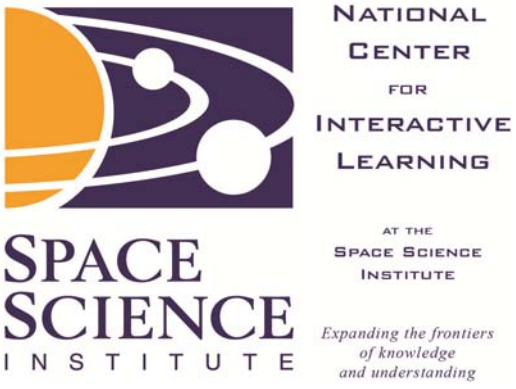
STARnet Science-Technology Activities & Resources For Libraries

Public Libraries as Places for STEM Learning: An Exploratory Interview Study with Eight Librarians

John Y. Baek, Ph.D.
October 2013

The public library as a venue for learning science, technology, engineering, and mathematics (STEM) is seen as having great potential for implementing informal STEM education. There are 17,000 public library locations in all 50 states; at that scale they can provide citizens in each community opportunities to engage in lifelong STEM learning. With such broad reach at a local level, public libraries are an exciting prospect for engaging the Nation in STEM learning. Broadly, the question that this paper seeks to address is, in what ways do libraries support the development of STEM learning? To answer this question, we can learn from librarians who have led initiatives that foster STEM learning at public libraries. We can draw on their experiences, their observation of change, what worked and what did not as a result of their STEM initiatives. Evidence was taken from exploratory interviews with eight librarians. Some of these librarians have been involved with federally-funded projects, while others have developed STEM programming on their own. This small sample represents a broad perspective on these issues that can inform the informal STEM education community about the characteristics of libraries that support the development of STEM learning.



National Center for Interactive Learning Education/Research Report

Space Science Institute
4750 Walnut Street, Suite 205
Boulder, Colorado 80301

http://www.nc4il.org/
http://www.spacescience.org

This material is based upon work supported by the National Science Foundation under Grant No. DRL-10-10844. Any opinions, findings and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation (NSF).

Table of Contents

Introduction

The public library as a venue for learning science, technology, engineering, and mathematics (STEM) is seen as having great potential for implementing informal STEM education. There are 17,000 public library locations in all 50 states; at that scale they can provide citizens in each community opportunities to engage in lifelong STEM learning. With such broad reach at a local level, public libraries are an exciting prospect for engaging the Nation in STEM learning.

One such project is the *STAR*[1] *Library Education Network* (STAR_Net) program funded by the National Science Foundation in 2010 (Grant No. 1010844). 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 are traveling to nineteen public libraries over three years. The additional programming included hands-on activities related to the content of the exhibits for different age groups. The project included 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[2].

STAR_Net is one of a number of federally sponsored projects[3] that have explored the potential of libraries to become venues for STEM learning. All of these projects implemented informal STEM education techniques to public libraries. These kinds of project interventions have been needed because libraries have not historically been places to develop one's scientific or engineering practice.

Libraries have been a place of books and a place to develop reading and information literacy practices. When it comes to STEM, libraries have focused on reading about STEM topics rather than doing and practicing STEM. Libraries are great sources of static formats for learning STEM. They offer collections that include science, mathematics, psychology, computer science, technology, engineering, and social science. STEM education supports the development of disciplinary thinking through engagement with authentic practice, in other words learning by doing. For science the authentic practice has meant the scientific method, in engineering the design cycle, in mathematics it is logic, and in technology it is the application of designed solutions to solve problems. Informal STEM learning environments (e.g. science museums, science centers, zoos, and aquariums) provide access to this type of thinking in the form of interactive learning activities and facilitation with educators and docents. Over time, learners progress in their development in this way of thinking as they engage in STEM practices.

