LB 21 RE-31-16-0013: *Supporting the Development of Public and School Librarians as Stewards of Cross-Setting STEM Maker Programs Through Implementation Research*

1. Statement of Need

The interest-driven youth engagement in the creation of digital and physical artifacts characteristic of *making* is being increasingly recognized as a powerful opportunity to support STEM learning (e.g., Austin et al., 2011; Balas, 2012; Bowler, 2014; Colegrove, 2013; Dixon et al., 2014; Slatter, 2013). Resulting *makerspaces* have the goal of providing a variety of entry points for users to engage with complex STEM problems in tangible and transparent ways (Peppler & Bender, 2013). Common digital technologies associated with making and the larger "maker movement" include electronic textiles, robotics, specialized computerized cutting tools, 3D printers, and simplified circuit boards (c.f., Peppler et al., in press). To date, the *Maker* movement has its own magazine, fairs, educational research conference, and even an IMLS-sponsored research planning meeting to understand how educators can better support and encourage making across diverse formal and informal learning settings (IMLS *Maker* meeting, Pittsburgh, PA, July 22-23, 2014).

Recently, the push for incorporating and facilitating more *making* practices into libraries has gone beyond initial success cases of large public urban settings and now extends to smaller and more rural towns and their respective public community libraries and school libraries (e.g., Austin et al., 2011; Britton, 2012; Canino-Fluit, 2014; Kurti et al., 2014; Barniskis, 2014; Preddy, 2013).

Yet many of the professional librarians working in these public and school libraries have limited experience or context-relevant professional development to help them optimally orchestrate *Maker* activities like fabric circuitry, design for 3D printing, or collaborative youth computer game design in their respective spaces (Canino-Fluit, 2014; Koh & Abbas, 2015). This is in part because approachable *making*-oriented models and resources for these librarians are lacking and also because invisible barriers often exist between different types of libraries (e.g., public and school), despite the fact that they are trying to reach some of the same populations of "connected youth" (Ito et al., 2012).

This **Research** project for the **Laura Bush 21st Century Librarian Grant Program** will develop and test models and practices to support and grow collaborative library professionals in both school and public libraries with a focus on rural and semi-rural regions. In particular, this research project will investigate, by way of implementation-oriented research, the learning needs and necessary supports that capitalize on both groups of librarians' prior expertise in order to develop replicable models for successful and cross-site librarianship practice that will support youth in *learning and making*.

The specific research questions driving this project are:

RQ1. How can learning around Maker programming be situated within existing librarianship practice?

RQ2. How are "learning practices" envisioned and realized in library Maker programs? What supports enable librarians to enact situation specific learning practices in their own Maker programming?

RQ3. To what extent are the models and materials appropriated for use in other settings? What, if any, modifications are necessary?
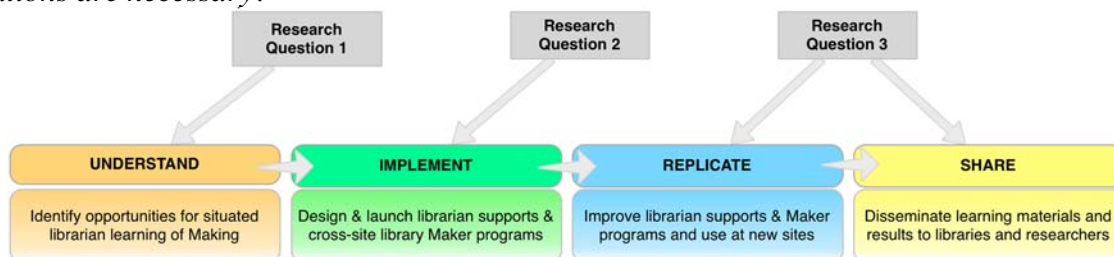
As shown in the figure above, these sets of questions map onto four project phases: *1. Understanding* situated librarianship learning; *2. Implementing* cross-site Maker programs with designed librarian supports and observing what additional supports are needed; *3. Replicating* efforts for use in another set of libraries; and *4.*

Sharing findings more widely through publication and presentation to researchers and practitioners. These phases and their activities are elaborated in the sections below.

2. Impact

While we will deliberately build on existing IMLS supported resources such as the *Learning Practices of Making* design framework for museums (Brahms & Wardrip, 2014) and the *Learning Labs* recommendations report (ASTC, 2014), we take seriously that the rural and semi-rural public and school libraries have different constraints and opportunities that may not be addressed through these resources, nor through other IMLS-funded research-practice partnership efforts (e.g., the *Bubbler* research-design partnership involving Halverson & Willett). While librarians in rural settings are being increasingly recognized as an important population for learning about *Maker* programming (e.g., the IMLS-funded program that involves a roadshow of *Maker* activities for libraries in rural areas led by Fontichiaro, a member of our Advisory Board), our primary interest is in supporting *Maker*-related learning and programming *across* library sites and spaces, one of the core tenets of the "connected learning" digital media and learning model associated with many adolescents today (Ito et al., 2012). Currently, the bulk of connected learning related research has emphasized the experience of youth (such as the relevant IMLS-funded youth experience research in Oklahoma by Koh), but research examining the experience and needs of the library professionals who are now increasingly asked to host connected-learning, *Maker*-oriented activities is lacking.

As such, we have assembled key partners for a design-oriented research-practice partnership (Penuel et al., 2011) involving university and library collaborations to develop an understanding of unique and common librarian learning needs in both library settings around the effective implementation and facilitation of making activities that can serve connected youth who visit both school and public libraries. We expect that, in addition to extending related IMLS-funded projects, one of our primary impacts will be the creation of a new approach for context-specific professional development. This new model for professional development will be developed through direct practitioner partnership in designing, implementing, and supporting new youth *Maker* programs and librarian learning activities. Following in situ formative and concluding summative evaluation of these activities, findings will be broadly disseminated, as described in our Communications plan.

