many years focused on new directions of libraries and the skills and knowledge required of ALA accredited library professionals. The ALA is currently revising the accreditation standards for the masters of library and information studies programs. The revised standards will be voted on in January 2015 (Committee on Accreditation, 2014).

A further novel project which is exploring ways in which libraries and museums can align the training and competencies expected of information professionals is the Salzburg Curriculum: Libraries and Museums in an Era of Participatory Culture. The Salzburg Curriculum "is designed to bring together the training processes for both library and museum professionals in order to align them with each other" (The Salzburg Curriculum, n.d.). In 2011 a group of library and museum professionals from more than 31 countries developed a framework for a comprehensive and joint library and museum curriculum. They proposed skills essential for librarians and museum professionals in a participatory culture including transformative social engagement, management for participation, asset management, technology, cultural skills, and knowledge, learning, and innovation. Members of the symposium signed an agreement to follow the framework. The framework and competencies outlined therein are a useful start for developing a joint curriculum or training expectations for library and museum professionals in the participatory culture. The proposed competencies, however, do not specifically address the unique needs of individuals working in Makerspaces and Learning Labs. The study presented in this paper represents the first research study that investigates the competencies needed by information professionals in order to be successful in these emerging and innovative learning environments.

Methodology

Research Design

The study aimed to identify competencies that are required for the successful performance of information professionals who work in library or museum Learning Labs and Makerspaces. This paper reports the findings from the first part of a two-phase research project including Phase 1: individual interviews and Phase 2: a large-scale survey. In Phase 1, the researchers conducted in-depth interviews with professionals working in leading Learning Labs and Makerspaces in either a public library or museum in the U.S. The goals of Phase 1 were to (1) explore competencies for professionals in Learning Labs and Makerspaces and (2) inform the development of a large-scale survey questionnaire. Phase 1 of the research project was informed by the following research question:

> What are the competencies required for information professionals to provide resources and services in library and museum learning spaces such as Learning Labs or Makerspaces?

Participant Recruitment

The study used the purposive sampling approach, i.e., selecting information-rich participants who can provide in-depth understanding on the study topic (Patton, 2002). The researchers identified leaders and pioneers in this area by examining publicly available resources such as the YOUmedia Network, the directory of Makerspaces, and lists of the recipients of the national competitions to design 21st century Learning Labs in museums and libraries by the Institute of Museum and Library, and John D. and Catherine T. MacArthur Foundation. An effort was

made to include professionals from both libraries (the sample only included public libraries) and museums as well as both Learning Labs and Makerspaces. Potential interviewees were contacted via email. Nine individuals agreed to participate in the interviews via phone, Skype, or Google Hangout. Each participant received an information sheet, which explained the study overview and provided contact information for the researchers. All participants reside in the United States and are English speakers.

Data Collection

The study adapted interview questions that were tested in a previous research study which sought to identify competencies for sustainability professionals (Willard, *et al.*, 2010). Their interview instrument was relevant to our study because they attempted to achieve a similar research goal, i.e., identifying competencies for staff in an emerging new profession. We adapted the semi-structured questions to elicit competencies required of library and information professionals who are responsible for developing and assisting users in Makerspaces or Learning Labs. (See Appendix 1 for the interview questions.) The researchers conducted interviews with professionals working in Learning Labs or Makerspaces in summer 2013. The professionals were interviewed via web conference using either Skype, Google Hangout (with audio and video), or by telephone, depending on their preference. The sessions were recorded using software called Audio Hijack Pro. The length of each interview varied between 30 to 70 minutes depending on the degree of detail in each interviewee's answers. All interviews were recorded and transcribed.

Data Analysis

Data collected from the interviews involved interview transcriptions from the audio-recordings. The data collected from the interviews were analyzed with Dedoose, a web-based data analysis software, using the method of content analysis. Both researchers analyzed all transcripts and compared the results by conducting qualitative content analysis. In this paper we focus on the findings related to the competencies participants reported as being important to work in a Learning Lab or Makerspace.

Findings

The findings described below include participants' demographics, top competencies and skills, and relevance of higher education to prepare them for their current positions.

