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Keywords (separated by '-')	Makerspace - Maker programming - Rural library - Cultural probes - Community engagement

Toward Context-Relevant Library Makerspaces: Understanding the Goals, Approaches, and Resources of Small-Town and Rural Libraries

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Abstract. While best practices for developing makerspaces in public libraries exist, there is scarce literature that describes how they apply to small-town and rural libraries in alignment with the libraries' existing assets, practices, and constraints. This paper aims to explore the small-town and rural libraries' goals, approaches, and existing resources towards establishing a future makerspace and investigate the extent to which these elements support or hinder the design of the makerspace or maker programming. From the qualitative analysis of cultural probes and interview data with nine librarians, this paper demonstrates two ways that small-town and rural libraries differed from the best practices in the field: a) focusing on attendance and equipping the materials within the makerspace over community building, b) lack of transfer of existing assets and practices to maker programming. Study findings suggest small-town and rural librarians' lack of STEM competencies and knowledge around makerspaces as a critical barrier for applying their existing assets and practices to a new area of maker programming. Our study proposes context-specific recommendations and directions for small-town and rural libraries to design and develop makerspaces.

Keywords: Makerspace · Maker programming · Rural library · Cultural probes · Community engagement

1 Introduction

With the advancement of digital technology and the changing landscape of informal youth learning, public libraries are challenged to transform the library into a hub for “smart and connected communities” [29]. The maker movement—a community of people who make, tinker, and share their processes and products in physical and/or virtual settings—is one way of expanding the role of public libraries towards sites of community engagement [27]. Makerspaces provide opportunities for problem-solving [8, 24] and STEM learning [9, 13, 22, 23]. Making can also empower learners to directly impact the local communities through design [11, 38]. As such, a growing number of libraries

are implementing makerspaces to strengthen community engagement, particularly for youth [26].

Library makerspaces have shown promising results in large urban settings [3, 18]. While the role of public library makerspaces has been discussed [31, 42], it predominantly focused on urban libraries despite that that small-town and rural libraries compose 80.5% of public libraries in the U.S. [36]. Research indicates that rural libraries have different resources, skills, and constraints which impact their librarianship. Rural libraries have fewer full-time employees ranging from 1.3 to 4.2 employees per site [34]. Small-town and rural libraries are often staffed by non-MLIS librarians. Compared to urban libraries that offer STEAM programs that make up 50% of their educational offerings, STEAM programs only comprise 19.7% in rural libraries [34]. Furthermore, the median size of a rural library is only 20% of the median size of an urban library [34]. These figures indicate varied resources within small-town and rural libraries that can impact their ability to shift their practices and reconfigure the library space to accommodate makerspaces or new maker programs.

Best practices provide guidelines for implementing public library makerspaces [1, 20, 40]. However, there is scarce literature that describes how these guidelines apply to small-town and rural libraries. Further work is needed to interrogate the extent to which these guidelines align with the small-town and rural libraries' existing practices. In addition, an explicit effort is needed to consider how the small-town and rural libraries' assets, practices, and constraints can be utilized to strengthen the sustainability and the impact of future makerspaces in rural communities.

Our research, therefore, aims to explore the current status of the small-town and rural libraries that currently do not have makerspaces or consistent maker programs. Given how small-town and rural libraries often do not have the space for permanent makerspaces, we considered supporting the development of consistent maker programs and/or the makerspace. We answer the following research questions:

- a) what are the small-town and rural librarians' goals and approaches towards establishing the future makerspace and/or maker programs?
- b) what are their assets, practices, and constraints towards designing their regular youth programs?
- c) to what extent do these existing assets, practices, and constraints support or hinder the design of the makerspace and/or maker programs?

2 Literature Review

The Maker Movement has quickly spread in public libraries [5], providing numerous reports and practitioner articles. We included both practitioner reports and empirical articles to conduct a literature review of public library makerspace around five themes: a) goals, b) approaches, c) space, tools, and equipment, d) ways to support learning, and e) library professionals' competencies.

