The Accidental STEM Librarian:
An Exploratory Interview Study with Eight Librarians

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Introduction

Many libraries are now providing innovative science, technology, engineering, and math (STEM) activities in their youth programs, including interactive exhibitions and hands-on workshops (e.g. Shipp, Nelson, Stockman, Weir, Carter, & Bleacher, 2008; Dusenbery & Curtis, 2012; Dusenbery, 2013; LaConte, Halligan, & Shipp, 2013). What started some years ago as independent experiments has become a national movement. More and more libraries are responding to the need to increase science literacy and support 21st Century skills, such as critical thinking, by adding to STEM programs for patrons of all ages, from pre-school to adults. (c.f. Char, 2002; Institute of Museum and Library Services, 2009; Kliman, Jaumot-Pascaul, & Martin, 2013; LaConte et al., 2013).

One such program is the *STAR Library Education Network* (STAR_Net) program funded by the National Science Foundation in 2010 (Grant No. 1010844). STAR stands for Science-Technology Activities and Resources. STAR_Net education programs have been designed with the goal to inspire lifelong learning through inquiry and play (Dusenbery & Curtis, 2012; Dusenbery, 2013). The project developed two interactive exhibits (*Discover Earth: A Century of Change* and *Discover Tech: Engineers Make a World of Difference*), accompanied by a variety of education and outreach programs, that travel to nineteen public libraries over three years. The additional programming includes hands-on activities related to the content of the exhibits for different age groups. The project includes a training program for librarians, an outreach program for out-of-school instructors, and a Community of Practice online network of librarians and STEM professionals[1].

STAR_Net is one of a number of federally sponsored projects[2] that have explored providing professional development to librarians in a variety of STEM-related areas. These kinds of project interventions have been needed because librarians do not have a background in STEM education. There are over 45,000 librarians working in 17,000 public library locations in all 50 states. With such broad reach, public libraries represent an important and largely untapped resource for increasing STEM literacy in the U.S.

Libraries in the past have been places of books and a place to develop reading and information literacy practices. The professional training that librarians complete at the Master's level is geared towards these competencies. But with a shift in programming that supports the development of STEM learning, how are librarians facing this change? Instead of pointing patrons towards the library's collections to read about science, mathematics, psychology, computer science, technology, engineering, and social science, they are now expected to facilitate patrons in participating in STEM learning activities.

STEM educators in both formal and informal learning environments are the ones who traditionally facilitate the development of STEM thinking. It is through interactive learning activities and facilitation with educators that learners can progress in their development of these types of thinking over time. With the introduction of STEM into the library's traditional programming, librarians need to evaluate the change in duties that may include taking on the role of a STEM educator. This includes implications for the broader field that provides the professional training for librarians.

With the introduction of new objectives for interactions with library patrons, in what ways have STEM initiatives challenged librarians' perspectives of their profession? What

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[1] As of October 2013, there are 450 CoP members nationwide.
[2] Institute of Museum and Library Services Grant No. 90100-99, 1999; National Science Foundation [NSF] Grant No. 0514746, 2005; NSF #0515597, 2005; NSF #0714537, 2007.

barriers and challenges have they faced on the job? We can learn from those librarians who have successfully initiated STEM programs in their library. We can draw on their experiences particularly in terms of how such programs have impacted the culture within their institutions. In order to answer this question, I will use evidence taken from interviews with eight librarians some of whom have been involved with some of the projects listed previously, while others have developed STEM programs on their own. This small sample represents a broad perspective on these issues.

Methods

Research Questions

- In what ways have STEM initiatives challenged librarians' perspectives of their profession?
    - What is librarianship in the context of STEM?
    - What is STEM anxiety for librarians?

Sample Design

A convenience sample of eight librarians from a recruitment pool of 54 librarians was selected to participate in the interview study. The size of the sample was chosen for two reasons. First, the time and effort to recruit, schedule, conduct, and analyze interviews was manageable for a single researcher. Second, there was a lack of evidence to support the initial hypotheses about which factors might inform how STEM initiatives develop in public libraries. Rather than design a large and elaborate study, an exploratory study could inform the development of a testable hypothesis.