Participants' Demographics

Interviewees included five museum professionals, three librarians working in public libraries, and one professional working in a science center. Four work in Makerspaces and three in Learning Labs; the organizations in which two of the interviewees work have both Learning Labs and Makerspaces. Because the authors aimed to interview the most experienced and knowledgeable professionals in these emerging areas, most of the interviewees (eight out of nine) were directors or managers. The educational backgrounds of the interviewees varied including Library and Information Studies, Museum Studies, Art History, Learning and Teaching, Film and Television, and Geology. One person had a Ph.D., while the others had Masters' degrees. The years of professional experience ranged from one year to more than 20 years. The interviewees included five females and four males. The interviewees had different position titles including Chief Scientist, Digital Learning Librarian for Teens, Senior Educator, Director of Digital Learning Programs, Manager of Creative Making and Learning, and more traditional names such as Young Adult Services Manager, director or manager

of the library, museum, or the lab. These positions require a variety of job responsibilities, including tasks related to management, grant writing and funding, partnership and advocacy, programming and content development, experimenting with new technologies, and more traditional tasks of librarians and museum professionals. Figure 1 shows the demographic information of interview participants. Numbers in the pie charts indicate the number of interviewees in each category.

Top Competencies

The analysis of interview data suggests key competencies needed for successful job performance of professionals in Learning Labs and Makerspaces, including (1) ability to learn, (2) ability to adapt to changing situations, (3) ability to collaborate, (4) ability to advocate for the Learning Lab or Makerspace, and (5) ability to serve diverse people. In this study, competency is defined as "the skills, technical knowledge, and personal attributes that contribute to an individual's success in a particular position" (McNeil & Giesecke, 2001, p. 55).

Ability to learn. Competent professionals in Learning Labs and Makerspaces must have the ability to learn and have a positive attitude towards learning new things. An interviewee mentioned, "learning is a critical part of everybody's job." They frequently encounter things that they do not know because Learning Labs and Makerspaces are continuously evolving and the technologies and tools they use are rapidly changing. It is an important quality for professionals to be willing to learn and enjoy exploring new things. As an interviewee stated, "one of the things I love about my position is that I have the authority to learn, essentially. So when I want[ed] to take up a [new] project . . . I was able to just pick up some time in my schedule and start reading research and making myself aware of what the research results [are]." An interviewee stated when they hire staff for their learning space they look for a person who knows how to learn and who is willing to learn:

> I think it would be, at this point, really difficult to find library staff that already has the skills that we would need from day one . . . So we would need to identify people that would be able to pick up on the skills. Like someone that is going to be comfortable learning graphic design software, learning to use a 3-D printer and software that's involved in that, those types of things. So they have to be flexible and they have to be energetic and willing to learn, and able to learn—that is really hard to identify though.

Ability to adapt to changing situations. The interviewees suggested they must be flexible because the nature, tasks, and responsibilities of their job have changed since they started the position and that the learning spaces are always in transition. They indicated the ability to improvise and be situational, or "the ability to flow with experimentation with a good attitude," is key. An interviewee stated, "I think having to just be very responsive . . . being able to react quickly is required in this kind of work."

Ability to collaborate. Interview responses revealed that the ability to collaborate with a range of partners is required for successful job performance. Interviewees coordinate and create partnerships for their programs and meet with makers, artists, and residents. They also work with partners on grant writing and funded project implementation. To be able to work with different entities, "being a people person" is desirable and further one must be "an interdisciplinary thinker" to work across different disciplines.

Ability to advocate for the Learning Lab or Makerspace. The interviewees identified themselves as advocates or representatives for their programs. They regularly advocate for their learning space to extend awareness of their programs to the public, potential funders, as well as the library and museum communities. One interviewee