In many studies, community building was the overarching goal of the makerspace rather than supporting specific skills (e.g., STEM knowledge) or tinkering with high-tech

equipment [6, 18, 26]. Digital media labs (e.g., YOUmedia) that expanded library services through increased technology offerings highlighted that the underlying elements that promoted success were not space or the increased technology, but a purposeful strategy that supported the knowledge creation and community engagement [10]. A review of notable library makerspaces illustrated that the common long-term goal was to create a sense of community in the makerspaces, despite their different short-term goals such as engaging the patrons with activities offered in the space or making the library a fun place to hang out [5]. Similarly, twenty-four learning labs established as creative teen spaces served as community catalysts [2]. For instance, Madison Public Library's maker program, the Bubbler, had the motto "people not stuff." Making Justice, one of the Bubbler programs, occurred at the juvenile detention center to invite participation from court-involved youth to reach out to and include every community member. Consequently, a sense of community grew among youth who participated in the Making Justice program. While goals such as promoting entrepreneurship, innovation, and STEM learning were also noticeable [6, 40], public libraries incorporated makerspaces as community catalysts aligned with libraries' mission to engage with and serve the local community.

Many library makerspaces took varied approaches to develop makerspaces; however, youth and community involvement were recurring themes [2, 3, 18]. Library makerspaces often provided maker-in-residence programs to involve community members with expertise to share and facilitate maker programs [5, 18, 41]. Particularly in rural libraries, library professionals often formed a teen advisory board to help reflect youth's needs and interests, which helped design an environment of belonging for youth [12, 33]. At Pima County Public Library, teens were involved as designers to co-design the community's maker program [2]. As a result of the participatory approach, the design of the maker program was emergent, fluid, and driven by learners who envisioned themselves as active users of the new space and programs.

Notable public library makerspaces generally provide a designated space and a facilitator for the makerspace, along with a range of high-tech and necessary craft equipment [2, 5, 40]. However, when permanent space was not a viable option, libraries often repurposed existing rooms or unused space and utilized rearrangeable mobile shelving to create the makerspace [5, 30]. Emerging examples of rural library makerspaces demonstrate that makerspaces do not solely depend on the space and the tools but on connecting the community needs with the opportunities that arise from the makerspace. For instance, the Simla library started a media lab with a couple of laptops, iPads, and recording equipment [37]. Initially, the community members were intimidated to use the equipment. The library professional actively shared with different organizations and community members to show how they can utilize maker technologies to meet their needs. Slowly, community members used the media lab to design menus for local restaurants, record workshops, and record the local community's oral histories.

Public libraries represent out-of-school contexts ripe for exploration and discovery that are not tied to formal education [35]. As such, library professionals need to consider ways to scaffold learning in makerspaces in addition to providing the tools and equipping the space. Dreessen and Schepers [14] proposed to involve novice learners, who may find high-tech equipment unfamiliar and intimidating, through a combination of an open-door policy, short-term workshops, and long-term community processes. They suggested first

familiarizing novice learners via open days that introduce and acquaint participants with the possibilities of tools and equipment, then shift towards combining open days with short-term and long-term community projects that focus on collective prototypes and experimentation. Einarsson and Huertzum [15] demonstrated scaffolding approaches that library makerspace practitioners employ in formal (organized, pre-planned instructions), informal (self-directed, interest-driven), and non-formal (hybrid of formal and informal) activities, which can be taken up by library professionals in other settings. To better support library professionals to support learning in makerspaces, Lee, Recker, and Phillips [28] suggested providing “at-a-glance” program planning materials with visual images that librarians can adapt without extensive preparation. While research has begun to investigate how to support learning in library makerspaces [14, 15], it is less clear how learning is supported in rural library makerspaces, as these studies are in the context of Europe and do not necessarily focus on rural libraries.

To manage and facilitate library makerspaces, scholars emphasized that library professionals reconceptualize their role from an expert to a facilitator or a mentor [12]. Koh, Abbas, and Willett [26] urged future library professionals to be “culturally competent” to connect the culture and the life stories of the community in the makerspace. Phillips, Lee, and Recker [33] described the librarian as “experience engineers” with the characteristics of being user-centered, connected to their communities, and comfortable with risk. Koh and Abbas [27] report the desired competencies for professionals in learning labs and makerspaces: technology, teaching, learning, community partnerships, flexibility, understanding diverse users, management, communication, curiosity, creativity, patience, and subject content knowledge. As such, future library professionals who facilitate maker programming should foster both the sensitivity to understand different cultures and the audacity to take risks to try different approaches towards learning, community engagement, and partnerships.

