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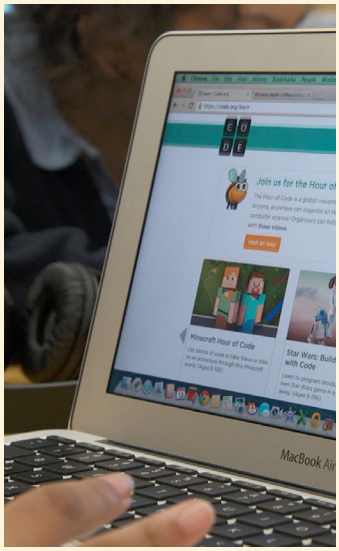

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Ready to Code

Connecting Youth to CS Opportunity through Libraries

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Through the work of libraries Ready to Code, communities will see young people who are ready to take on their futures, who have robust career options, and who guarantee the economic and social vitality of the cities, towns, and reservations in which they live.

ABSTRACT

With 500,000 current job openings in the field of computer science, all 115,000 of the nation's school and public libraries are crucial community partners to guarantee youth have skills essential to future employment and civic participation. To discover how libraries support computer science, coding, and computational thinking skills acquisition by youth, the American Library Association's Office for Information Technology Policy initiated a year-long "Libraries Ready to Code" research project. Research identified priority areas including securing additional funding, professional development opportunities for library staff, and broader strategic partnerships. This report explores these priorities and highlights recommendations.

ALA American Library Association

oitp Office for Information Technology Policy

EXECUTIVE SUMMARY

Librarians, educators, elected officials, policy makers, and parents need to make sure that young people know how to code. Coding however is more than learning how to program a piece of software. Knowing how to code requires computational thinking skills and an understanding of how to troubleshoot, problem solve, and think critically. It requires trial and error, instituting iterative processes, collaboration, and reflection. When a young person learns to code they gain STEM skills (which includes computational thinking) plus an ability to persist, and a confidence in what they are able to achieve.

School and public libraries are located in rural and tribal locations, in suburban and urban communities, in small towns and our very largest cities. Many of these libraries host coding activities for all ages of children. They do this to fill a need and to guarantee that youth have the skills required for the future these youth will help design. Decision makers in local, state, regional, tribal, and federal agencies should see libraries as a community resource that is ready to assist young people in learning to code and to do so in a way that extends and enhances classroom-based learning.

GAINING SKILLS FOR TODAY AND TOMORROW

Youth need computational thinking skills now that reflect the world they currently live in and the one they will be a part of in the future. With 500,000 computer science jobs currently available, and an expectation that the growth rate will be twice that of any other job over the next several years, there is a national economic imperative to prepare youth. All community members working with and for youth must be a part of this preparation.

School and public libraries are perfectly positioned to assume a leading role in preparing youth. Libraries are open during out-of-school time when youth are able to participate in informal learning activities that augment their classroom experience. Libraries have an infrastructure that enables learning which includes space, staff, technology, and connections to community members from work environments infused with computational thinking and with expertise in coding. When youth connect with role models in these fields, they can see themselves in, and aspire to, a similar future. For libraries to take the next step in this work, they need high-level funding and support for building out the technology made available inside their buildings and for re-envisioning their models of operation in order to better serve communities of today and tomorrow.

71%
of all new STEM jobs are in computing

8%
of STEM grads are in computer science

67%
of computing jobs are outside the tech sector

500,000+
unfilled computer jobs across the nation

Source: http://bit.ly/code_org_stats

EXPANDING THE PLAYING FIELD

Girls, youth of color, young people living in poverty are a few of the populations that require out of classroom time coding opportunities. Many of these young people only have access to technology when visiting a public or school library. Even when these youth have technology access at home, the quality and capacity of that access is frequently limited with a young person having to share a smartphone or tablet with other family members and data plans limited to a minimum number of megabytes per month.

Libraries are the ideal location for these youth to gain the coding experience they need. Staff in libraries provide access to the tools and

access to mentors and experts to guide in using those tools. Libraries have the space required for coding experimentation and staff can help all youth to evaluate their learning in order to understand what took place and take the next steps to build skills. Throughout the country libraries are in locations not always served by other organizations outside of school. From southeast Seattle to the Ak Chin Tribal Community Library in Arizona, library staff are connecting with disadvantaged youth to support learning coding skills that lead to computational thinking achievement.