The study participants were recruited from STAR_Net's online Community of Practice (CoP) website (http://community.starnetlibraries.org/). The CoP was created by the STAR_Net project team as a place for librarians to gain access to STAR_Net resources, participate in a variety of forums, and find a community of likeminded librarians who were interested in STEM or conducting STEM programs at their libraries. STAR_Net includes the librarians involved in its exhibition program and all librarians interested in joining the CoP[3]. Librarians were encouraged to join the CoP at librarian professional conferences and webinars.

Librarians in the sample represented individual library branches or large library systems that serve rural, suburban, and urban communities. Librarians in this sample held varying position titles, from branch director, library director, children's librarian, and adult services coordinator. Librarians in this sample had provided STEM learning activities for five years on average, with a range of two to eight years.

Procedures

Using a semi-structured interview protocol (see Appendix), the librarians were asked about their library, their role in STEM programming, the community served by the library, their efforts with regard to STEM, and partnerships with community organizations. The questions were designed to investigate changes in the libraries as a result of implementing STEM activities or programming at their library. The study protocol was approved by an independent review board (Aspire Institutional Review Board ID: STARNET). All interviews were conducted in

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[3] This community is also unique in that it includes STEM professionals (e.g. members of the American Geophysical Union and IEEE-USA) who are interested in working with librarians to support their STEM development efforts.

November 2012 over the phone during business hours, and the interview time ranged between 25 and 55 minutes.

Interview transcripts were open-coded for rich descriptive quotes. These quotes were compiled into a single document. Quotes provided in this paper are made anonymous, and given two letter identifiers at the end of the quote. This will help the reader identify when a quote is provided by the same person. Similar quotes were organized into groups and were given a descriptive code that illustrated the group. A total of 15 codes were identified and developed. The codes were organized into three broader categories: librarians, the library, and learners.

Since these librarians are the most qualified to explain how the library setting is suited to STEM learning, the data in the following sections are presented as intact quotes. The quotes represent the librarians' own words that were identified in the coding analysis. In order to answer the primary research question, I needed to identify and articulate broader concepts rooted in these experiences. This is a type of connecting analysis that identifies the constituent elements and reconnects them to tell a larger narrative about libraries and their communities (Maxwell, 2008). Librarians serve as key informants to understanding the larger macrosystem that includes libraries and other STEM settings such as schools and museums.

Librarianship and STEM

STEM programming is causing discussion and debate about the legitimacy of whether such activities should even be offered at a public library either by librarians or external partners. Do such activities fall under the traditional definition of librarianship? Librarianship is defined here as performing the following five primary functions of library services based on the needs of the population served: collect information, acquire information, organize information, retrieve information, and disseminate information (MacKellar, 2008). Secondary duties include: assist and instruct, provide services and programs, utilize technology, preserve and conserve library materials.

With changes to duties, librarians are questioning whether this is what librarians should be doing. The peripheral librarian duties like instructing patrons, utilizing technology, and providing programs are at the core of supporting STEM learning. The issue of offering STEM programs in a library setting creates a tension between the primary day-to-day functions of the librarian and the emphasis on secondary functions as part of STEM education.

> *Librarianship in general, this has been something that's popped up over and over and over again. People, when the light bulb comes on, that they understand that this type of service evolution is in line with our missions as public libraries and the place where people should have access to whatever's next, but I think what happens frequently, at least in my experience over the last couple of years, is librarians wonder, "Is this what librarians do?" We would argue, "Of course it is," but some of the things that we've had to talk about, in terms of challenging assumptions is, our role is evolving and has been for some time, into this role of community educator. #BB*

While not the same as traditional librarian duties, even here we see the expansion of the role of the librarian shifting to have an educational role. In the above quote, STEM is not seen as in conflict with librarianship when redefined as a community educator.

Librarians raised the critical question at the core of librarianship. Is this what librarians do? In this question, they are reflecting on the meaning of librarianship. Is the core of the profession better understood in terms of functions or activities? Which one allows one to

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continue to serve the community as their mission evolves? The above librarian spoke about how STEM very much fits in with the mission of the library, particularly the role of community educator, rather than as a curator of information resources. Interpretation and revisiting how librarians can support the needs of the community mission of the library seems to be a natural process. But STEM programming may be so different and new that the change seems less like evolution and more like a paradigm shift. The librarian below talks reflectively about the process that librarians face when deciding on new technology to introduce to patrons.