Our work built upon this literature to explore the extent to which small-town and rural libraries’ goals, assets, and practices aligned with the themes that emerged in previously reported cases of public library makerspaces.

3 Methods

This study conducted a case study of nine small-town and rural libraries in the Midwest to identify their motivation for establishing future makerspaces and examine facilitators for and barriers to establishing library makerspaces and/or maker programs. The research includes three phases: cultural probes, semi-structured interviews, and co-design. This paper builds on initial analysis [21] and reports findings from the first two phases of the study. For all methods described in this paper, IRB approval was obtained.

We used purposive sampling to identify libraries in the Midwest that serve a legal service area population that is less than 25,000 and/or is considered either rural fringe, distant, or remote library following the ALA guidelines [36]. Then, we contacted libraries that do not have makerspaces or run consistent maker programs by checking their websites. We also utilized the State Library listserv to send out recruitment emails. The study participant had to be working full-time with at least two years of experience in the youth services department. Saturation of themes was reached after nine participants. The

The cultural probes included six activities: a) mapping, b) youth learning landscape, c) user diary (part 1: describe routines involved in youth program design, part 2: describe routines involved in maker program design), d) floor plan (describe how library space

is serving or not serving the community), e) magic paper (imagine future makerspace), and f) time capsule (professional aspirations). The mapping asked participants to rate the making activities four times from our provided list and provide reasons: a) activities that librarians are interested and confident in, b) activities that youth are interested in, c) activities that community members have expertise in, and d) activities that outside members have expertise. The cultural probes package included the cultural probes, an instant camera, and post-its. The completed cultural probes included descriptions and pictures (Fig. 2). Cultural probes were transcribed for analysis.

Fig. 2. Examples of the completed cultural probes

The findings from the cultural probes were used to design the interview protocol, which consisted of 25 questions to understand the participants' background, youth program, and maker program design experience (spectrum of programs, how you evolve the program, how you reach out to youth), perspectives towards the makerspace (motivation, expected outcome, development plan), resources, and constraints to establishing a makerspace at the library. The interviews took 60 to 90 min, which were video-recorded and transcribed.

The research team inductively analyzed the cultural probes and the interviews using the constant comparison method [17]. Two researchers individually developed a set of codes and applied them to the dataset, then compared the codes and developed a master set of codes. Then, two researchers coded all the transcripts using ATLAS.ti. The Cohen's Kappa (inter-rater reliability) was 0.87. After coding, we conducted the analysis in two phases. First, we identified participants' goals and approaches towards establishing the makerspace and compared them with previous literature to identify similarities and differences. Second, we identified the participants' assets, practices, and constraints they experienced in youth program design and analyzed how these elements

were utilized to design the makerspace or maker programming. Emergent findings were discussed and reviewed iteratively.

We acknowledge that this study, based on nine libraries, is insufficient to provide a complete view of the assets, practices, and constraints of small-town and rural libraries. However, we also note that the goal of qualitative research is not generalizability but transferability. By creating detailed accounts of nine small-town and rural libraries, we argue that the context-specific recommendations and directions that we propose can apply to similar public libraries in the U.S. In future work, we will extend the findings to inform the development of co-design guidelines for small-town and rural libraries to engage in the last phase of the study.

4 Findings

Our findings demonstrate that nine small-town and rural libraries focused on increasing attendance, equipping the materials within the makerspace over community building, and experienced challenges in transferring existing practices related to youth involvement and partnership building to maker programming. Study findings further suggest small-town and rural librarians' lack of STEM competencies and knowledge around makerspaces as a critical barrier for applying their existing assets and practices to a new area of maker programming.

4.1 Goals and Approaches

Participants in this study commonly expressed increasing attendance by providing STEM-related programming in the makerspace as the primary goal. One participant expressed: *"This is almost like... a brand...and any time we have STEM...it will attract them."* Another participant shared a boost in circulation as a result of increased attendance from the STEM programs: *"That increased right away, the number of people that you have at your program... They start checking books out, or they come for other reasons."* While providing access to technologies (*"Children and adults in our community have very limited resources and I believe that a makerspace can create a variety of opportunities for everyone"*) and promoting personal growth through life-skills, critical thinking, and problem-solving (*"It would help them to solve problems, and it would help them to learn how they solve problems"*) were mentioned as important goals, participants anticipated increased attendance as the primary long-term outcome from the makerspace since it would promote the library as a place to engage in STEM learning.