Second, this project will demonstrate how the expertise and resources already available at two different kinds of libraries already frequented by a generation of "Connected" youth can be bridged to achieve similar aims. While we recognize that there are a number of substantial differences related to patronage, learning standards, and preparatory training between community and school librarians, we also recognize that there are under-exploited opportunities for synergy and collaboration. For example, cross-site community-based teen peer mentorship programs for school credit could help libraries in both sites better prepare for technical demands associated with running *Maker* activities and expose librarians to new tools. Alignment of tools and activities (such as a junior high school *Maker Fair* hosted at the local library) can also help create continuities and connections as youth move across these settings. The impact of such crossovers could be designed to better inform how connected teaching and learning can move across different library settings and what librarians at different sites can do to make it happen in more consistent and sustainable ways (Ito et al., 2012). In this way, this research directly addresses IMLS strategic goals 1, 2, and 3 by supporting engaging technology experiences for learners in libraries to enable them to be full participants in local communities and global society. Project activities also align with provisions in Congress's 2015 *Every Student Succeeds Act* around developing effective school library programs to provide students with opportunities to develop digital literacy skills.

Third, this project will help improve our understanding of professional learning in the context of *Maker* activities through the lens of *situated learning theory* (Lave & Wenger, 1991). Situated learning theory applied to these contexts suggests that "making" represents both a set of new practices and a distributed social community (Gee, 2005) for librarians. At the same time, situated learning theory recognizes that library professionals are already part of a social community of librarianship that has a valuable set of prior knowledge, practices, and routines. Because changes in practice are gradual and dependent on how prior resources are used,

we cannot assume that simply introducing "making" as a professional imperative will lead to meaningful learning or change in librarianship activity. Rather, librarians' current practices must be understood, engaged, and gradually adapted while new ones are learned. Yet, we lack a clear image of how those changes and the concomitant learning take place and how new learning materials are taken up in existing practice to support this kind of growth.

Through extended partnership and implementation research of the professional learning of the librarian partners, we will be able to articulate clearly how librarians develop new practices, adapt existing ones, and use new learning resources. In this way, we build on existing theory related to learning in context. We will also generate a concrete roadmap for others illustrating how individual librarianship can realistically change over time to support youth in "making." Outcomes from this project can be used to support dissemination and learning for librarians at sites beyond those who are our immediate partners.

3. Project Design

The **Goals and Objectives** of this proposed project are to: 1) Understand the practical maker-related learning needs for public and school library professionals serving rural communities; 2) Design and implement professional support via continuing/professional development workshops and embedded learning tools through enacted cross-site *Maker* programs with two library partners; 3) Replicate the implementation with two new library partners located in a different area in the Mountain West; and 3) Share locally and nationally demonstration cases, materials, and lessons learned highlighting how formal (i.e., school libraries and media centers) and informal (i.e., public community libraries) can establish partnerships to support connected maker-related learning for both library personnel and youth.

This project will unfold as iterative cycles of a design-based research-practice partnership (DBR, 2003; Penuel et al., 2011) between university researchers at Utah State University (USU), two community libraries, North Logan City Library (NLCL) and Hyrum City Library (HCL), and two nearby Junior High school libraries in the Cache County School District, North Cache Center Junior High School (NCC) and South Cache Center Junior High School (SCC), all drawing youth from surrounding rural communities in Northern Utah. Briefly, our design-based research approach is consistent with some of the most forward-looking models for understanding the challenges of professionals working within learning spaces and uses both research and collaborative design methodologies to articulate and test new tools and supports that can be effectively implemented in practice.

Based on reviewer feedback on the pre-proposal, our project design adds a second implementation and feedback loop. In particular, the project design will incorporate two separate design cycles involving additional library sites, which will provide design feedback and better examine model replicability. The first cycle will involve our originally planned partners, NLCL and the nearby school library at NCC. These sites had initially been selected because of some initial success with pilot programs related to making that took place at NLCL during the summer of 2015. The second design cycle, testing model replication, involves newly recruited partners, HCL and the nearby school library at SCC

Our newly enhanced project plan involves the originally intended first phase of **understanding** and articulating librarian learning needs at both school and community libraries. That phase of work will identify and initially pilot some *Maker* activities and librarian learning supports. Our second phase will continue to involve **implementation** of professional development models and support structures that fit within current librarianship schedules and demands, and working with libraries to launch youth-serving cross-site *Maker* programs.

As the project progresses, we will continue to work with and research activities within the two libraries from the first cycle (NLCL and NCC), and will also **replicate** the use of our learning materials and our emerging professional learning model at the two additional partner libraries (HCL and SCC). With programs and supports in place at two pairs of sites, we will then formatively evaluate replicability, impact, and sustainability so that we can further revise support tools as part of a reflective cycle of continuous improvement. Finally, we will

share materials, cases, and research findings through dissemination and communication strategies as elaborated in our Communications plan.

The project will begin 1 July 2016, end 30 June 2019, and unfold as described below.