> *We're evolving because that's the need, and that's the kind of need the community is bringing to us every day, but when we bring in something really off the beaten path, or off the chart, like [new technology], for example, suddenly we're questioning whether or not this is something that a librarian should do. "Is this the level of expertise that I want to add to my toolkit, or that I should add to my toolkit?" Of course, clearly our unit would be, "Yes," but that's definitely something that we keep running up against. #BB*

STEM Librarians

The term, STEM librarian, is used to define a librarian who contributes to the design, development, or delivery of STEM learning activities and programs even if not part of their primary duties. STEM librarians can be found playing any number of roles in the library. Within the small sample of eight librarians in this study, the departments ranged from children services, youth services, and adult services in addition to those that serve in leadership positions at the library, such as director. When asked who besides themselves was involved with STEM at the library, librarians said most everyone in the library would or should be expected to support STEM learning. Someone in circulation might be as likely to be asked a STEM related question as someone whose job it is to develop STEM programming. However, not all I spoke with had the full support of their peers.

STEM librarians may serve as change agents in their libraries, at the forefront of trying to change how people view libraries. Because STEM represents a change in programming that focuses on new sets of disciplinary thinking, the community may see the library differently.

> *I think that a lot of times people look at the library as books are nice, books are fun. Reading all day must be a nice job to have. I think that STEM kind of gives us some gravitas, that we definitely deserve, but maybe the community didn't see in us before, that they'd never really thought of us … it helps seal the educational aspect of what we do in ways that, just being a resource for research and things like that. #GG*

A STEM librarian who was not interviewed in this study (Duff, 2010) discussed this contrast as she brought STEM to her school library, "I am trying to change the tradition of humanities-dominated libraries by diving into STEM and bringing the students and teachers with me on this journey into the sciences."

A STEM librarian is distinguished from a science librarian, who typically works with scientists in an academic library that specializes in a scientific discipline, like chemistry or geology. Science librarians may even have a science or engineering degree. In the literature published about science librarians, the role of disciplinary knowledge of STEM in librarianship has been a topic of discussion (Dervin, 1977; Haselbauer, 1984; Slutsky, 1992; Beck & Callison, 2006; Tchangalova, 2009). Much of the discussion centered on the preparation or credentials that such a librarian should have in order to work in such a position.

STEM Anxiety

A lack of background knowledge and professional training in STEM can be the source of a lack of enthusiasm and even anxiety. Librarians mentioned anxiety about mathematics and science as part of the profession and with their colleagues.

> *What I'm starting to feel is that there's probably a significant number of librarians that have a fear and that have science anxiety. They don't perceive themselves as being able to do it necessarily. I think that that's probably one of the biggest stumbling blocks that we're going to have is how to help librarians overcome their science anxiety and hand-in-hand with that how to help parents overcome their science anxiety too. #CC*

STEM anxiety is not specific to librarians working in public libraries[4]. Anxiety arises when an individual is expected to perform beyond their perceived self-efficacy (Bandura, 1988). For example, afterschool providers care deeply about children's mathematical success, but they often are math-avoidant themselves and thus shy away from doing mathematics with children (Kliman et al., 2013). With new professional duties come gaps in competencies and skills, and this perceived gap with an expectation of professionalism causes anxiety[5].

One perceived gap between expectation and competency seems to be the ability to teach science. How can one engage others in loving science if they themselves don't know or love science, even fear science themselves? Working with librarians to participate in STEM activities as learners themselves is an important first step in addressing the perceived gap.

> *some staff is nervous about it. Some staff feels that they don't know how to teach science, so getting that message across is, of course, a challenge. It is not intended that you teach it, but that you play with it and play with it with the kids. Just figure out an experiment and then show it to them and explain why it works and they'll be thrilled. #GG*

Another perceived gap is the ability to conduct science as a professional. Some librarians seem to feel that only scientists should be the ones that are qualified to facilitate STEM learning. Librarians need to understand what skills in science are necessary and can be learned without having a career in science.

> *Some people may be nervous about having to deliver this kind of service where they had never delivered it before. Again, we have to look back and go back to, okay, this is a new skill set that we need people to have. What kind of training module do we have to come up with so people can develop this new skill set? There are some librarians who have science backgrounds and so they're only too happy to do the science work, etc. There are some people who are not comfortable with that. That is quite understandable because then we're not hired to be a scientist. #FF*

A third perceived gap is the ability to work with parents and model positive experiences in STEM for children. If a librarian is not having a positive experience, it is not possible to model this for others.