Schools have traditionally been the place for children and teens to develop disciplinary thinking. But schools are not the only place in a community where education takes place; they exist within a community's learning ecosystem (Goodlad, 1984). Schools, businesses, museums, libraries, and the home are settings that make up a community's learning ecosystem, and this subset of places is designed to support the development of STEM disciplinary ways of thinking. As libraries increase their capacity to offer STEM by adapting their learning environment to support STEM disciplinary thinking, they also enter into an ecosystem of STEM education. In order to have a coherent role in the lifelong learner landscape, we need to better understand what

[1] STAR stands for Science-Technology Activities and Resources.
[2] As of October 2013, there are 450 Community of Practice members nationwide.
[3] 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.

niche libraries fit. Few researchers have investigated how libraries are suited for becoming a place for STEM learning as well as how they fit into an ecosystem of other STEM institutions[4].

Broadly, the question that this paper seeks to address is, in what ways do libraries support the development of STEM learning? To answer this question, we can learn from librarians who have led initiatives that foster STEM learning at public libraries. We can draw on their experiences, their observation of change, what worked and what did not as a result of their STEM initiatives. I will use evidence taken from exploratory interviews with eight librarians. Some of these librarians have been involved with the federally-funded projects listed previously, while others have developed STEM programming on their own. This small sample represents a broad perspective on these issues that can inform us about the characteristics of libraries that support the development of STEM learning.

Methods

Research Questions

- In what ways do libraries support the development of STEM learning?
    - Are libraries learning environments for STEM?
    - How do libraries support STEM learning at schools, at home, and in the community?

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 like-minded librarians who were interested in STEM or conducting STEM programs at their libraries. The site is not restricted to librarians from the 19 STAR_Net libraries hosting the traveling exhibitions. Non-host librarians were encouraged to join the CoP through outreach events 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

[4] Networks of informal science education have been investigated previously, but the studies excluded libraries (e.g. St. John, Dickey, Hirabayashi, & Huntwork, 1997; Falk, Randol, & Dierking, 2008).

efforts with regard to STEM, and partnerships with community organizations. The questions were designed to investigate changes in their libraries as a result of implementing STEM activities or programming. The study protocol was approved by an independent review board (Aspire Institutional Review Board ID: STARNET). All interviews were conducted in 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. 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 best suited 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 research questions, 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 education settings in their community.

Libraries as STEM Learning Environments

A STEM learning environment includes places where STEM activities and programs are offered. Yet, this is only a necessary but not sufficient condition. The National Research Council (Bell, Lewenstein, Shouse, & Feder, 2009) identified a broad set of characteristics of science learning in informal environments. For the purposes of this study, I will adopt these as the set of necessary conditions that the environment must be able to support for the development of STEM learning. The six strands that were identified articulate science specific capabilities supported by informal environments.

1. Experience excitement, interest, and motivation to learn about phenomena in the natural and physical world.
2. Come to generate, understand, remember, and use concepts, explanations, arguments, models, and facts related to science.
3. Manipulate, test, explore, predict, question, observe, and make sense of the natural and physical world.
4. Reflect on science as a way of knowing; on processes, concepts, and institutions of science; and on their own process of learning about phenomena.
5. Participate in scientific activities and learning practices with others, using scientific language and tools.
6. Think about themselves as science learners and develop an identity as someone who knows about, uses, and sometimes contributes to science.

The descriptions about STEM provided by librarians in their interviews fit within three of the six strands. Given our small data set, I mapped the data to the six strand framework to see what does and does not fit.

Strand 1: Supporting Excitement, Interest, and Motivation

Librarians emphasized that STEM activities need to be fun and exciting. Often this emphasis was in contrast to the perception of STEM in schools as not very exciting. STEM programs in libraries can fill a gap left by school-based STEM learning and change student attitudes towards STEM from negative to positive. If programs generated enough interest, children will also be motivated enough to return.