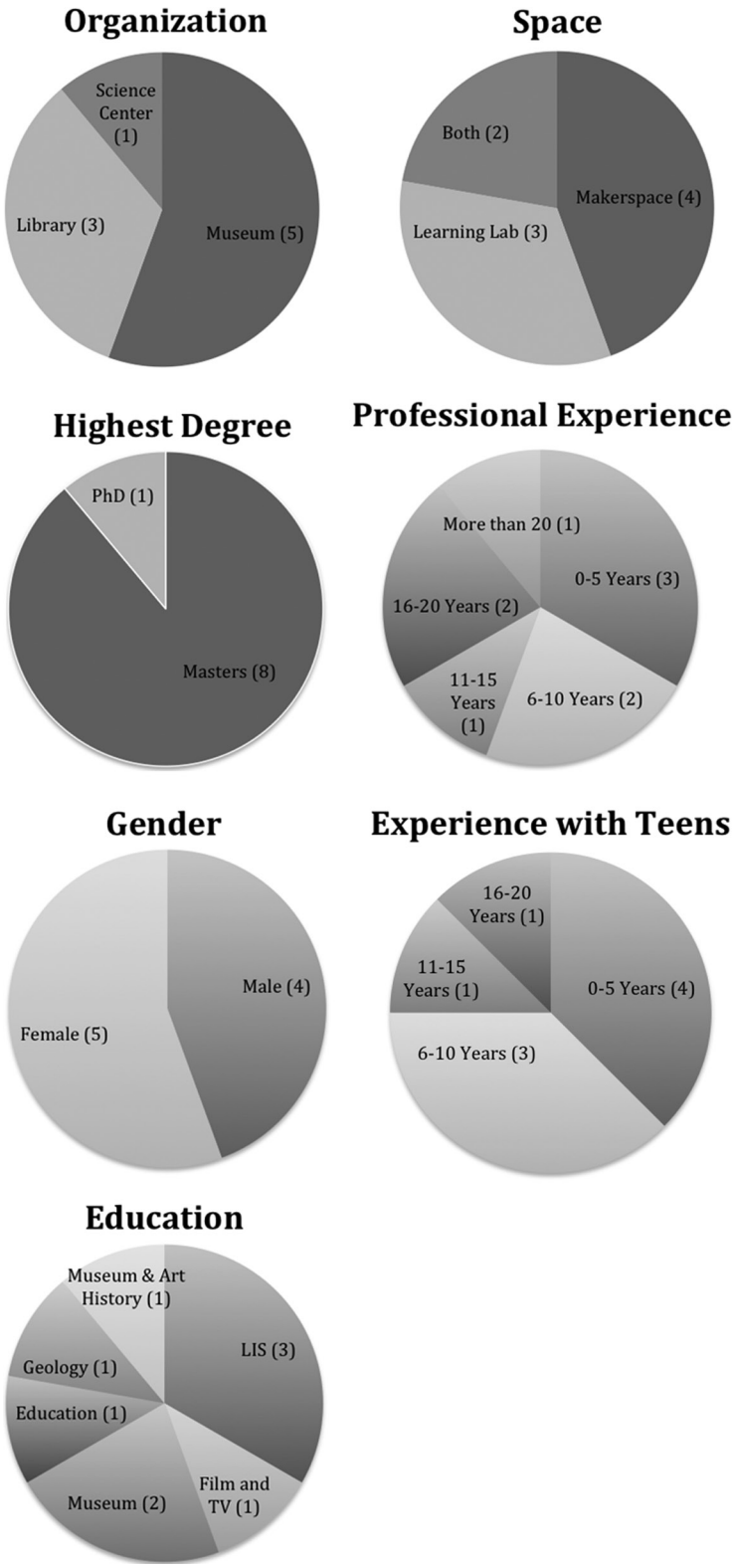

Figure 1. Participant Demographics.

stated "[I am trying to keep] spreading awareness and developing programs, nationally and internationally, really delving into more of that almost representation. I don't know if 'diplomat' is the right word. But the idea of, like, I've been on the front lines, I've been there, I know the spaces, I know how they work—how can I help you with what you want to achieve and what you want to do?"

Ability to serve diverse people. As the professionals serve a range of people in their Learning Labs and Makerspaces, they must know how to work with diverse populations, such as people with different cultural backgrounds, skills, and ages. The interviewees indicated it is important to be culturally competent and that professionals must feel comfortable with different user groups such as teens.

Top Skills

While many of the competencies addressed by the interviewees included soft skills based on personality traits, several skills that can be taught were also identified. These included skills and knowledge related to (1) management, (2) program development, (3) grant writing and fund raising, (4) technology literacy, and (5) facilitating learning based on learning theories and user behaviors.

Management. Interviewees are involved in different types of management—from people management, project management, space management, to information management. Interviewees are in charge of running and sustaining the general operations of the Learning Lab and Makerspaces because most of them hold a manager or director position. They plan and coordinate strategic planning and the annual planning process. Personnel management includes hiring, training, supervising, and managing staff, mentors, interns, work-study students, and volunteers.

Program development. Professionals need skills and knowledge on developing learning resources and delivering Maker and Learning Lab programs. Their major responsibilities include developing curriculum, creating programming kits, prototyping a Makerspace, providing content expertise, and delivering instruction sessions and workshops.

Grant writing and fundraising. Funding is a key issue for professionals in both Learning Labs and Makerspaces. They conduct overall management of grant activities, such as fundraising and funding management.