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[4] Science anxiety is something that has been mentioned in the science librarian community (Slutsky, 1992).
[5] Further investigation of the topic of STEM anxiety of librarians might review the literature on mathematics and science anxiety of elementary school teachers. This is beyond the scope of this study.

We [librarians] know what to say to parents about how to help them get their kids to read. We don't know what to say to parents to help them help their children love science. Because part of it is we're dealing with our own anxiety #CC

Lack of Enthusiasm

STEM librarians that I spoke with see science anxiety in their fellow librarians as a major issue to confront when delivering science in the library setting. When this definition of the role of the librarian is not a shared one by all in a branch, this is a serious barrier to implementing an effective STEM program. Librarians often find it difficult to get their peers to be as enthusiastic about STEM as they are.

… sometimes not so enthusiastically either. Like I said, Monday to Friday, 8 - 4, let's go to the job, let's get it done. Not, let's get some help, let's get the kids in here, let's show them what we can do. Let's get involved with the … I made some of the staff here create the [activity] for me. Rather than me doing it here.... It was a little bit of a challenge for some. You wouldn't think [an activity] that big a deal. .... Sometimes it's been difficult to do. Not so much with the delegating, it's getting it done. #AA

Having a great STEM program does not seem to be enough to overcome the anxieties or lack of enthusiasm that librarians have with STEM. The level of concern about an innovation is a known issue that mediates the level of adoption (e.g. Rogers, 2005; Hall & Hord, 1987). These programs are an innovation that has to be adopted by other librarians if it is to be offered system-wide.

What a great program, why don't I see if I can't get this system wide. I threw it out to the children's librarians who would be in charge of that age group that would be important for it. I got a fairly lukewarm response. #CC

Discussion

As libraries increase their capacity to offer STEM, some librarians are put into positions where they have to facilitate learning something for which they have little prior knowledge. Librarians were hired into their position for their library duties not necessarily STEM. I use the term, accidental STEM librarian, to describe librarians who do not have professional training in designing, delivering or facilitating STEM education yet wind up providing these services for the library. The term is borrowed from the term accidental librarian and coined by MacKellar (2008). She defined an accidental librarian as a librarian that did not have the professional training by earning a Master's of Library Science (MLS) degree accredited by the American Library Association. The accidental nature is a bit different in the context of STEM. Librarians are accidental STEM librarians once they are asked to help deliver this kind of programming. Consequently, librarians are faced with STEM anxiety and question whether such activities are part of their profession. The concept of the accidental STEM librarian illustrates an important set of issues around the nature of the profession and the anxieties that arise. It's important to name this concept in order to plan for interventions and to call attention to issues that need support over time.

The findings in this study are corroborated in an evaluation of STEM exhibit-based library program. The Science in the Stacks project developed science exhibits with eight rural Vermont and New Hampshire public libraries. The evaluation found that "librarians do not have a background in the interpretation of STEM topics for the public (Char, 2002)." One librarian

expressed her concern with her relative lack of knowledge about scientific concepts and vocabulary. The concerns that librarians expressed in this project centered upon the time commitments and expectations given their already full work schedules and responsibilities: lack of staffing, whether an exhibit could fit a library's tight space requirements, whether it was sufficiently durable to withstand heavy handling by children.

Professional Development

The concept of accidental STEM librarians can inform the design and planning for professional development of librarians in STEM education. It may be that accidental STEM librarians will be the majority within a library. As a target audience, they will require professional development that addresses their concerns and perceived gaps in competency.

The first strategy is anticipating the reflective question of whether STEM is in line with a traditional set of librarian duties, "is this what librarians do?" They will ask this question and will be evaluated against each new thing they are asked to learn. Providing professional developers working with this audience a ready set of answers might start the conversation in a way that acknowledges the issue at the beginning.

Leveraging existing librarian skills will ease anxiety by focusing on strengths rather than weaknesses. It also values the discipline of librarianship. For example, librarians have experience with literacy development. By engaging librarians in a conversation about their literacy practices, they can discover how STEM activities can be used to meet the same goal.