To establish the envisioned makerspace, participants focused on providing the space and the tools within the makerspace. Many considered securing a designated area for the makerspace as a necessary step, followed by furnishing it with appropriate equipment through funding opportunities. One participant mentioned: *"And so that is one of our biggest issues, just finding the space in our library and maybe redeveloping what we have so that we could have something where we can set it up. So, the money for what we would need and just space trying to figure out."* When libraries already had a designated space for a makerspace, participants considered the equipment they planned to purchase.

However, their approach to establishing the makerspace lacked articulation of how they plan to facilitate the kind of engagement and learning they expressed as the learning goals for the makerspace (e.g., problem-solving, critical thinking). Many participants expected that an organized space with high-tech materials would naturally trigger community members to engage in making independently. They expected youth to independently engage with making, without facilitation, as many participants struggled with a busy schedule.

There's electrical kits and engineering kits...just have things there and organized and it would be open and clean and ready for someone to walk in... pull it out and work on it.

I typically don't have a lot of free time to just go over there one-on-one and try and do something with them. So, they would get a lot more exposure to being able to make, not on my schedule, but on theirs.

The interview excerpts highlight the participants' expectation that learning would occur once youths were given the space and the tools. Although some participants emphasized the importance of first understanding the community members' interests towards the makerspace, overall, there was evidence that participants focused more on the material aspect rather than considering the role of facilitation in the makerspace to support community building.

4.2 Resources for Youth Program Design

Assets. Notably, many (seven out of nine) participants had degrees in education with professional teaching experience at the K-12 level. Having an education background was considered an asset: *"Having a degree in education and having that curriculum background helps a lot when I'm planning storytime because I run a curriculum for that. And I kind of use those lesson plans in the same manner to do that."* Also, many shared the passion for supporting youth to learn and grow, as evident in the remark below:

I originally, from the jump, wanted to work with teens. That's always been kind of my mission, why I started with the secondary English education degree...And being in the library setting has been fun...but exposing our rural kids to maybe socially conscious materials, more challenging materials, things that they may not have been exposed to...so that they can have better well-rounded thoughts. Not just so ag [agriculture] focused and small-minded. I mean, not small-minded, small-town focused.

Interestingly, several participants described that becoming a librarian was "unplanned." Many started as a teacher but found that teaching was not aligned with their goals. Finding a library position was unintentional but fit well with their life situations. Several remarks expressed the unintentionality of finding their current positions: *"I was offered this job when my kids went away to college, so the timing was perfect and I've*

always loved it”; “Yeah, so the lady that actually did it, she went on maternity leave...So, I went ahead and I applied for the position and got it.” Our analysis illustrated that many participants shared a similar trajectory of realizing that the teaching profession did not live up to their expectations and found library positions in unanticipated ways, which aligned closely with how they want to support learning. The following remark highlights the participants’ motivation to promote youth learning in authentic learning settings, rather than focusing on the assessment.

But the whole, the formalness of the, not that the standards are bad, but just that there was a lot more to it than just what I felt was important to the kids as far as getting them to learn what they wanted to learn...So, when the opportunity came to work in the library, I was like, this would be great...it felt a lot, it was less formal and it was more authentic, I guess more authentic learning.

Practices. Analysis findings further illustrated that many participants actively engaged youth to find out their interests and connected the youth programs to their interests. Several mentioned getting an idea about a new program by talking to the youth informally when visiting the library. Participants also utilized their regular school visits to gauge interests from the youth on what has been trending, as reflected in several participants:

I think for some reason they were big into Harry Potter and Doctor Who. So, we were kind of dealing every week a different theme and we were talking about different books so that we would do activities that were related to those books.

So, it’s trying to find out what their needs are, what their interests are, and how to bring kids in, youth in general... We’re willing to try just about anything, we’ve tried lots.