Project Activities
Phase 1 (Year 0-0.5): *Contextual and Design-Based Research to understand School/Public Librarian Learning*

The first phase will focus on conducting *contextual inquiry* at the first partnering public and school library sites. Contextual inquiry comprises a suite of research techniques that developed out of user-centered system design research and serves as a model for leading design organizations (e.g., Kelley & Littman, 2001). In contrast to approaches that make general assumptions about specific learning needs or those that try to find ways to immediately push professionals to quickly learn new tools or practices, it privileges direct observation of people working in their respective settings and treating them as experts on what things work or not in their given setting (Beyer & Holtzblatt, 1998). The role of the researcher is to follow and understand the daily tasks, activities, and tools naturally used over the course of a workday by those who operate in that setting. To do this well, the emphasis has to be on in-depth understanding of what happens at a specific site rather than trying to achieve a shallow understanding of commonalities across sites. It is often the case that the depth of understanding is more productive because it yields more accurate insights about daily practice that are highly applicable and valued across sites.

Specifically, in Phase 1, the research team will conduct systematic and recorded observations in the ethnographic tradition (often involving field notes, photographs, and other recorded collection activities) and interviews of library personnel in their work settings over the course of multiple weeks. These observations will include shadowing librarians and asking them to "think aloud" (Ericsson & Simon, 1984) as they describe various tasks that they do and when they are confronted with unexpected situations, whether it involves collections management, patron services, or running an existing community/school program. Interviews will focus on understanding the skills the librarians have had to learn on the job and what resources they have used and found most helpful. We are also concerned with using contextual inquiry techniques to understand how librarians are made aware of what is taking place at other libraries, whether it is through email lists, social media, patron/student reporting, or direct mailing.

The reason for this intensive period of qualitative inquiry is to identify highly situated resources and constraints that are involved in school and community librarianship practice, consistent with the situated theoretical lens we apply to professional learning (i.e., Lave & Wenger, 1991). For instance, we may discover that the librarians find that occasional workshops provided by a central school district or through a local public library consortium are of limited value, or are more useful in certain formats. We may find that for some librarians, more usable knowledge comes from resources such as librarian-specific websites or in-house individuals such as classroom teachers or professional support staff who provide just-in-time instruction (e.g., Brown & Duguid, 2000). In sum, if library personnel do much of their learning in-the-moment using resources most immediately available, then we, as designers and researchers, want to work with that way of learning rather than insist on the "one-time workshop" professional development model.

We also plan to identify what low-cost ways librarians learn about what other types of libraries in their community are doing (e.g., if the junior high school is bringing in an author or the public library is hosting a teen program). For instance, it may be that our partnering librarians learn about other libraries' activities when they are updating the library social media page, sorting local newspapers for their current periodicals section, or overhearing some of their teen patrons talking. Such activities are often not explicitly recognized, even by those who participate in them, as important learning opportunities. For us, the identification of these will serve as leverage points for infusing knowledge related to *Maker* practices and *Maker* programming into professional practice. Using data obtained from our observational notes and video/audio-recordings from the library sites, the research team from Utah State University will then make a formal presentation to the staff at the partner community and junior high school libraries to share research findings, receive feedback, and brainstorm with all

parties to discuss these and other possible leverage points for developing youth *Maker* programming and supporting librarianship learning that crosses library sites.

In preparation of later activities, this phase will also involve recruiting, with help from our librarian partners, a focus group of teens who attend NCC and visit NLCL regularly. Currently, many youth from NCC go to NLCL after school hours to do homework and meet with friends (NLCL offers teen programs and has already suggested ideas for working with our target youth groups). We will solicit from these teens their ideas and recommendations for *Maker* activities that they would be interested in pursuing and feel would be personally relevant. For instance, teens might suggest a library-based e-textiles sewing activity that draws on knowledge and resources from both their school library and community library (see example scenario below). Based on the youths' suggestions, researchers will work with a small group of teens to test feasibility and identify some initial challenges with these *Maker* activities to inform work in later phases.

Example Making and Learning Scenario

*A youth visits the school library to make a light-up shirt as part of her Halloween costume. The librarian tells her that they have Lilypad Arduino starter kits for checkout (figure above, left) and some starting guidebooks to make interactive clothing (or e-textiles). She then takes the student to a makerspace computer to view videos of electronic e-textile projects. The school librarian finds one guidebook, **Sew Electric** (Buechley & Qiu, 2013) (figure, center), and helps the youth to check out that book and a Lilypad Arduino kit. The librarian also mentions that the local community library is hosting a youth e-textiles fashion show and that they have other programmable accessories, such as Adafruit LED strips (figure, right). The youth, who already is involved in a homework group at the community library, makes a note to talk with the library staff there to see what resources they have that can help her to potentially participate in the community e-textiles fashion show.*

Phase 2 (Year 0.5-1.5): *Designing and Launching the First Iteration of Supported Maker Programs*

Drawing upon findings from Phase 1, Phase 2 will involve working with the head librarians at the first partner community (NLCL) and school library (NCC) sites to co-develop tractable and desirable programs and then jointly implement the first design iteration of our research-practice partnership.

Having learned about where the library personnel obtain the information they need and having developed an understanding of where their strengths are in the first phase, we will create professional development support materials that will be tested and used in the launch of the youth makerspace programs. These materials may include public demonstration videos that the librarians can play for themselves or their patrons, visual paper-based quick start guides, or sample starter materials (e.g., cut out paper circuit templates with facilitation tips) for library personnel to use in order to introduce activities in their respective spaces. These would act similarly to what teachers have encountered as "educative curriculum materials" (Davis & Krajcik, 2005), where library staff can draw on specially designed but frequently used program materials as resources for their own learning. We expect to prepare the materials (including librarian support materials) necessary for a minimum of **two distinct cross-site *Maker* programs** that can be implemented across the partnering school and public library sites.