> *I always say, "It really doesn't matter how much science activities we offer to children and their families. If they can't read, it really doesn't matter." Literacy is also at the heart and the focus of this [program], although we have all of this... At the end of the day, we're still a library so we're going to also--all of those programs and services that enhance literacy skills of all the people coming into the library. The STEM activity is an added value, and additional bonus. It is something that we're very focused on, but we also have to have that literacy piece as well. #FF*

In the *Math off the Shelf* project, they found that librarians particularly valued the fact that they could integrate mathematics into their existing areas of strength and expertise, drawing on the themes, projects, and ways of interacting with children they had developed over time to address local interests and needs (Kliman et al., 2013). However, it was not until they encountered resources that honored and built on features of the library setting and on their own unique talents as informal educators that they saw themselves as capable of helping to realize that success.

Another strategy is to leverage the reference interview, a protocol used by librarians working at the reference desk to guide patrons to the information source they seek by asking them a series of questions. In many ways this protocol is analogous to inquiry questioning that is used in science classrooms and informal education environments such as a science center. This library practice is already used as the basis for STEM professional development at one library.

> *Yeah, because what we do right now as librarian, sitting at the reference desk, we call it the reference interview. A person may come to you, you want to ask them a series of questions to find out exactly what it is they're looking for and how we can assist them. I mean a librarian sitting at a desk, a person will come to you. They would have a question. Working with [a science center], we find ways of phrasing different questions or leading a conversation, where a child or young people can really delve within*

themselves and come up with the answers, instead of us just giving them the answers. It's giving them a way to think and really be logical and thinking a way to find out why something works. Yes, we're here to assist you but we want you to delve a little bit further. We want you to explore a little bit more. The librarians they find that part of the inquiry based method very useful... #GG

It is interesting to note that the librarian is considered the source of answers in the reference interview. In developing professional development for librarians to adapt this practice, it would be good to highlight how one is working with children to explore the question so that children arrive at a conclusion themselves. Librarians may find that this type of questioning can lead to development of other STEM skills based on librarianship practice, such as facilitation and partnering with experts in the community.

The reference interview was mentioned by another librarian in the sample, she described this event as a profound example of how her library could facilitate STEM learning. Placing an object suited for scientific observation and inquiry near the reference librarian provides the librarian an opportunity to facilitate effective inquiry questioning.

Let me give you an example and this is going to sound like a silly example but really was quite profound in my branch. When we popped the tank on the reference desk, we always keep track of our interactions with patrons ... as that's one of the normal statistics that we keep track of and questions that are asked and interactions relating to activities because that brought in so many people to come visit the reference desk. We've had more robust interactions with all our patrons and it's been very exciting for the librarians.

A typical scenario, and one thing that's interesting about this too is that it involves parents and children often. The parents, it becomes a critical piece of this. A child will come up and saying, oh, what's this? Then their parent will follow up behind them. The librarian would start up interacting, oh, these are [animals]. Then, we'd look into the tank and we'd find some that were crawling around. The child may ask a question about, oh, what are [animals]? Then we had a shelf [of books], a [animal] shelf for a while. We talked about this is what they grow into, how they grow up. Then the parent would chime in and say, oh, remember we saw those ... last summer. Do you remember those things, ... and oh, yes! It's a wonderful three-way interaction, the parent providing a context; the librarian providing information to both the parent and the child; and the child asking questions and getting answers to them. ... The parent's interaction with the child has been very interesting to watch, because I think that even parents that are uncomfortable with science are very comfortable having that conversation. It's been a revelation to us, I think.

We have a little bit of training every week,.... After a while the librarian get the pattern about explaining about the [animal], telling patrons about them. The interactions between the librarians and the customers have become so profound just by the very fact that we have that tank sitting there. It's really changed how we do our jobs kind of because we're interacting more. #CC

The librarian is not conducting a reference interview in this example, since the parent and child were not seeking an information source. The librarian was primed to ask questions and facilitate a dialogue about a live animal exhibit. This is an example where a librarian at the reference desk can engage patrons in a dialogue rather than the more typical transaction of the reference

interview. The librarian is facilitating the interaction between parent and child in a way that is consistent with the librarian practice of providing information. Parental involvement can also support the development of understanding about the animal in the tank, helping with recall and tying the observation back to previous experiences. The interactions between librarian, parent and child are all important.