Technology literacy. Interviewees responded that skills and knowledge related to appropriate use or application of current technologies are necessary for them to maintain or grow in their position. An interviewee mentioned "tools literacy" indicating

> understanding how these tools work and utilizing them within a program, and also the acquisition of these tools. What do we use these for? How do we get them? Depending on the tools—like a hammer is pretty simple or at least in my mind—but then we have a laser cutter. So how do you even research a laser cutter? How do you figure out how to buy one? Understanding tools and proper ways to use tools I think is incredibly important to anyone that is working in this type of focus.

An interviewee indicated knowledge about technology and society is also important saying "it's keeping abreast of what changes in technology, how changes in technology impact the lives of people in a very social way."

Facilitating learning. Interviewees discussed skills and knowledge for effective teaching based on understanding of user needs and behavior. They are frequently involved in educational activities from teacher professional development to public education. They suggested that knowledge and skills about learning and teaching are required for them to grow in their positions. According to the interviewees, skills and knowledge for being an educator and mentor include facilitator skills, the abil-

ity to ask "the probing question that is going to open that person's ability to express themselves," understanding of how people learn, teen development theories, and how to make their programs more effective. For example, a librarian working in a Learning Lab discussed how he started to see himself as an educator, which is not the way he thought about being a librarian in the past. He also reported that he plans to keep up on readings and research on the role of a mentor.

Because many of the Learning Labs are geared toward teens, understanding of this particular user group was addressed, such as knowing "what do your teens need, what do they want, what interests them and what is the best way to present it in a meaningful way to learn . . . search for innovative ways to teach teens . . ." An interviewee stated:

> In Learning Labs I think the number one thing I look for is an understanding of teens that fits with our model. Somebody who comes into the project thinking that teens are uncontrolled bags of hormones, and you can't do anything with them until they grow up and turn into normal human beings again will not be successful working in this project. They really have to see teens as competent agents and really deeply believe that, because sometimes the teens will do a fair amount to try to convince you otherwise. And so you kind of have to hold on to that belief and say, 'No, I know that you are a competent agent, you can actually do this. And I can actually trust you to do this, and I can step out of the way and let the process move forward and not interfere, because I know if I interfere I'm going to wreck what I've just created.' And I think sometimes that is really hard for people, and so attitudinally that piece is really important.

Relevance of Formal Education

Besides qualities that come naturally from personalities, interviewees seemed to agree on four ways of obtaining the competencies and skills including (1) networking (e.g., conferences and conversations with professionals in different Labs), (2) learning by doing on the job, (3) self-education (e.g., online training resources, reading articles, and reflection), and (4) formal education. However, interviewees provided differing opinions in response to the question posed about higher education: "How relevant do you feel your completed or current educational program was in preparing you for the current job position?" Four out of nine participants found the higher education programs they had completed offered relevant knowledge and skills for their current positions. The skills they learned from formal education included management, grant writing, research skills, the ability to learn, and relevant theories and knowledge such as understanding of the user group and teen developmental characteristics.

On the other hand, three out of nine participants did not find their educational background particularly useful. One interviewee indicated a lack of entrepreneurship in higher education:

> I feel that a lot of people can skip going into higher education and learn a lot from YouTube videos, tutorials, and things on the Internet. I think entrepreneurship is something that should be taught better. I think there are a lot of people where more traditional systemized ways of learning do not work for them, especially if they are artistic or creative and they already have their own process. I think, though, that survival skills—figuring out ways to support yourself, ways to develop a client base, or ways to be an individual making a living rather than working for someone else—is something that should be emphasized more. I think if our higher education were to do that it would allow for more innovation. Which right now, what often happens is that innovative and creative people end up having to keep that on the outside of their lives in order to just work standard and more traditional jobs.

Two participants did not find their formal education relevant because they had graduated before Learning Labs or Makerspaces appeared. The other two participants said yes or no; formal education somewhat helped them but did not directly inform their current job performance in the Learning Labs or Makerspaces.

Interviewees with a Masters of Library and Information Science (MLIS) degree made suggestions for Library and Information Science (LIS) education. An interviewee mentioned that "it might be a good idea . . . for library schools to prepare people for the fact that there might be a lot of change coming up in the field" because her position required a high degree of adaptability. They suggested it would be relevant that LIS curriculums cover digital media and 21st-century skills teaching "how users would learn, [and] what are the twenty-first century digital literacy skills that both adults and youth need?" Also, it was suggested that an interdisciplinary curriculum approach is desirable so LIS students can take appropriate classes from other parts of the college to bolster their technology skills if these courses are not offered in the library school.