To ensure libraries continue this critical work, decision makers need to expand their understanding of what libraries provide to communities. The library is an institution committed to guaranteeing the economic and cultural success of all those they serve. As a result they are well attuned to the youth coding needs of these communities and are ready partners for meeting these needs.

LEARNING THROUGH DOING

In public and school libraries youth participate in hands-on learning and connect that learning to the activities that fuel their personal passions and interests and lay the groundwork for future career opportunities. Take Senait, now pursuing a CS degree at Harvard University. When she was 17, Senait propelled her interest in computers and coding into a library program for young girls. She saw that in her community not enough girls were taking advantage of opportunities to gain technology expertise in school. So, she approached her public library and asked them if she could start a Girls Just Want to Compute club. The library gave Senait the support she needed to develop the club, teach girls in her community technology skills, and train other teens so they could lead the club when Senait left for college. That's only part of the story. Senait also gained confidence in herself and skills that go way beyond knowing how to use computers and coding. The library gave Senait the chance to become a leader in her community and to gain a set of valuable life skills that set the course for her success in college and beyond.

Senait is just one example of a young person having opportunity to pursue personal interests and build on formal learning experiences through the school or public library. In order to continue and increase these types of experiences, library staff require opportunities to gain skills necessary for supporting young people like Senait. This staff education must come from graduate schools of library science, information schools and professional development experiences for both pre-service and in-service library staff. These educational institutions in turn require funding and research and development to make curricular changes a reality.

LEARNING THROUGHOUT THE DAY

While some K-12 institutions provide computer science instruction as a part of the classroom experience, there are still many that do not. This is when the school and public library are an essential launch pad for youth to begin learning coding skills. In the locations in which computer science is a part of the school day, libraries are the place youth can go to broaden their classroom learning while at the same time tie that learning to personal passions and interests. The knowledge and skills that are a part of computational thinking are required beyond a 9 to 5 environment. By giving youth the chance to continue their learning outside of the classroom, they are able to scaffold the learning across experiences. This leads to a growth in competence and confidence.

CS + X

Computer science is not a field only for those planning to work in technology specific businesses and professions. All fields from advertising to construction and from theatre to environmental science have a place for the knowledge and skill that comes from learning to code. CS + X, now an academic program at several institutions of higher education, lays out a framework for learning computer science within the construct of another field of study. It is this framework which libraries already employ when they provide youth with opportunities to learn to code as a part of learning what it takes to be a professional disc jockey. Or, when libraries offer fashion design programs that include opportunities to build websites and apps to display the fashions created. The librarian serves as a guide helping youth connect their interests to career paths they might not have otherwise envisioned by connecting the real world of coding to their personal interests.

To succeed in integrating computer science with personal interests, the library must engage with community agencies and partners. These community members have, for example, the knowledge and skill youth need to write, record and perform music or create fashion that can be worn by others. Through community relationships, librarians assist youth in finding their pathway to achieving goals in academics, careers, and life. It is within this synergistic environment, connecting youth to their real life passions and interests, in which communities will ultimately thrive.

Overall, when libraries across the United States champion the computational thinking learning needs of youth, communities will see young people who are ready to take on their futures, who have robust career options, and who guarantee the economic and social vitality of the cities, towns, and reservations in which they live.

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INTRODUCTION

When Sunny was in fourth grade she started attending her public library's coding programs. Sunny is an artist and wanted to learn HTML so that she could publish her work on the web and she also wanted to open an e-store. Library staff noticed that Sunny was a shy and introverted girl. While she was very interested in learning to code, she kept to herself and lacked overall confidence when among her peers or adults. Now in sixth grade Sunny has learned HTML and is still attending library coding programs. Not only that, she is a youth leader in the library's robot programs, helping other young people learn how to code and how to build robots. Sunny's lack of confidence is gone. She is a poised and self-assured girl. What happened? Through learning to code at the public library, Sunny had the opportunity to gain skills and be supported while learning about something she was personally interested in. She started to feel better about herself. Sunny's goal wasn't to learn more than HTML but through the library's programs she gained that knowledge and more.