In addition, during the collaborative design of the two distinct cross-site *Maker* programs, we will conduct research examining an initial set of "Learning Practices," as identified within prior IMLS-funded research for *Maker* programming (Brahms & Wardrip, 2014). This prior work, emerging out of the *Makeshop* at the Pittsburgh Children's Museum, identifies key learning practices that can emerge during making activities, using shorthand names such as "inquire," "seek & share resources," and "simplify to complexify," among others (one of its authors, Brahms, is a member of the Advisory Board). As our second research question (see Table 1)

specifically addresses how learning practices are incorporated into library *Maker* programming, personnel from the partners libraries will participate in video-recorded work-circles (Shrader, Williams, Walker, & Gomez, 1999) where these practices are introduced and discussed through early iterations of our test support materials, and where the library personnel work with the research team to engage in *Maker* activities themselves (e.g., making their e-textile and testing the accompanying librarian support material). This embedded research can be thought of as a combination of prototype testing and elicitation of whether and how library personnel envision learning practices to unfold in library-housed *Maker* programs.

The activities involved in preparation for the program launch for the partner librarians will also be documented through observational notes, photographs, interviews, and video-recorded librarian feedback sessions facilitated by our research team. These will help us to understand where materials are falling short in preparing library personnel to launch a program. The program implementation itself will also be documented and evaluated with post-program interviews in terms of what the librarians felt prepared to do and what they had to learn during program implementation. Participating librarians and personnel will also complete surveys comprised of structured and open-ended items drawn from existing instruments (e.g., Science Learning Activation Lab, 2015). The impact of the program will also be evaluated through counts of teen attendance and through compiling focused case studies and surveys of teens who participated in both library spaces to see what resources they were able to best leverage from the two sites and where they faced challenges. The qualitative data will be analyzed through research coding, and triangulated with descriptive statistics from the surveys and previously collected data from other programs offered by the libraries. We will then present our findings to our partner librarians for feedback and solicit recommendations for iteratively refining learning and professional development support materials. We will also begin preparation for our second cycle of cross-site programming in Phase 3, involving similar research and design activities with our two new partners.

Phase 3, Year 1.5-2.5: *Replication of Cross-Site Librarian Learning Model*
At the end of Phases 1 and 2, we expect to have a model identifying: 1) school and public librarian learning needs with respect to *Maker* programming; 2) situation-specific learning resource models; and 3) a set of tested cross-setting *Maker* activities and accompanying librarian learning materials.

With these in place, we will replicate the same or similar programs from our first two libraries with a new pair of libraries, HCL and the school library at SCC. Our research question at the second set of sites will focus on understanding how these newly involved library personnel think through the materials and supports we have designed during our first 18 months. In recognition of pre-proposal reviewers' suggestions to build additional test cycles and take some steps toward generalizability, our goal here is to determine if our findings about situated librarianship learning and supports for cross talk around making can be effectively used with new partners. In the new library settings, we will once more conduct observations, interviews, collect photographs, lead focus groups, and conduct surveys with librarians and teens. Again, we will seek feedback and brainstorm with librarian partners from the new sites improvements to our model and learning materials. Those improvements will be implemented into another iteration of librarian support materials. Support for and observation of activities from our first partners (NCC and NLCL) will continue as well.

Phase 4. Year 2.5-3: *Model Validation and Broader Communications*
While we plan to share our work with interested libraries as opportunities arise, we will also deliberately involve up to three additional sites in the neighboring regions (including sites in rural northern Utah, southern Idaho, and western Wyoming) by leading workshops at local libraries and at local librarian meeting groups. At these sites, we will present cases from our first two years and disseminate our materials for use at their respective sites. As libraries indicate interest in conducting similar programs and partnerships, we will use these opportunities to solicit more feedback and, when possible, collect firsthand accounts of the use of materials and the efforts of these new sites to use the provided materials to develop the capacity of their own library personnel

and to implement cross-site *Maker* programming. This will be an opportunity for us to further see how well our implementation research-based approach generalizes to other sites.

Our team will again also continue to offer support to the initial partner libraries (NLCL, NCC, HCL, and SCC) as they continue program implementation during another school year (in consideration of the work cycles of our school library partners). By design, this level of support is expected to decrease over time as library personnel become more fluent in *Maker* programming. This fading of university researcher support also serves as an initial test for the sustainability of the *Maker* education efforts.

Research and Evaluation

Each phase of the research is guided by the research questions and activities shown in Table 1. Diverse forms of data will be used throughout the entire project and in response to each of the research questions as appropriate. Specifically, the research design will draw on qualitative data sources (interviews, observations, focus groups), complemented by descriptive statistics tabulated from surveys administered on paper or online through the *Qualtrics* web tool. Using qualitative analysis methods, interview and focus group data will be iteratively coded by multiple researchers to identify major themes related to situated librarianship learning and appropriation of *Maker* practices. These data will also help establish design scenarios and use cases to inform any learning materials development. Consistent with recommended best practices for coding verbal data (Chi, 1997; Saldaña, 2012), codes and coding processes will be iteratively refined until a high level of inter-coder reliability is reached. These data will be triangulated with observation and survey data to tease out more versus less supportive or productive project elements. In addition, narrative case studies will be prepared to illustrate if and how materials support librarianship learning and *Maker* programming over time.