There are some lessons that can inform the design of professional development of accidental STEM librarians. First, the new practice of inquiry questioning is very much like traditional practice of the reference interview. By leveraging this existing practice, librarians can develop inquiry facilitation skills. Second, a learning STEM object was placed in the natural work setting of the librarian, therefore not changing the activity structure completely for the librarian. Such objects could be different types of animal skin, different types of rocks, some LEGO bricks that children can use to construct simple structures, and even live animals. The underlying approach to the design of professional development outlined here is one of which starts where the librarian is at rather than what deficits they seem to have.

Conclusion

The accidental STEM librarian is a consequence of the introduction of STEM programming in the library. I would expect to find an increasing number of librarians that would self-identify as accidental STEM librarians as more libraries implement inquiry-based STEM activities, programs, or exhibits. This is certainly the direction that the federal agency, the Institute of Museum and Library Services (2009), would like libraries to head. They support libraries to develop the institutional capacities to support individual development of 21st Century skills, which include information, communication and technology literacy, critical thinking, and problem solving.

The change in programming will come with increased STEM anxiety. These concerns can sometimes slow down or derail efforts to offer such programming system-wide. The role of the librarian does change with STEM from a focus on information gathering to facilitating real STEM learning. They will need help in developing new skills and knowledge. This can be done by showing them that they can use STEM to engage patrons as they always have.

In comparing the skills associated with librarianship, there is some overlap with the skills of STEM educators needed to facilitate STEM activities. Finding ways to improve the self-efficacy and motivation of librarians in facilitating STEM activities is important. In one sense STEM is no different than what the library has always done, which is provide learning opportunities that help them fuel new interests, support career development, and engage in lifelong learning. When seen from this broad mission of the public library, providing STEM is just business as usual. Librarians who take this perspective may well be better positioned to integrate STEM into their existing practice, rather than see it as something that undermines years of professional training and identity development.

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Appendix

Interview Protocol

1. Briefly describe your role with providing STEM learning opportunities at your library?
   a. Probe: How did you get involved in the STEM programming at your library?
2. What motivates you to engage your patrons and community in STEM?

Library's Perspective on STEM

3. What do you see as your library's role in encouraging STEM learning in your community?
4. What is the library's strategy for providing STEM learning opportunities to just patrons? at the community level?
   a. Probe: Is it working? Why? or Why not?

STEM Partnerships

5. How is the library working with partners to bring in STEM content?
   a. Probe: Faculty and students from universities
   b. Probe: Scientists and engineers from agencies or businesses
   c. Probe: Science teachers from schools
   d. Probe: Science center, museums, aquariums, zoos
   e. Probe: Local media, tv meteorologists
   f. Probe: Any others?
6. How is the library working with partners to bring audiences to STEM programs?
   a. Probe: Student groups from schools
   b. Probe: Children and teens from youth groups
   c. Probe: Any others?
7. How is the library working with partners to get the word out about STEM programs?
   a. Probe: Local media outlets like tv, newspaper, radio
   b. Probe: Inviting government officials to events
   c. Probe: Any others?
8. Has the library needed to change in order to work with any of these partners?
9. Are STEM partnerships different than other partnerships the library has?
10. Are there partners you wish you had?

Patrons and Community

11. Please tell us about the community your library serves (such as demographics, community strengths, community needs). How would you describe it to someone who has never been there before?
12. How might your community needs differ from your patrons needs?

13. When it comes to STEM in your community, who is the major provider?
14. Do you see your library filling a niche in the community of STEM providers?
15. Probe: Please, describe.
16. Have you or your staff encountered resistance to these reforms from patrons? or the community?
17. What have you learned about how your patrons engage in STEM that is not reflected in schools, universities, or elsewhere?
18. Has the STEM programming so far changed the library's relationship to its patrons? to its community?

Library Capacity for STEM

19. What are some of the major challenges your library faces in attempting a STEM initiative? What are some of the major opportunities?
    a. Probe: How can barriers be overcome?
    b. Probe: How can opportunities be maximized?
20. Who is crucial amongst your staff for STEM programming?
    a. Probe: Who's the keystone?
21. Has the library needed to change in order to do more STEM? Have the librarians?

Conclusion

22. Is there anything you would like to add that I didn't ask about that you think I should know?