> *Some of it is shifts in what the kids are getting in school. I feel like, in some cases, what's available to the kids in school covers the bases of what they "need" for STEM, but I kind of feel like if things were more interesting and exciting, they would continue in that interest outside of school, if that makes sense. I would prefer that kids come to my program because it's fun, and they happen to be learning something in the process. While a lot of my programs are designed around the idea that there is information or a process that I would like to share in their learning, the goal really is for them to have fun doing it, enough fun that they would be interested in coming to another science related program somewhere down the road. Part of that interest then is simply maintaining my attendance numbers, but it's more about getting them interested in things that they might not otherwise encounter. #DD*

Librarians in reading programs aim to get children and adults to love reading. It is not their goal to teach the mechanics of reading, from phonemic awareness to literary analysis. Analogically, librarians are not in a position to teach STEM content knowledge but to get students to love science. That love is instilled in an environment that is cool and non-judgmental, even to those that have not had a positive relationship to science in the past.

> *I guess my take on that is that for years and years, libraries have focused on trying to get people to love to read. My take on it is that we've now included getting people to love science. Loving science is different than simply learning science. You know what I mean? I think at least what I'm trying to do is get kids who wouldn't normally give science another look to say, hey maybe this is cool, that's kind of neat. I never really gave it a chance, but maybe science is okay and trying to figure out ways to do that. We don't have the mission like schools do of imparting a certain amount of information. What we're trying to do is make the kids love the information they get. #CC*

By taking an informal, playful and inviting approach, librarians see STEM activities as opportunities to change attitudes about STEM. Through engagement, students participate in the activity without pre-judging their abilities or being self-conscious about cultural norms.

> *Yes, you're here in the evening after school, but let's do something in an informal way where they can learn something fun. While they're doing all of these fun science activities, a kid may not like math. A kid may not like whatever science there is But while they're doing all of these fun activities, they're not necessarily knowing that they're doing it, until you tell them they're actually doing it, so then they see the fun side of it as well. ##FF*

Librarians also emphasized that STEM activities should be hands-on and iterative. This description seems to be in contrast to perceptions of school-based STEM learning that is not active or engaging.

Well I think part of the excitement is the hands-on of it and the thinking differently. You know, using a different part of the brain than a lot of people do and giving kids a chance to touch, which they don't get necessarily a lot of time to do in school. That's one of the things … I think the unique opportunities a library can present, is more hands-on experience than they might have in the classroom. #GG

The emphasis on hands-on may also be in contrast to traditional library programs where attendees are expected to sit and listen. A side effect of this kind of programming is that it is motivating for library staff as well.

Ultimately, we want these programs to be fun for the staff and fun for the children that participate. I think that our awareness came from that, and then it took a while for us to pull together these hands-on activities, because that's what they are. We're not developing a program where children sit. They use activities to explore with puzzles and games and experiments to understand simple math and science curriculum. #EE

Strand 5: Engaging in Scientific Practices

Librarians design programs and resources across a wide range of STEM topics that include robotics, astronomy, chemistry, and archeology. Like other informal learning environments, children and teens have the opportunity to learn about topics they are unlikely to address in a formal curriculum. One approach used by libraries is the development of STEM kits that allow patrons to engage in STEM practices in a self-directed manner away from the library.

Our entry into STEM programming started about five years ago where we received the grant to develop science kits that could be checked out at the library and taking home and these kits are experiments in a box. They range from microscopes, to mind storm robots, to snap circuits, to bird watching tools with binoculars, and bird songs; it's quite a range of things. #DD

Librarians described a number of partnerships with institutions that bring STEM expertise to their library patrons. While presentations are common, some librarians described programs that engage participants in more authentic learning experiences. By partnering with local scientists and engineers, libraries can be a place where the community can come together and learn about these practices.

We had a great program for moon viewing night, and I showed a movie about the original Apollo 11 landing on the moon back in 1969 and all that. Then we had a professor from [local] university, about 20 miles down the road from us, and she came and talked to the audience about what we should look at when we took the binoculars out, what we should be looking at, interesting features on the moon. Then when it was dark enough, we went outside and sure enough the binoculars were great. #AA

Librarians also mentioned plans to participate in citizen science programs[5]. These programs generally leverage the interest of citizens to make scientific observations and measurements and share them back with the scientists who need that data.