Table 1. Overview of Project Activities

Phase	Research, Design, Evaluation	Primary Partners	Outcomes
RQ1: *How can learning around Maker programming be situated within existing librarianship practice?*			
1 (Year 0-0.5)	• Contextual inquiry of library personnel activities • Focus groups with cross-site teens • Early pilot testing of *Maker* activities	• North Logan City Library • North Cache Center Junior High School Library	• Research on librarian learning practices • Model of constraints and opportunities affecting librarian capacity to support *Maker* activities • Piloted *Maker* activities and support materials for each library setting
RQ2: *How are "learning practices" envisioned and realized in library Maker programs? What supports enable librarians to enact situation specific learning practices in their own Maker programming?*			
2 (Year 0.5-1.5)	• Design and implementation of two complete cross-site *Maker* programs • Design and testing of librarian support materials	• North Logan City Library • North Cache Center Junior High School Library	• Implementation of cross-setting library *Maker* programs and support materials at each library site • Formative research and evaluation data about impacts
RQ3: *To what extent are the models and materials appropriated for use in other settings? What, if any, modifications are necessary?*			
3 (Year 1.5-2.5) and 4 (Year 2.5-3)	• Further refinement of *Maker* programs and librarian learning support materials • Communications of materials, outcomes, tools in other counties and states • Presentations at professional/research conferences, publications	• Continued involvement with NLCL and NCC • Hyrum City Library and South Cache Center Junior High library • Rural libraries in Box Elder (UT), Franklin (ID), and Uinta (WY) counties.	• Expanded and refined implementation for sustainable school and public library *Maker* partnerships • Improved librarian learning materials and tools for use at other sites • Research reports examining learning practices for making in and across public and school libraries • Documentation and cases of librarian learning over time related to *Maker* programming

Evaluation. An implementation research project naturally includes evaluation within its iterative cycles. Thus, as described above, the two design and implementation cycles will serve to evaluate and refine library learning models, materials, and *Maker* programs in ways that deeply engage and build on current practices.

In addition, the Advisory Board will play a key evaluation role. Prior to its yearly meetings, the Board will receive documents, materials, and artifacts summarizing the year's work, including photographs and video excerpts from interviews, work circles, and *Maker* programs. The Board will also receive a set of probing evaluation questions aligning to each phase of research. For example, evaluation questions will include: *To what extent is the project meeting the current year's objectives? To what extent are models, materials, programs responsive to audience needs? To what extent can they be adopted for use in other settings?* At the Board meeting, partner librarians will also be invited to present first hand accounts of their experiences, which will be particularly important as we incorporate in new sites. In this way, the Board will engage in expert review of materials, provide evaluation and project oversight, as well as provide recommendations for mid-course corrections or changes to the research and design plan as appropriate.

4. Diversity Plan

Beyond focusing on the needs of librarians, library personnel, and patrons located in more rural, but rapidly growing, regions located outside of major cities in Utah, we intend for this project to be an opportunity for individuals of different backgrounds to do research and design work relevant to the library, information, and learning sciences. Doctoral students will be recruited through several means, including targeted communications through the USU Access and Diversity Center and the student Diversity Council.

5. Project Resources: Personnel, Time, Budget
Personnel

Dr. Victor Lee, PI, is an Associate Professor in the Department of Instructional Technology & Learning Science (ITLS) at USU. He is the recipient of several major awards from the National Science Foundation (NSF) (including an NSF CAREER award recognizing early researchers), the Jan Hawkins Award for Research in Learning Technologies, and a National Academy of Education/Spencer Foundation fellowship, all in recognition of his work studying student learning of complex STEM topics and novel use of learning technologies, including makerspaces (Lee & Fields, 2013; Lee, King, & Cain, 2015). He brings considerable expertise in qualitative methods (Russ et al., 2012), science education (Lee, 2010), and programmatic needs for supporting learning activities targeted at underserved youth (Lee & Briggs, 2014). His responsibilities will be to lead the design and implementation of the *Maker* activities, and conduct the contextual inquiry, including developing protocols for and analyses of interviews, observations, and focus groups.

Dr. Mimi Recker, Co-PI, is a Professor in ITLS, and has over 15 years of experience as a principal investigator and project manager on over a dozen extramurally funded digital library, educational research, and evaluation projects. She and her colleagues have developed an innovative web-based tool to help teachers and school librarians develop lessons using digital library resources, still in use after 10 years (Recker et al., 2014). She also evaluated the impact of teacher professional development programs aimed at technology integration (Walker et al., 2012), including a technology scale-up project deployed in 5 school districts and used by over 100 teachers and their 2,500 students (Lee et al., 2014; Ye et al., 2015). Her primary responsibilities on this project will be to conduct the iterative development of librarian learning materials, coordinate evaluation efforts, and lead communications efforts.

Two graduate student research assistants will be assigned to the project and mentored by project PIs. The graduate students will be doctoral candidates in the ITLS department and it is expected that the project activities and funding will support their doctoral research.

*Adam Winger (*Director*) & Paul Daybell* (Assoc. Director), librarian partners at NLCL, will be actively involved in the first two phases of the project. Winger has had previous academic librarian experience as the

head of special collections at the Stevens Institute of Technology where his leadership led to a substantial collections improvement and new collaborative educational programming. Daybell was hired to oversee NLCL's extensive and expanding programming for youth. He is president-elect of the local county library association and is a regular presenter at state librarian conferences.

Alison Griffiths (School Library Media Specialist), librarian partner at NCC, will be an active collaborator during the first two project phases as well. She has over 25 years of experience working with youth and students professionally as a teacher and school librarian, and currently serves as the rural library liaison for the statewide educational librarian association and presents frequently across the state.

Emily Coltrin (Library Director), our partner at HCL, will be working with our team most during the third phase. Coltrin has been working in libraries in Indiana, Nevada, and Utah for 17 years in several different capacities. While serving as director at HCL, she is also pursuing part-time studies to advance her education as a city library director.