Discussion and Implications for LIS Education

The findings of the study uncovered several competencies that interviewees indicated were necessary to be successful in Learning Labs or Makerspaces. As noted above, ALA has already established competencies for information professionals who provide service to children and youth. The YALSA (Young Adult Library Service Association), the AASL (American Association for School Librarians), and ALSC (Association for Library Services to Children), each divisions of ALA, present standards related to some of those uncovered by our study. These standards include understanding the unique, developmental-based needs of the users in order to provide programming and services; keeping up to date with popular culture and technological advances that interest the user group; developing relationships and partnerships in the community who also are interested in serving the user group; and management and administrative issues including, for example, strategic planning, developing budgets, managing people (staff, volunteers, youth), grant writing, and facilities management.

The competencies from each of these associations, however, are focused on *providing services* and *resources* to either children or young adults and what the information professional must know in order to do so (services- and resources management-oriented). The competencies, with the exception of the compe-

Table 1. Competencies from Findings Compared to ALA Competencies.

Competency from Findings	ALA Competency
Ability to learn	No comparable found
Ability to adapt to changing situations	No comparable found
Ability to collaborate	YALSA III.2; AASL 1.3, 4.1; ALSC VII.4
Ability to advocate for the learning space	YALSA III.3; AASL 4.4; ALSC VII.1, 2, 4
Ability to serve diverse people	YALSA II.3, VII.3; ALSC I.5; AASL 2.3
Management	YALSA I.5, 7; IV.1,5; AASL 5.3; ALSC II.4,5.9
Program development	YALSA VII 1,3,4; AASL I.1-I.4;
Grant writing, fund raising	ALSC II.9
Technology literacy	YALSA II.2, VII.4; AASL 3.3; ALSC IX.1-4
Facilitating learning	AASL 1.1-1.4; YALSA I.7

tencies of the AASL, are not focused on those related to *teaching* these user groups, or how to effectively *integrate* and *facilitate learning* with technologies heavily emphasized in Learning Labs or Makerspaces into programming (teaching and learning-oriented). The ALA competencies are also by nature fairly general so that they can be applied in several environments. Table 1 compares the findings of the study as generally represented in relevant ALA associations' competencies, including YALSA (2010), ALSC (2009), and AASL (2010).

It is important to note that the existing standards do *not* include those competencies related to having the ability to learn and ability to adapt to the often changing environment and needs of a Learning Lab or Makerspace. While some of the existing competencies for information professionals who provide services to children or youth were found in this study, subtle, but perhaps significant differences exist between competencies required in traditional library settings and emerging learning spaces. For example, our findings suggest it is a critical that professionals facilitate learning and understand how to effect user-appropriate and hands-on learning. The AASL standards (Standard 1: Teaching for Learning) that emphasize a school librarian's role as a teacher are relevant. Yet, facilitating learning and mentoring in Learning Labs and Makerspaces, which are a user-driven and unstructured information learning environment, requires somewhat different skill sets from teaching in the formal school environment.

Also, although the existing standards do address technology literacies, a deeper level of technology understanding and skills is required for professionals in Learning Labs and Makerspaces. These professionals are called on to identify, purchase, and learn to use several different forms of technologies unique to these learning spaces. Integrating the appropriate technologies into successful instruction sessions and workshops is a skill that cannot be underemphasized. The findings of this study indicated that it is not just important to include technology in the workshops, it is important to understand *why* a technology is appropriate to include in the program or workshop, and *which* technologies will help achieve the desired learning outcome. If Learning Labs and Makerspaces continue to develop in libraries and museums, a set of competencies designed for the unique needs of information professionals working in these learning spaces will need to be established. This study is the first step in that direction.

The findings also suggested several implications for Library and Information Science (LIS) higher education. Courses on the instructional role of librarians and information literacy seem particularly relevant to future professionals in Learning Labs and Makerspaces. As contemporary libraries transform to community learning centers, interviewees identified themselves as educators, learning facilitators, and mentors, which was not necessarily a dominant self-perception of librarians in the past. LIS educators must teach concepts and strategies related to facilitating learning, particularly learning in an informal, less-structured, and creative environment.

Knowledge on what users need and how they learn should be a key takeaway for LIS students. The focus of LIS programs needs to be user-centered. For example, Agosto suggests "in youth library courses, LIS educators should first teach students about teen behaviors and needs and then move on to show how information resources, library programming, library services, etc., can best be leveraged to meet those behaviors and needs" (as quoted in Hughes-Hassell, 2013, p. 39). The same approach can be applied for different user groups.