It was noticeable that all participants actively sought public school partnerships to support youths’ literacy from early years. They provided regular visits to daycares and elementary schools to promote storytimes or summer reading programs. Some established specific partnerships with the school to go in during designated times to start a book club with interested students. A few participants reached out even further to invite community members with various professions during a guest reader’s week: *“I invited, you know, bankers people worked in banks. I invited the jailer from our, our jail, the EMS people, all of them. And I had the mayor as well. They came and I let them pick out their own books so they feel a little more comfortable...They would read to the students.”* As such, participants engaged in regular practices of reaching out and involving youth to make their library programming relevant to youth’s interests and needs.

Constraints. Lastly, our analysis demonstrated that participants frequently experienced constraints related to lack of time, staff, budget, which hindered them from investing time in programming design. One mentioned the challenge of not having enough time because of the number of responsibilities she would take on, given the low number of staff: *“It’s not that we don’t have the money to purchase the books or information or look it up. Time is a big issue...my biggest issue is time. You know, I would love to do a whole lot of things, but by keeping track of everything else...the program development right*

now for me is not high on my priority list.” When participants were asked about their experience of completing the cultural probes, several shared the lack of time in their daily routine to think and reflect. The following remark reflects this: *“This is probably some of the longest time that I ever just sat at my desk... I don’t, I don’t have a day where I just sit and plan. I’d love a day where I just sit and plan.”* Also, most participants mentioned the lack of budget as a barrier towards providing new programs to patrons, as highlighted in one participant’s remark: *“A very small budget. I think this year our budget for programs is \$1,400 total for the whole year.”*

4.3 Supporting Maker Programs with Existing Resources

Misalignment Between Assets and Youth Interests. The last stage of our analysis investigated how the participants’ assets, practices, and constraints experienced during youth programming were utilized to design the makerspace and/or maker programs. Findings from the cultural probes mapping activities illustrated that librarians’ areas of interest and confidence in making (e.g., crafts, sewing) were the opposite of what youth in their communities may be interested in (e.g., robotics). Interestingly, the librarians’ area of expertise mapped closely with the community members’ perceived expertise while making activities in which youth might be interested in mapped closely with what the outside members might offer. This finding highlights the misalignment between librarians’ assets and youth’ interests.

Lack of Transfer of Youth Involvement Practices. Our findings previously showed that participants routinely engaged in practices that were supportive towards designing youth programs (i.e., youth involvement and active partnership with schools). However, within the domain of maker programming, there was no evidence of youth involvement. As many experienced the lack of time, participants frequently used available lesson plans or crafts activities from Pinterest, State library training materials, and summer reading program manual: *“I try to just not recreate the wheel and steal someone else’s programming.”* As a result, the maker programs that participants shared were generic, lacking connection to community interests. For instance, the most memorable maker programs that participants shared in the cultural probes related to arts and crafts (i.e., marshmallow toothpick challenge, knitting, tie-dye, canvas painting, gingerbread making program).

In contrast, the most memorable youth programs described in the cultural probes included creative ideas relevant to the community. One participant described the Karen Land program in which she invited the veteran racer of the Iditarod, Karen Land, around the time of the Iditarod itself. Iditarod is a sled dog race in Alaska that many elementary-aged youths learn. The program had high attendance, bringing out of county attendees as well. Other examples included the Candyland program, teen game day, summer-long maker event, and summer reading programs with activities that tied with community interest. This finding demonstrates that participants’ regularly-engaged practice of youth involvement did not transfer to maker programming.

Lack of Transfer of Partnership Practices. Participants’ prior knowledge and experience in establishing partnerships to develop regular youth programs also did not transfer to maker programming because it required creating new connections in STEM areas.

We posit that because STEM was not their “wheelhouse,” participants found it challenging to recognize the social capital and resources that may already be available in their connections, as highlighted by one participant:

But, again, I struggle with the technological side of making. Where, my younger brother... he has a 3D printer and he is awesome on it...And I'm like, gosh, you should come into my library and show these kids...I need to do that. It's like, again, one of those things where it was like, I thought, I didn't think about, I should just really pull in more people.