An *Advisory Board* consisting of outstanding local and national scholars and practitioners in librarianship and *Maker* programs will meet annually with the research team and partners via videoconference (see letters of commitment in the Appendix). This diverse group of six individuals consists of leading thinkers in the area of *Maker* program design and implementation, as well as seasoned administrators and librarians (see Table 2).

Table 2. Advisory Board Members

	Affiliation	**Expertise and Role**
Dr. Lisa Brahms	Children's Museum of Pittsburgh	Co-author of *Learning Practices of Making* framework; evaluation *Maker* and learning practices
Bill Derry	Westport Library, Former Director of Innovation and *Maker* initiatives	Expert on public and school libraries and initiation of *Maker* programming in libraries; evaluate programming with community libraries
Dr. Kristin Fontichiaro	University of Michigan, School of Information	Expert on school and public rural libraries pursuing IMLS-funded work with rural community libraries; advise on *Maker* activities and librarian support
Curt Jenkins	Cache School District, Curriculum and School Librarian Director	Expert on school curriculum/libraries; evaluate school implementation strategies
Dr. Kylie Peppler	Indiana University, Director of the Creativity Labs	Leading scholar of the *Maker* Movement; evaluate design of high-quality educational *Maker* programs for youth
Paula Zsiray	Cache School District, High School Librarian	Veteran school librarian and officer of regional library organizations; provide school librarian perspective

Time

This three-year research project will run from 1 July 2016 to 30 June 2019. As noted in the *organizational profile*, the partner institutions provide a variety of supporting resources to ensure the success of the project. The *schedule of completion* supplemental document shows the timeline for the key activities in each year of the project, as described in the Project Activities section above. The adjacent figure shows the general timeframe for each phase and how each research question aligns with phase activities. Table 1 on page 7 also shows each phase of research activities, associated research questions, and intended outcomes.
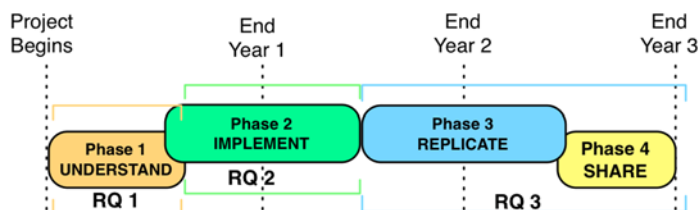
Budget. The budget submitted with this proposal is cost-efficient and includes the major categories described below. Additional detail is provided in the budget documents.

University Personnel: 1-month summer salary for each of the two PIs; graduate student funding for two USU doctoral students specializing in qualitative research and librarian education.

Librarian Stipends: Stipends for head librarians for each year of involvement in major research and design activities at the four partner libraries to support their time and effort.

Advisory Board Stipends: Stipends each year for critical expert consultation and evaluation of major project activities.

Travel: Travel for PIs and head librarians to attend national and regional conferences to disseminate research results and to conduct dissemination activities at interested libraries.

Participant Incentives: For 20-30 participants per year (e.g., teen advisors, community members and program patrons) and for 8 librarians or library personnel each year participating in new professional development activities and using early versions of library learning materials.

Other Direct Costs: Research materials and *Maker* equipment to be housed at the partner library sites, printing for advertising programs, transcription services, fringe benefits, and graduate student tuition.

6. Communications Plan

A strong communications effort, during and beyond the funding period, is critical for the success of this project in order to assure that project information is available to library professionals, teachers, caregivers, and youth. Project information will be developed for and shared with the following audiences: librarians, researchers, library patrons, teachers, and policymaker communities at the local, state and national levels.

A project web site will be created to act as a repository and communication platform. It will contain a description of project objectives, research findings as they become available, professional development materials, models, cases, and lessons learned. The site will be engineered to collect and report detailed analytics about site visits and usage as another means of evaluating impact. Research papers and project data will also be archived and curated in USU's Institutional Repository, Digital Commons, which is part of an international network of repositories. The project team will communicate research findings through education research and library professional and practitioner-oriented publications (e.g., *Journal of Teaching and Technology*, *School Library Monthly*), conferences (e.g., AASL, ALA, PLA, NARST, AERA, ISTE), and via local and state librarian e-newsletters. Through existing networks in USU's School Library Media Administration (SLMA) program, we will also communicate findings and materials to USU students, and at workshops offered at local and regional venues, including UELMA (Utah Educational Library Media Association) and ULA (Utah Library Association).

In addition, *Dr. Sheri Haderlie,* the Director of USU's SLMA program and faculty in the same department as the Co-PIs, will assist in our communications activities. As part of her regular duties as Director, she will integrate cases and librarian learning materials into USU's school library program and help disseminate findings to school librarian organizations and to USU's librarian alumni network. Finally, the Advisory Board will also help with communications of project research findings and professional learning models via their extensive networks in both the research and practice communities related to Making and librarianship.

7. Sustainability

Phases 3 and 4 (and Research Question 3) directly address sustainability. They examine how librarian learning models, materials, and maker activities can be adopted for use in different library settings, and what contextual adjustments best support sustainability. The phases also examine how *Maker* programs and materials may evolve as researcher involvement fades.

In addition, project PIs have experience in building sustainable interventions. For example, Recker's software tool designed to help teachers and school librarians develop lessons using digital library resources is still in use after 10 years – far exceeding the shelf-life of typical educational technology innovations.