Beginning in January 2016, the American Library Association's (ALA) Office for Information Technology Policy (OITP) (with funding from Google K-12 Education Outreach) launched the Libraries Ready to Code project. This project marked the beginning of an investigation into the current nature and scope of computer science (CS) activities in public and school libraries for youth starting at the earliest ages through high school. The project team included staff from OITP, the OITP Youth & Technology Fellow, a project researcher, and an advisory committee made up of library staff and educators from across the United States. (See the full list of core team and advisory committee members in Appendix C.)

It is a crucial time for this investigation. Librarians know they have a unique role to play in ensuring young people of all ages participate in creating communities that are economically and socially robust. This report investigates how libraries can build on and strengthen that role. As noted in the 2016 Aspen Institute report, "Libraries in the Exponential Age," "Library practices have traditionally been centered on the work of building and maintaining collections, and interactions with users and other institutions have been largely transactional although this is beginning to change. As the role of the library evolves beyond access and lending to providing a platform for learning, innovation and creativity, libraries need to think in dramatically different ways and develop new approaches to their work in line with this changing role."[1]

It is a role that directly supports and connects with what John Fallon, CEO of Pearson, articulated about the value of learning to code, "Not being able to express yourself is frustrating. Yet, if we don't encourage young people to grasp the basics of coding language, we are setting them up for that kind of frustration. And the world can't afford that - Code.org predicts that by 2020 there will be a shortfall of more than one million computer programmers in America alone. So I'm encouraged by any initiative that gives young people the skills they need to

[1] Garmer, Amy K. "The Aspen Institute - Libraries in the Exponential Age: Moving from the Edge of Innovation to the Center of Community." Accessed November 11, 2016. http://csreports.aspeninstitute.org/Dialogue-on-Public-Libraries/2015/library/details/98/Libraries-2015.

create, build, and be competitive in the 21st century workforce."[2]

Librarians in school and public libraries are essential community resources ensuring our youth are equipped with the skills and competencies required for full participation in today's and tomorrow's workforce. The University of Maryland released a report in 2015, "Re-Envisioning the MLS" that describes findings of a study on the value of and future directions for the Master of Library Science degree. That report notes, "Participants specifically mentioned the opportunities of focusing on youth learning and education … working with youth in schools... facilitating learning in libraries through making, STEAM (STREAM), coding, and a range of other activities. This not only promotes information organizations as essential to learning and education, but also enhances youth learning."[3]

At the launch of their work, the Libraries Ready to Code project team focused on an environmental scan of school and public library coding activities for youth of all ages. The first steps included a survey of libraries to learn what coding activities were already taking place. During this phase a literature review of articles and blog posts was also initiated. The team quickly realized there was a broader focus that required in-depth investigation moving beyond a review and analysis of currently available materials. The focus of this report, therefore, is on how libraries - school and public - facilitate learning and how that facilitation has an impact on activities related to critical thinking, problem-solving, collaboration, and computational thinking (CT).

The project team initially focused on the needs of youth of diverse backgrounds or living in low-income areas as well as youth in rural, small, and tribal communities. However, the team realized that guaranteeing all youth have access to quality coding activities through libraries is not just a matter of gender, ethnic or cultural background, or community size. Knowing the needs of a community and tailoring learning programs to those needs is at the heart of successful learning and successful libraries. This is not to say that underrepresented youth do not need significant attention. Our findings and recommendations highlight that in order to support all youth, libraries need to recognize and serve children and teens that are less likely to have technology access and access to extended learning opportunities (ELOs). This includes those living in poverty, rural and tribal youth, African American and Hispanic youth, and girls generally. The importance of recognizing this need is brought home in the Afterschool Alliance 2016 report, "Afterschool in Rural Communities" which states, "Nationally, opportunities for students to engage with technology in afterschool programs is not high, with just 3 in 10 parents reporting that their child's afterschool program offers technology and engineering learning opportunities. Parents living in rural communities are even less likely to report that their child's afterschool program

[2] "Leaders and Trend-setters All Agree on One Thing." Code.org. Accessed November 11, 2016. https://code.org/quotes.