Given the lack of STEM professionals in the community, most STEM partnerships were one-off programs by borrowing STEM resources from the State Library or the museum. A few participants sought out STEM expertise from the university, but it was challenging to get connected without knowing anyone personally (“I've tried to make connection there a few times, and I just get sent to the next person, then the next person, then the next person and it fizzles out...So, unless you know somebody, it's hard to get into that”). Also, being geographically far, these small-town and rural libraries experienced challenges to invite outside STEM experts to come in: “We keep trying to send out letters... it's just frustrating because it's such a small area and everything was so far away from us.”

Limited STEM Competencies. Importantly, our findings suggest that participants' limited STEM competencies and experience with makerspaces potentially influence the lack of transfer of the participants' existing practices to maker programming. Overall, participants expressed their lack of knowledge on makerspaces. When asked to share any makerspaces that they considered to be exemplars and describe the characteristics of the exemplar makerspaces that they wanted to adopt, the majority expressed that either they do not know or have not seen a makerspace: “I see things through email and stuff of what people have in their makerspaces, but I personally haven't seen any real phenomenal ones”; “There aren't very many in our area, I don't know a whole lot.” One participant expressed the difficulty in keeping herself up-to-date given her location and personal situation: “We're kind of sequestered out here. And don't have little kids anymore, so my, I'd have to go out and seek those opportunities.”

In addition to their limited experience with makerspaces, all participants expressed that their limited STEM competencies would hinder them from offering more STEM programs.

Our biggest response was that they wanted STEM or STEAM-related activities. And for us, it's uncomfortable doing it.

But I will be honest that this is where I feel a lack of confidence in that area, so I fear the technology so I don't lead it. It's terrible, I really need to step out of my comfort zone, learn something new for them, but the way I generally choose the programming is what I feel comfortable leading, what I feel like I can provide some expertise.

Participants mentioned seeking outside expertise rather than leading STEM programs due to their limited STEM competencies: “*There are certain activities that I or other staff members are not comfortable with, such as digital fabrication, robotics, or even animation. Therefore, if we were to do something with one of those, it would make more sense for us to bring someone from the outside to present a program in order to better serve our patrons.*” However, seeking out STEM expertise outside the community was challenging, as mentioned by many participants earlier.

We found that the lack of STEM competencies also influenced some participants to label themselves as “non-STEM” and establish that as part of their identity.

I’m okay with Legos, but I am not a building kind of person.

Those types of things [robotics, engineering] I’m not necessarily, my husband is very much into. And my husband and my oldest son are very, they just have that ability. I am not. I’m a books person, I’m not a hands-on person by nature...if we have a makerspace on robotics, I’ve got to be trained in robotics. You know, I have to know more than the kids to be able to do it, basically.

As expressed through participants’ description of themselves as “a books person” and “not a building kind of person,” the lack of STEM confidence influenced them to avoid taking risks and try out a new technology-oriented program. One participant described her encounter with library staff at a conference who described using a robotic kit to build a walking robot using electrical tape. The participant shared the fear she had towards the technology, which hindered her from running a similar program.

If it’s electrical, I’m going to cut the wire. You don’t just cut it... I can’t do this... I’m going to have kids that are frying themselves. But she’s [librarian at the conference] like, “it’s really simple and then you just stick it on here and plug the two ends in. And then, the robot just walks on the table.” I’m like, “I can’t, I just have visions of people being electrocuted.”

Findings show that participants’ limited STEM competencies and their perception of technology as too complicated hindered them from designing and introducing STEM programs with technological components (e.g., robotics, animation). We suggest that participants’ limited STEM competencies and perception of technology are critical barriers to applying their existing assets and practices to maker programming.

5 Discussion

Our study investigated the small-town and rural librarians’ goals, approaches, and resources (i.e., assets, practices, constraints) towards establishing their future makerspaces or maker programming through a case study of nine libraries. From the qualitative analysis of cultural probes and interviews, this paper illuminates two ways that small-town and rural libraries differed from the best practices in the field. First, they focused on attendance and equipping the materials within the makerspace over community building. Second, they experienced lack of transfer of existing assets and practices to maker programming.