[5] For more information about citizen science programs see Bonney, R., Ballard, H., Jordan, R., McCallie, E., Phillips, T., Shirk, J., and Wilderman, C. C. 2009. Public Participation in Scientific Research: Defining the Field and Assessing Its Potential for Informal Science Education. A CAISE Inquiry Group Report. Washington, D.C.: Center for Advancement of Informal Science Education (CAISE).

This club will also be doing ... participating in the Mastodon Matrix project where we're analyzing the Mastodon that was dug up in New York State. As part of that dig, they saved the matrix from around the bones and they give it out a kilo at a time for groups to analyze and submit the results back to the scientist at the Museum of the Earth.

Strand 6: Development of a Science Learning Identity

Librarians also described the library as place where learners come to deepen their interests by participating in programs, using the space to work, and to explore the library's collections. The challenge for librarians is to be able to support a wide range of offerings that address individual and community interests.

I see learning in our library as being mostly informal and self-directed. The patrons come into the library with an idea of what they want to learn, and while they may ask the librarian for help, usually the process that they take to get to the outcome of having learned it is something that they choose for themselves. Exactly. By design, there's ... the space, the collections, the programs are built strategically to provide this opportunity for informal learning, but certainly there's thoughtful planning put into more formalized programming and learning opportunities that hopefully are reflecting the needs and desires and the wants of our community. #BB, #CC

Development of a science learning identity takes time and requires a range of activities that continually engage the learners as their interest develops into something that is sustained and well-developed (Hidi & Renninger, 2006). Libraries are places to initiate and develop those interests over time, in turn leading to opportunities to advance that development in other settings.

I know we had one kid a few months ago, my [staff member] said to me about this that the parent came to her and she said, "There's a specialized program here in the city that take children who are interested in science and they only take like five children a year." One of the little girls that come to our [library] on Saturdays she was accepted into the program. The mother came back and she said, "I owe it all to the library." Because she was able to get into this program because of so much stuff she had learnt here at the library in the [STEM program]. #FF

Surprisingly, librarians mentioned the impact of STEM activities on parents' science learning identities. Parents engage in STEM activities by participating alongside their children. Activities are open to parents, and that provides an indirect approach to engaging parents themselves, though in the context of a children's program. The outcome is not so much to teach STEM but to model and facilitate STEM practices for parents to engage with their children after they leave the library. In addition, they provide an avenue to change negative attitudes towards STEM.

There's more enthusiasm from the family, as a whole, it seems to me. I have a lot of regular attendees for my programs, and in a lot of cases, it started off with just the child coming, because I do school aged programming. It's not required that an adult stay in the program with them. ...But as I have incorporated a wider variety of STEM related things, more of the parents stay in the program. I actually think that a lot of what I'm doing interests the parents as much as it interests the kids...I think involving the whole family is an important thing for me to do, if possible. #DD

Of great value is that children see their parents as role models with positive and engaging interests in STEM. This positive role modeling reinforces STEM learning identity development as something positive and a social norm.

> *I think that they [parents] have a profound impact on how kids view science. I mean a lot of parents will go, "I was never good at science or I was never good at math." That opens the door to allow the kids a way out...Just by them [parents] thinking it's interesting, it's communicating to the child that it must be interesting too. #CC*

Mothers, in particular, are the parents that bring their children to programs. This is an opportunity to address female anxiety in STEM.

> *Actually, that has been proved that by bringing mothers into programs that are math and science, it breaks down a lot of anxiety in females. ... I think a lot of mothers bring in their kids for these programs. It's very encouraging to see that because, if they understand the concept, then they feel more comfortable working with their kids in those areas too. #EE*

Community Aspects of Libraries and STEM

There was additional interview data for which the above strands were not a good fit. Overall these data describe how the library supports STEM learning in concert with what is offered and needed by the community. Librarians described how they support the STEM learning at schools, at home, and in the community.