Proposal References are provided in Supporting Document 1

LB 21 RE-31-16-0013: *Supporting the Development of Public and School Librarians as Stewards of Cross-Setting STEM Maker Programs Through Implementation Research*

Schedule of Completion (2016-2017)

Activity	Year 1				Year 2				Year 3			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Contextual Inquiry; Ethnographic observations; Interviews of librarians	■	■										
Teen focus group		■	■		■	■			■			
Advisory Board meeting Design learning model and *maker* programs			■				■			■		
Develop and maintain project website	■	■	■	■	■	■	■	■	■	■	■	■
First implementation of librarian learning model and librarian feedback			■	■	■							
First implementation of *maker* programs			■	■	■							
Collect and analyze librarian learning and "learning practices" data			■	■	■							
Revise librarian learning model and *maker* programs						■						
Second implementation of librarian learning model and librarian feedback							■	■	■			
Second implementation of *maker* program							■	■	■			
Collect and analyze librarian learning and "learning practices" data							■	■	■	■		
Recruit additional sites										■		
Disseminate model and materials to additional sites											■	■
Disseminate model and materials at professional librarian venues									■	■	■	■
Disseminate results at researcher and practitioner venues			■					■			■	

DIGITAL STEWARDSHIP SUPPLEMENTARY INFORMATION FORM

Introduction
The Institute of Museum and Library Services (IMLS) is committed to expanding public access to federally funded research, data, software, and other digital products. The assets you create with IMLS funding require careful stewardship to protect and enhance their value, and they should be freely and readily available for use and re-use by libraries, archives, museums, and the public. However, applying these principles to the development and management of digital products is not always straightforward. Because technology is dynamic and because we do not want to inhibit innovation, we do not want to prescribe set standards and best practices that could become quickly outdated. Instead, we ask that you answer a series of questions that address specific aspects of creating and managing digital assets. Your answers will be used by IMLS staff and by expert peer reviewers to evaluate your application, and they will be important in determining whether your project will be funded.

Instructions
If you propose to create any type of digital product as part of your project, complete this form. We define digital products very broadly. If you are developing anything through the use of information technology (e.g., digital collections, web resources, metadata, software, or data), you should complete this form.

Please indicate which of the following digital products you will create or collect during your project
(Check all that apply):

	Every proposal creating a digital product should complete …	Part I
	If your project will create or collect …	**Then you should complete …**
☐	Digital content	Part II
☐	Software (systems, tools, apps, etc.)	Part III
X	Dataset	Part IV

PART I.

A. Intellectual Property Rights and Permissions

We expect applicants to make federally funded work products widely available and usable through strategies such as publishing in open-access journals, depositing works in institutional or discipline-based repositories, and using non-restrictive licenses such as a Creative Commons license.

A.1 What will be the intellectual property status of the content, software, or datasets you intend to create? Who will hold the copyright? Will you assign a Creative Commons license (http://us.creativecommons.org) to the content? If so, which license will it be? If it is software, what open source license will you use (e.g., BSD, GNU, MIT)? Explain and justify your licensing selections.

All products created for this project including published research, professional development materials such as activity guides, guidelines, etc., will be publicly available for use and sharing using a non-restrictive license that provides credit to the project and to the individual educators who created the lesson plans and materials made available. A statement will appear on the project web site: "This work is licensed under a Creative Commons Attribution 4.0 International License" allowing users with the permission to share and adapt content as long as attribution is provided.

A.2 What ownership rights will your organization assert over the new digital content, software, or datasets and what   conditions will you impose on access and use? Explain any terms of access and conditions of use, why they are   justifiable, and how you will notify potential users about relevant terms or conditions.

All content developed as part of the project will be accessible to users without restrictions via the project website or through an institutional repository. The communication plan outlines how potential users of will be made aware of project resources.

A.3 Will you create any content or products which may involve privacy concerns, require obtaining permissions or rights, or raise any cultural sensitivities? If so, please describe the issues and how you plan to address them.

Yes, this project will involve minors. After identifying potential minor participants, a request will be sent to the parents or guardians requesting permission for their child(ren) to participate in recorded interviews. Per IRB regulations: caregivers and children will received the IRB consent form; these data will be stored on password-protected machines; we will not ask or publish private information about children.

Part II: Projects Creating or Collecting Digital Content – NOT APPLICABLE TO THIS PROJECT

A. **Creating New Digital Content**

A.1 Describe the digital content you will create and/or collect, the quantities of each type, and format you will use.

A.2 List the equipment, software, and supplies that you will use to create the content or the name of the service provider   who will perform the work.

A.3 List all the digital file formats (e.g., XML, TIFF, MPEG) you plan to create, along with the relevant information on the appropriate quality standards (e.g., resolution, sampling rate, or pixel dimensions).

B. **Digital Workflow and Asset Maintenance/Preservation**

B.1 Describe your quality control plan (i.e., how you will monitor and evaluate your workflow and products).

B.2 Describe your plan for preserving and maintaining digital assets during and after the award period of performance (e.g., storage systems, shared repositories, technical documentation, migration planning, commitment of organizational funding for these purposes). Please note: You may charge the Federal award before closeout for the costs of publication   or sharing of research results if the costs are not incurred during the period of performance of the Federal award. (See 2   CFR 200.461).

C. **Metadata**

C.1 Describe how you will produce metadata (e.g., technical, descriptive, administrative, or preservation). Specify which standards you will use for the metadata structure (e.g., MARC, Dublin Core, Encoded Archival Description, PBCore, or PREMIS) and metadata content (e.g., thesauri).

C.2 Explain your strategy for preserving and maintaining metadata created and/or collected during and after the award period of performance.

C.3 Explain what metadata sharing and/or other strategies you will use to facilitate widespread discovery and use of digital content created during your project (e.g., an API (Application Programming Interface), contributions to the Digital Public Library of America (DPLA) or other digital platform, or other support to allow batch queries and retrieval of metadata).