LIS programs should help improve students' technology literacy. Current uses of technology prevalent in Learning Labs and Makerspaces include, but are not limited to, 3D printing, photo editing, video

editing, computer programming, arts and crafts, scanning photos to digital formats, creating a website or online portfolio, digital music recording, 3D modeling, Arduino and Raspberry Pi, and animation (Burke, 2013). It would be beneficial for LIS students to have an opportunity to learn some of these technologies, but also for them to learn how to best incorporate their use into Learning Lab and Makerspace programming. Further, LIS programs that cannot provide courses in technology application should consider allowing students to take courses in other academic departments or from other universities or colleges if necessary.

Instead of focusing on technical skills, however, it would be more valuable to enhance students' ability to learn new technologies, as technologies continue to change rapidly. LIS programs can provide students with an experience of mastering a tool; the experience may reduce their technology anxiety and enhance confidence in learning new technologies. Also, the knowledge and skills of using the tool can be transferred to other similar technologies. Although technology was a key theme throughout the interview answers, the interviewees stated they look for potential employees who have the ability to learn and are willing to learn, rather than those who already possess all different technology skills.

The top competencies identified in this study are not always skills or knowledge that can be taught in class, but these qualities can be promoted in higher education. For example, LIS educators can facilitate students' problem-solving skills and research skills by applying a problem-based instructional design. It is important that LIS programs are designed to facilitate students' *ability to learn* and their problem-solving skills, as professionals in these emerging learning spaces in libraries and museums must be flexible learners themselves. It is noteworthy that an interviewee reported he obtained the ability to learn, not the content relevant to the Learning Labs and Makerspaces, from higher education. Team projects and collaborative assignments can be used to foster students' ability to collaborate. Working in Learning Labs and Makerspaces requires cross-disciplinary collaboration between a range of individuals and entities; therefore, it would be a valuable experience for students to have an opportunity to work with people from different disciplines during their higher education program.

Limitations and Future Research

This study presented interview findings from 9 purposefully selected professionals. We do not attempt to generalize the findings owing to the small number of participants in the sample and the nature of qualitative study; rather, these exploratory findings were intended to inform the development of Phase 2: an online survey for information professionals working in learning spaces across the country.

Future research can further investigate the topic and inform LIS education. It would be important to examine current LIS and iSchools curricula to explore to what extent they incorporate competencies and skills identified in this research. Longitudinal research that traces recent LIS graduates who work in learning spaces will be beneficial in assessing how effectively LIS education prepares our students to become competent professionals in Learning Labs and Makerspaces.

Conclusion

The study described above provided findings from interviews with professionals in Learning Labs and Makerspaces—evolutionary learning spaces in libraries and museums. The data provided timely insights on skills, knowledge, and attitudes required for information professionals. Compared to the competencies found in existing ALA standards, our findings showed a significant emphasis on teaching and facilitating learning with tech-

nologies. Professionals in these learning spaces viewed themselves as educators, which was not a dominant perspective of librarians or museum professionals in the past. Professionals in these learning spaces must be learners themselves who are flexible and able to adapt to the changing environment and technologies. They must facilitate learning for diverse users and be knowledgeable about theories of teaching and learning as well as user needs and behaviors. Professionals incorporate a range of low and high technologies into Learning Lab and Maker programs. They work with people from different entities, partnering to provide programs, securing and implementing funds, and advocating for their Labs.

The findings suggest that LIS programs should address skills identified in this study, such as facilitating learning, technology skills, management skills, grant writing, and community advocacy and outreach. To best prepare future professionals in learning spaces in libraries, museums, and other information organizations, LIS programs must focus on a user/learner-centered approach, offer updated technology and digital media courses, and seek innovative ways of working across related disciplines and promoting creative learning approaches.

APPENDIX

1. Interview Questions

<Demographics>

- How long have you been a librarian in a professional-level position?
- How long have you been working with teens in your current or past position(s) in a library?
- What is your highest educational degree?
  - —Are you currently pursuing any educational degree or certification programs? If so, please describe the degree or certificate program more.

<Position Descriptions>

- What is your job title?
  - —How would you describe your position?
- Tell us briefly about your primary job responsibilities.
- (In case a job description document is available) Does your job description accurately reflect what you do? If not, what would you add or take away?
- Is your position a new role within your organization?
  - —Do you know why your organization created your role? If yes, please explain.