Libraries Bridge STEM Learning with Schools

Librarians described their niche in terms of STEM learning as a provider in a supporting role to what is taught in schools. They are not educators, so much as secondary providers of STEM education. In this support role, they provide another place in their community for students to engage in STEM, outside of school hours and perhaps in ways that might be more engaging and fun.

> *Our role I think it's to be a key player, integral player in the school systems here... One kind of works off the other, but I think we as a public library here need to be really in "cahoots" if you will with the school system to make sure that we're on track together and we know what their aims and goals are and they know ours as well. #AA*

Librarians understand that alignment and coordination with what schools are teaching is important but not required. STEM programming needs to enrich the understanding but not limit itself to what schools are teaching.

> *We're always the sort of handmaidens in life here. It's really the role of the schools in the community, but we play a supporting role in these educational opportunities. Sometimes we play a better supporting role than schools, but that's my opinion. #EE*

By sharing STEM learning goals, both schools and libraries can support each other in mutually beneficial ways. The stronger the connection between the schools and libraries, the more coherence there is for the student learner as they move between places.

> *I think it's also changed how we interact with the schools a fair amount. I think we provide more outreach that expands on what the teacher is doing in the classroom, but it also has strengthened the ties between the library and the school, in terms of the school*

being an advocate for the library. I think the teachers, perhaps, are more prone to suggest the library as another resource, pretty much from the get-go on some assignments, than they might be otherwise. #DD

Libraries Bridge STEM Learning to the Home

Libraries that offer STEM kits seem to be a bridge to learning STEM at home. Libraries have always served as a resource of learning materials to borrow and bring home. STEM kits extend this paradigm by providing ways for children and parents to learn STEM at home.

In fact to give you an example when I was at the STEM outreach program at the school last week, there were a bunch of parents that came through and said, oh yes, we get the [STEM kits] for our kids all the time, but there were quite a few parents who said, wow the library has this and that how the library has this, discovery has been happening ever since we introduced our [STEM kit] program. It's like, oh, I'll just ... it's a way to demonstrate that a library is about learning and not just about books... That's been an increasing discovery by the community. #CC

For homeschoolers, the notion of place is blurred. By providing STEM programming specifically for homeschoolers, libraries fill a niche that is free-choice without the requirements of school.

When I say school systems, that involves homeschoolers as well. We have quite a large group of homeschoolers that come to the library quite frequently. In fact, the [STEM] program that I was mentioning to you earlier, we also have a version of that that is done on Wednesday mornings and that's for the homeschoolers that come in. #AA

Libraries are an Equalizer

Libraries serve everyone in the community. They are free. There are no minimum requirements for entrance and provide an equal opportunity to the resources and programs offered by the library. Libraries can serve to counterbalance a lack of access to resources at schools or in the home.

Well the science, the hands-on, but we're a central location, I think, and available to all of the public no matter what school you go to. It's an equalizer. The library is … one of the great things about us is that we are an equalizer for any opportunity, but especially for STEM. You don't have to go to the best school in the area to take advantage of us. Any child can have the same opportunities if we can provide them for them. #GG

Libraries are used to accommodating the many different languages spoken in their communities. In one library system, 83 languages are spoken in the community. Programs are designed by necessity to be inclusive in order to accommodate the needs of the community. Libraries emphasis on hands-on activities can help second language learners overcome a critical barrier to STEM learning.

We have found that the math and science programs are really great for kids where English is a second language, because so much of it is hands-on, not like a ... for this age group we have book discussion groups where the kids read a book and meet with a staff member and discuss it. While that's certainly a vital part of our programming, with that you need to talk. Children, like anybody speaking in a second language, adults too, that's very uncomfortable and it doesn't allow the same kind of progression of interest and

being able to actually participate, as these programs do. It's a lot of hands-on kind of activities. That was one of the key things about this type of programming, is that we didn't leave anyone out, which is obviously the role of the library to be inclusive and make sure everybody is participating. #EE

Libraries are Continually Evolving

Librarians described the changing landscape of the needs of their community and how their libraries fill in the gaps. By listening to needs and collaborating with schools and businesses, libraries can be responsive with their programming. This responsiveness is ideal for STEM learning, since STEM is also ever-changing.