D. **Access and Use**

D.1 Describe how you will make the digital content available to the public. Include details such as the delivery strategy (e.g., openly available online, available to specified audiences) and underlying hardware/software platforms and infrastructure (e.g., specific digital repository software or leased services, accessibility via standard web browsers, requirements for special software tools in order to use the content).

D.2 Provide the name and URL(s) (Uniform Resource Locator) for any examples of previous digital collections or content your organization has created.

Part III. Projects Creating Software (systems, tools, apps, etc.) – NOT APPLICABLE TO THIS PROJECT

A. **General Information**

A.1 Describe the software you intend to create, including a summary of the major functions it will perform and the intended primary audience(s) this software will serve.

A.2 List other existing software that wholly or partially perform the same functions, and explain how the tool or system you will create is different.

B. **Technical Information**

B.1 List the programming languages, platforms, software, or other applications you will use to create your software (systems, tools, apps, etc.) and explain why you chose them.

B.2 Describe how the intended software will extend or interoperate with other existing software.

B.3 Describe any underlying additional software or system dependencies necessary to run the new software you will create.

B.4 Describe the processes you will use for development documentation and for maintaining and updating technical documentation for users of the software.

B.5 Provide the name and URL(s) for examples of any previous software tools or systems your organization has created.

C. Access and Use

C.1 We expect applicants seeking federal funds for software to develop and release these products under an open-source license to maximize access and promote reuse. What ownership rights will your organization assert over the software created, and what conditions will you impose on the access and use of this product? Identify and explain the license under which you will release source code for the software you develop (e.g., BSD, GNU, or MIT software licenses). Explain any prohibitive terms or conditions of use or access, explain why these terms or conditions are justifiable, and explain how you will notify potential users of the software or system.

C.2 Describe how you will make the software and source code available to the public and/or its intended users.

C.3 Identify where you will be publicly depositing source code for the software developed:

Name of publicly accessible source code repository:
URL:

Part IV. Projects Creating a Dataset

1. Summarize the intended purpose of this data, the type of data to be collected or generated, the method for collection or generation, the approximate dates or frequency when the data will be generated or collected, and the intended use of the data collected.

   Research data will be collected as part of this project from librarians and students who use the makerspaces. Evaluation data will be also collected to measure impact, as per the project design in the narrative of the proposal and Schedule of Completion. Data will be collected throughout the 3 years of the project.

2. Does the proposed data collection or research activity require approval by any internal review panel or institutional review board (IRB)? If so, has the proposed research activity been approved? If not, what is your plan for securing approval?

   Yes. An IRB application will be submitted to USU's board as soon as we receive word that the proposal will be funded in order to secure approval before the proposed start date of this project.

3. Will you collect any personally identifiable information (PII), confidential information (e.g., trade secrets), or proprietary information? If so, detail the specific steps you will take to protect such information while you prepare the data files for public release (e.g., data anonymization, data suppression PII, or synthetic data).

   Following IRB regulations, any personally identifiable information about participants will be anonymized using a coding system developed by the researchers and kept separate from the data in password-protected files. All participants will be assigned pseudonyms, and will identify if they are adult or children. For research purposes, most data will be reported in aggregated form.

4. If you will collect additional documentation such as consent agreements along with the data, describe plans for preserving the documentation and ensuring that its relationship to the collected data is maintained.

   Parental/caregiver permission will be collected for any youth participating in the proposed project. The consent form (which will also be available in Spanish for those requesting it) will advise parents/caregivers that data collected will only be used for research and evaluation purposes. All consent agreements will be stored in electronic form in password-protected files.

5.

What will you use to collect or generate the data? Provide details about any technical requirements or dependencies that would be necessary for understanding, retrieving, displaying, or processing the dataset(s).

We will conduct surveys and interviews of project participants (youth and adults). An online survey tool, Qualtrics, will be used to collect survey data. Interviews will be conducted in person and recorded. HD Videorecordings will also be obtained and stored digitally on password-protected servers and on protected external media (removable drives stored in a locked room). These video files can be viewed on most current computer platforms and can be transcribed and coded using a variety of software tools, including some for which we already possess licenses. Because video has inherently identifiable information and raises concerns about confidentiality, it will not be made publicly available through any public site or hosting service. Any others who wish to view portions of the original video will have a period of time to do so (5 years after project completion) should they contact one of the investigators. After the requisite time, the raw video must be destroyed. Anonymized transcripts will be retained and available upon request.

6.

What documentation (e.g., data documentation, codebooks, etc.) will you capture or create along with the dataset(s)? Where will the documentation be stored, and in what format(s)? How will you permanently associate and manage the documentation with the dataset(s) it describes?

N/A

7.

What is the plan for archiving, managing, and disseminating data after the completion of the award-funded project?

Project data will be anonymized, aggregated, and deposited in USU's Institutional repository, Digital Commons. This repository is hosted by BEPRESS, and part of international network of repositories. Data stored in Bepress is discoverable in Google, Google Scholar, and other search engines. As stated in #5 above, videorecordings will not be made publicly available on any public site or hosting service. Videorecordings will be accessed via direct contact with one of the investigators for up to 5 years after completion of the project.

8.

Identify where you will be publicly depositing dataset(s):

Name of repository: *Digital Commons*
URL: *http://digitalcommons.usu.edu/*

9.

When and how frequently will you review this data management plan? How will the implementation be monitored?

We will review the data management plan with our Advisory Board, as part of the first meeting, and will implement all reasonable changes that are suggested. At project meetings, all research staff will be reminded about the kinds of data that we are collecting, and our IRB, dissemination, and curation requirements.