<Learning Lab/MakerSpace Information>

Please tell us about your Learning Lab/MakerSpace, such as

- History—when was it built?
- Space
- Opening hours
- Staffing
- Programs
- the audience, and others.
- example of a program you thought was successful and why it was successful
- benefits you see for participants
- any other information you wish to share

<Barriers and Challenges>

- What are some of the challenges that you face regularly in your position?
- Describe one of the toughest challenges you've encountered in your current position. How did you respond? What did you do and what was the outcome?
- In your current position, have you ever been called upon to do something that you didn't feel you had the knowledge or skills for? If so, what was the situation? What knowledge or skills did you wish you'd had?

<Facilitators>

- Describe the outcome or achievement that you are most proud of. What resources—both in your library/museum and for you specifically--were needed to make it possible?
- How relevant do you feel your completed or current educational program was in preparing you for the current job position?
- Before accepting your current position, were you employed elsewhere within the organization, or did you join the organization from outside?
  - —Do you feel that your previous experience somehow helped make you successful in your current position? How?

<Success Criteria and Goals>

- What criteria are you using to measure success in your job? Is it, for example, based on outcomes, results, or benefits?
  - —And how does your manager evaluate your success?
  - —(Or if the interviewee is a director or manager) how do you evaluate your librarians' success in the Learning Lab/ MakerSpace?
- Give me an example of an important goal you had to set as part of your role. Was this goal attained? Why or why not?
- Within your position, what are your professional goals for the next year or two? What are you hoping to achieve for your learning lab/ makerspace?
- How do you see your position evolving, both professionally and organizationally?
- What new knowledge or skills do you think you will need to maintain or grow in your position? If any given, what are your plans to attain these?

<Issues in this area>

- We'd like to know your opinions about issues related to the Learning Lab and MakerSpace.
- What would you say is the single most important issue that your Learning Lab/ Makerspace is facing?

<Competencies>

- Thinking about the challenges facing your organization, what are the top skills that someone would need in order to be successful as an information professional working in a Learning Lab/ MakerSpace?
- Are these skills that you think they can learn on the job? If not, how do you think they can attain them?

<Referrals and Close>

- Do you have any other individuals in positions similar to yours we should talk to? If so, please tell us contact details.

References

Abram, S. (2013). Makerspaces in libraries, education, and beyond. *Internet @Schools, 20*(2). 18-20.

American Association of School Librarians (AASL). (2010). ALA/AASL Standards for initial preparation of school librarians. Retrieved from http://www.ala.org/aasl/sites/ala.org.aasl/files/content/aasleducation/schoollibrary/2010_standards_with_rubrics_and_statements_1-31-11.pdf

American Library Association. (2009a). *Core Competencies in Librarianship.* Retrieved from http://www.ala.org/educationcareers/careers/corecomp/corecompetences

American Library Association. (2009b). *Knowledge and competencies statements developed by relevant professional organizations.* Retrieved from http://www.ala.org/educationcareers/careers/corecomp/corecompspecial/knowledgecompetencies

American Library Association. (2013). *Digital literacy, libraries, and public policy. Report of the Office for Information Technology Policy's Digital Literacy Taskforce.* Retrieved from http://www.districtdispatch.org/wp-content/uploads/2013/01/2012_OITP_digilitreport_1_22_13.pdf

Association for Library Service to Children (ALSC). (2009). Competencies for librarians serving children in public libraries. Retrieved from http://www.ala.org/alsc/edcareeers/alsccorecomps

Association of Science-Technology Centers, & Urban Libraries Council. (2014). *Learning Labs in libraries and museums: Transformative spaces for teens.* Washington, D.C. Retrieved from http://www.imls.gov/assets/1/AssetManager/LearningLabsReport.pdf

Balas, J. L. (2012). Do maker spaces add value to libraries? *Computers in Libraries, 32*(9), p. 33.

Bowler, L. (2014). Creativity through "maker" experiences and design thinking in the education of librarians. *Knowledge Quest, 42*(5), 58–-61.

Britton, L. (2012). A fabulous laboratory: The makerspace at Fayetteville Free Library. *Public Libraries, 51*(4), 30–-33.

Burke, J. (2013). *Makerspaces in libraries survey results.* Retrieved from http://www.users.miamioh.edu/burkejj/Makerspaces%20in%20Libraries%20Survey%20Results%202013.pdf

Committee on Accreditation. (2014). *Standards Review.* Retrieved from http://www.oa.ala.org/accreditation/

Dresang, E. T. (2013). Digital age libraries and youth: Learning labs, literacy leaders, radical resources. In J. Beheshti & J. A. Large (Eds.), *The information behavior of a new generation: Children and teens in the 21st century* (pp. 93–116). Lanham: The Scarecrow Press.