We're just not a place for dusty old books anymore. The library has to be a vibrant place for the community to come to. It is not just to check out books, it's for unique programming or programming that we can offer to enhance or be in collaboration with the schools or with businesses in town. That's how you think you're probably getting a little flavor of that of what we're trying to do here. We're offering some unique programs that the schools, don't or haven't, maybe we fill a little void with that but we have to be outreaching to the library, where I think in the past, libraries didn't do that so much. #AA

The digital shift in information and computer technology over the past decade has transformed the media on which information is published and forced libraries to accommodate the information literacy needs of their community. Educating the public about using technology provides patrons access to information as media change over time. In terms of technology education in the community, libraries are the leaders.

We've always been all about access. It's exactly what we do. Creating access to new and interesting technologies, to provide new ways to support the interest of the community is no different if that access is to a 3-D printer than it is to an e-book, or an Early Literacy program or whatever it might be. We feel that this is just another natural progression in the evolution of integrating technologies into our services. #BB

Discussion

The first set of analyses used the strand framework about science learning in informal environments to look at STEM activities and programs in libraries. The data indicated that STEM learning in libraries focus on sparking interest and contribute to developing STEM learning identities. The second set of analyses used an emergent framework that looked at how the librarians connect outside the library with schools, home and the community to deliver STEM.

To accommodate both analyses, a multi-level model that situates the role of the library in improving STEM literacy in relationship to other community institutions is needed. STEM learning is nested within the library and connects on a macrosystem level to other institutions that support STEM learning. A multi-level ecological model can be used to make sense of learning and human development at multiple levels of a social system (Bronfenbrenner, 1977). Applying this approach, libraries would be considered members of an ecosystem of STEM educational institutions in a community. Such a model would explore how the context, activities, resources, and relationships found in the library setting and its relationship to other settings provides opportunities for STEM learning (Barron, 2004).

Libraries as Third Places

An ecological model that may provide guidance about the relationships between the library, school, and home for members of a community is called a *Third Place* (Oldenburg, 1989). Third places are informal public spaces which act as anchors of community life and facilitate and foster broader, creative interaction among all levels of a community. Home is considered the first place. Work is considered the second place for adults, but for the purposes of this study school will be considered the second place for children. Third places that best exemplify the type of setting and conversation are pubs, cafes, taverns, and coffeehouses. They fill the gap in community members' lives in terms of socialization and community building. Third places are places that support the intellectual development of individuals in ways that are unique and apart from what happens at home and at work. The characteristics[6] of third places may shed light on the unique affordances that libraries can support the development of STEM learning apart from schools and home.

One characterization of a third place is as a leveler, similar to the description of the library as an equalizer, previously presented. Both terms indicate that a person's economic or social status does not figure into any restrictions or requirements for the acceptance or participation in a third place. The library is an institution that is inclusive to all levels of society, including the homeless and immigrants who do not speak English. Inequalities that may exist in other settings like school or home can be leveled in the library setting. By attracting people from all walks of life, the library can host a learning environment that is diverse with different cultural and linguistic backgrounds. Gutiérrez, Baquedano-López, and Tejeda (1999) argued that these kinds of interactions fuel productive learning environments. Third places can support the development of STEM identities from all levels of society and are not burdened by systems that recreate persistent achievement gaps.

Another characteristic of third places is the involvement of regulars. In libraries, parents are more likely to use library services that other adults (Miller, Zickuhr, Rainie, & Purcell, 2013). Data was presented previously that discussed the role that parents play in STEM activities with their children as well as engaging for their own interest. Thinking of parents as regulars of third places might provide librarians a different way of providing services. Oldenburg describes regulars as those visitors that habitually congregate, that shape the mood of a third place, and that help newcomers feel welcome. By creating an environment that welcomes newcomers to the community, libraries can become an on-ramp to STEM learning. An inviting environment with a social norm for habitual visitation creates a productive context for development of STEM disciplinary thinking over time[7].