Compared to notable makerspaces that put a strong emphasis on community building, the nine small-town and rural libraries in our dataset focused more on increasing attendance through providing STEM programs and technologies in the makerspace. In addition to providing equitable access to technology and a social space for collaboration, which were reported as goals of rural library makerspace [6], the study finding demonstrates that small-town and rural librarians emphasized increasing the attendance for the library—contrary to the community-oriented, collective goal of notable makerspaces [2, 40]. The emphasis on STEM programming also illustrates that nine librarians in this study did not attend to diverse learning practices that emerge from the makerspace, such as collaboration [1] or empowering youth to impact the local community [2]. We posit that the emphasis put on increasing attendance through STEM programming may relate to the decrease in visitation [36] and the lack of makerspace examples from rural public libraries. This finding points towards the need to support rural library professionals to reimagine the potential of the makerspace (or maker programs) towards community building and broaden their conceptualization of making beyond STEM. For instance, the Bubbler makerspace was an arts-based makerspace that moved fluidly into the neighborhood and community spaces to serve various needs of the community [18]. Small-town and rural library makerspaces must consider different ways to connect with and meet community members.

Our study also suggests that small-town and rural librarians' lack of STEM competencies potentially hinders them from transferring their assets and practices related to youth involvement and partnership to a new area of maker programming. Since the adoption of the makerspace requires a shared vision from the library professionals who will design and develop the makerspace, it is crucial to examine how the social norms of the makerspace align with current practices of rural librarians. Makerspaces generally require a different style of facilitation and tools than literacy programs. As such, librarians' compatibility with these less familiar STEM tools and maker practices may be low, particularly when the librarian finds high-tech equipment and STEM knowledge to be too complicated, as illustrated by multiple interview excerpts in this study. Public librarians' lack of STEM competencies and confidence in technology have been reported [4, 7]. However, our findings add to the literature that their lack of confidence in STEM and technology can be a critical barrier for applying their assets and practices that support the design of makerspace. Given the extent to which prior experience and knowledge influence STEM programming in libraries and an apparent lack of competencies related to facilitating learning and community-based collaborations, iSchools should consider including in their curriculum elements of design thinking, facilitation in formal and informal learning settings, technical and tangible making, as well as methods for collaboration and partnering. The authors advocate a facilitated learning curriculum, similar to the one designed by the first author [39], to address the future needs of rural librarians.

This finding suggests several implications for rural library practices and public library makerspace research. Although a makerspace facilitator's competencies depend on individual librarian's prior experience and knowledge [27], strategies such as augmenting existing programs with maker elements [30], while applying their existing practices of youth involvement and school partnership, could potentially support small-town and

rural library professionals to incrementally develop technological fluency and increase confidence towards maker programming. Library professionals could begin with smaller-scale maker programs and observe how the patrons react to reimagine different ways of incorporating maker elements into their regular programs. As they engage in trial-and-error, they can also learn to shift their conceptualization of mentorship from an instructor to a facilitator [12].

Similar to how youth were positioned as designers for the learning lab [2] or how the teen advisory board could actively advocate youth's voices [12, 33], small-town and rural librarians could involve youth and patrons, in ways that they have done in the past, to brainstorm the context-relevant makerspace for the community. If the library does not have the budget to create a designated space for the makerspace, the librarian and the community members could imagine different forms of hybrid spaces (i.e., physically meeting at the library teen room two days and virtually collaborating for three days). Such efforts should also continue within the community of practice—consisted of similar-sized rural and small-town libraries—that share similar norms and practices to inform one another. The community of practice can help share similar challenges and possible solutions based on tested cases in the field. This would also support small-town and rural libraries to continuously motivate themselves with examples that they can model and adopt instead of cases that may seem irrelevant to their context. Importantly, large-scale efforts to systematically support small-town and rural libraries with STEM resources and expertise, utilizing networks between informal learning institutions, research institutions, and government agencies, may be needed to strengthen STEM partnerships. Finally, public library makerspace research needs to continue the empirical research to design, develop, and investigate different configurations of rural library makerspaces to suggest models, frameworks, and practices that rural library professionals can adopt to build their capacity to design and facilitate learning in makerspaces.

6 Conclusion

Traditionally, the small-town and rural public library has been recognized as a trusted institution in the community to access information services and support [34]. As such, small-town rural libraries are well-positioned to support their community members by leveraging available library resources and services. To support community members in the changing landscape of digital technology and informal learning, small-town and rural librarians must continue to enact their unique assets and practices while acknowledging the barriers to developing context-relevant rural library makerspaces.

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