Graves, C. (2014). Teen experts guide makerspace makeover. *Knowledge Quest, 42*(4), 8–-13.

Haug, C. (2014). Here's how we did it: The story of the EPL makerspace. *Feliciter, 60*(1), 21–-23.

Hughes-Hassell, S. (2013). Some thoughts on the future direction of Library and Information Science education. *Young Adult Library Services, 12*(1), 39–44.

Houston, C. (2014). Makerspaces@your school library: Consider the possibilities! *Kentucky Libraries, 77*(3), 26–-28.

ICOM. (2009). ICOM Curricula Guidelines for Museum Professional Development. Retrieved from http://icom.museum/fileadmin/user_upload/pdf/professions/curricula_eng.pdf

IMLS. (n.d.). Learning labs in libraries and museums. Retrieved from http://www.imls.gov/about/learning_labs.aspx

Ito, M., Baumer, S., Bittanti, M., Boyd, D., Cody, R., Herr-Stephenson, B., Tripp, L. (2009). *Hanging out, messing around, and geeking out.* Cambridge, Massachusetts: The MIT Press.

Ito, M., Gutierrez, K., Livingstone, S. Penuel, B. Rhodes, J., Salen, Watkinds, S. C. (2013) *Connected learning: An agenda for research and design.* CA: Digital Media and Learning Research Hub. Retrieved from http://dmlhub.net/sites/default/files/Connected_Learning_report_0.pdf

Jensen, K. (2013). Tapping into teen's creativity and turning libraries into makerspaces. *VOYA, 36*(3), 25.

Larson, J. (2014). A learning lab makes it in Saint Paul. *Young Adult Library Services, 12*(2), 22–-24.

Larson, K., Ito, M., Brown, E., Hawkins, M., Pinkard, N., & Sebring, P. (2013). *Safe space and shared interest: YOUmedia Chicago as a laboratory for Connected Learning.* Irvine, CA: Digital Media and Learning Research Hub. Retrieved from http://dmlhub.net/publications/safe-space-and-shared-interests-youmedia-chicago-laboratory-connected-learning

Loertscher, D., Preddy, L., & Derry B. (2013.) Makerspaces in the school library learning commons and the uTEC Maker Model. *Teacher Librarian, (41)*2, 48–-51.

Maker Media. (n.d.). Makerspace Directory. *Makerspace.* Retrieved from http://makered.org/wp-content/uploads/2014/09/Makerspace-Playbook-Feb-2013.pdf

The Makerspace Team. (2013). *Makerspace Playbook School Edition.* Retrieved from http://makerspace.com/wp-content/uploads/2012/04/makerspaceplaybook-201204.pdf

Mayo, J. (2013). Learning labs learning curve: The Digital Media Lab-Kansas City Project. *Young Adult Library Services, 11*(2), 32–-34.

McDonald, N. (2013). Get making: Incorporating maker ideas at your library. *VOYA, 36*(3), 30–-31.

McNeil, B. & Giesecke, J. (2001). Core competencies for libraries and library staff. In E. F. Avery, T. C. Dahlin, & D. A. Carver (Eds.), *Staff Development: A Practical Guide* (49–-62). Chicago: American Library Association.

New York Hall of Science. (2013). *A blueprint: Maker programs for youth.* Retrieved from http://dmp.nysci.org/system/files/filedepot/1/NYSCI_MAKER_BLUEPRINT.pdf

Patton, M. Q. (2002). *Qualitative research & evaluation methods* (3rd ed.). Thousand Oaks, CA: Sage Publications, Inc.

Preddy, L. (2013). Creating school library "makerspace." *School Library Monthly, 29*(5), 41–-42.

The Salzburg Curriculum. (n.d.). *The Salzburg Curriculum.* Retrieved from http://salzburg.hyperlib.sjsu.edu/

Steele, K-F. (2013). What we think actually matters: Teen participatory design and action research at the Philadelphia Free Library. *Young Adult Library Services, 11*(4), 12–15.

Willard, M., Wiedmeyer, C., Flint, R. W., Weedon, J. S., Woodward, R., Feldman, & Edwards, M. (2010). *The sustainability professional: 2010*

competency survey report. International Society of Sustainability Professionals. Retrieved from http://www.sustainabilityprofessionals.org/system/files/ISSP%20Special%20Report_3.10_final_0.pdf

Young Adult Library Services Association (YALSA). (2010). YALSA's competencies for librarians serving youth: Young adults deserve the best. Retrieved December 17, 2014, from http://www.ala.org/yalsa/guidelines/yacompetencies 2010.