Conversations are the key unit of activity in a third place. Playful and light hearted conversations are the central focus of interactions between third place occupants. As learners engage with each other in STEM hands-on activities, they are going to be talking with each other and necessarily louder. Yet, the history of the library setting as a place for books generally imposes an institutional norm of low noise level. Kliman, Jaumot-Pascaul, and Martin (2012) found in their project that librarians implementing their informal mathematics program identified

[6] The eight characteristics of a third place: 1) on neutral ground, 2) the third place is a leveler, 3) conversation is the main activity, 4) accessibility and accommodation, 5) involve regulars, 6) a low profile, 7) the mood is playful, and 8) a home away from home.

[7] The Learning Lab project invites teens to become regulars of the library and develop their interests in STEM learning. Libraries that participate in this project set aside space for developing digital media projects. The kinds of activities are described as hanging out, messing around, and geeking out (Ito, 2009).

noise and conversations during the activity as a challenge requiring a separate space. If libraries treat STEM programs as places hosted by third places, they will need to think strategically about the noise profile of the learning spaces they are providing.

STEM Learning in a Third Place

Consider that the learning and work that goes on in third places is characterized as a place where one pursues one's interests in a STEM topic or discovers a new topic of interest. The data presented explained how librarians seek a type of STEM learning that is different but complementary to what happens in schools and at home. Future research that looks at STEM learning in libraries should consider both the STEM learning that occurs within the setting, but also how that learning is connected to what happens at home and school. This simple model (Figure 1) provides a framework for more structured data collection from learners or librarians.

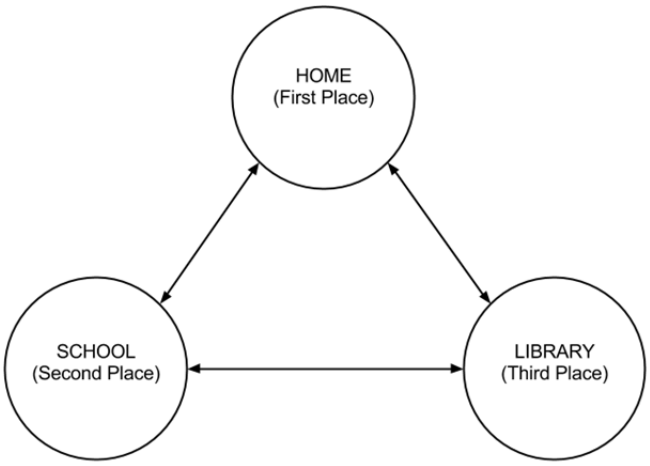


Figure 1: STEM Learning in a Third Place

The data provided in this paper were pulled from a small convenience sample. However, the analysis frameworks used in this study provide a structure for researching STEM learning in libraries using any methodological approach. The six strands are an important assessment and design framework for the study of informal STEM learning. Each strand provides a depth that allows needs to be explored and unpacked particularly for the library setting. As a design framework, the strands provide a framework of objectives for STEM initiatives. A library can be strategic in how it tries to support the development of each of these strands. In addition, it can use this as a community strategic planning tool to identify collaborations between STEM learning institutions.

Conclusion

Libraries that reinterpret their traditional mission of providing resources for self-directed learning that meet the above criteria are going to be seen as STEM learning centers that foster literacy of its patrons. In one sense STEM experiences are no different than what the library has always done, which is to provide learning opportunities that help them fuel new interests, support career development, and engage in lifelong learning. Libraries are an important institution that serves the learning needs of its community. STEM is an important lifelong endeavor and

libraries are uniquely positioned to support lifelong learning of STEM for members of their community.

Thinking of libraries as a third place for learning STEM is one approach to resolving librarians' perceptions of STEM learning at both an individual and community level. Perhaps, even more broadly, I would encourage researchers of informal learning to accommodate both the learning that occurs within this setting but also connecting to what is learned in other settings.

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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?