[3] Bertot, John Carlo, Lindsay C. Sarin, and Johnna Percell. *Re-Envisioning the MLS: Findings, Issues, and Considerations.* Report. August 1, 2015. Accessed November 11, 2016. http://mls.umd.edu/wp-content/uploads/2015/08/ReEnvisioningFinalReport.pdf.

offers these activities. Only 21 percent of rural parents report that technology and engineering learning opportunities are offered, 9 percentage points below the national average."[4]

With original assumptions revised the research for this project took a slight turn and looked at how libraries build:

- Opportunities for exposure to coding.
- Experiences that augment what youth of all ages learn in the classroom.
- Experiences for youth who lack access to coding activities outside of the classroom.
- Youth passion for coding.
- Connected learning experiences. (See defnitions to the right to learn more.)
- Community connections that enable youth to learn from experts and practitioners.

As a result of this analysis, the findings and recommendations in this report focus more broadly on ensuring all libraries are "Ready to Code" so they have the resources, capacity, and inspiration to embrace and design coding activities that promote computational thinking among our nation's youth.

WHAT MAKES THE LIBRARY THE PLACE FOR COMPUTATIONAL THINKING

In the winter of 2016, the Joan Ganz Cooney Center published the report, "Opportunity for All: Technology and Learning in Lower Income Families." Central to this report is the finding that for many youth and families, limited access to technology creates barriers to young people's abilities to learn the skills needed in order to succeed in life after high school. Even if youth have internet access at home, that access is often limited by data plans a family can afford and/or

Definitions

Computer Science – Computer science is the study of computers and algorithmic processes, including principles, their hardware and software designs, applications, and impact on society. (Based on Computer Science Teachers Association definition.)

Computational Thinking – Computational thinking refers to an underlying set of skills foundational to computer science though also transferable to broader applications for college and career readiness. Mastery can be seen in the ability to ask and answer questions using procedural thinking; the ability to define, model, and solve complex and ill-defined problems; and the ability to create personal meaning by processing information and creating connections to transform data into understanding.

Connected Learning – Centers on the idea that for youth to have beneficial learning experiences, those experiences have to be tied to passions and interests, create possibilities to learn and work with others, and create potential to connect interest learning to future opportunities.

Informal Learning – Whereas formal learning is structured and teacher led, often in a classroom environment, informal learning takes place in unstructured environments and focuses on knowledge creation through hands-on and iterative activities that lead to understanding.

[4] *America After 3PM Special Report: Afterschool in Rural Communities.* Report. March 2016. Accessed November 12, 2016. http://www.afterschoolalliance.org/AA3PM/Afterschool_in_Rural_Communities.pdf.

> **"I was listening in on a conversation between my son, who is involved in the library's coding club at school, and his older sister. They were talking about movies or music or something like that and I realized my son was using computational thinking language. He made an 'if this then that' statement. Obviously, the school library's coding club is helping him gain critical thinking skills and coding skills that he is able to transfer into a variety of aspects of his life."**
>
> ***– Parent interview***

the devices used for that access. For example, a tween learning to code on a smartphone screen using a data plan where megabytes (MB) available in the current billing cycle may be used up at any moment, has much more limited opportunity to learn that content successfully than a tween who has a large screen to work from and a stable internet connection at any time of day or night.[5]

In communities around the United States, public and school libraries are the ideal community institution for filling in the gaps highlighted by the Cooney Center report. In a 2015 ALA survey of Chief Officers of State Library Agencies, 76% of the state library agency chief officers noted that they either have STEM efforts underway or are planning on implementing STEM efforts.[6] This demonstrates a commitment across the United States, by libraries, to provide the types of supports needed for youth to move forward in gaining skills related to computational thinking. In Wisconsin and Arizona efforts are underway to provide library staff with training and resources for hosting coding activities specifically as a way to address the computational thinking needs of youth in communities.[7]

Public libraries power digitally inclusive communities

98% offer free Wi-Fi

76% help people use e-government

90% offer tech training

73% help people apply for jobs

Source: Digital Inclusion Survey 2014-2015 • http://www.ala.org/research/digitalinclusion

The American Library Association's comments on the United States Department of Education's Every Child Succeeds Act regulation highlights the value school libraries bring to communities, "School libraries are a safe learning environment where all students have equal and equitable access to learning, support, and information for

[5] Rideout, Victoria, and Vikki S. Katz. *Opportunity for All? Technology and Learning in Lower-income Families.* Report. January 2016. Accessed November 11, 2016. http://www.joanganzcooneycenter.org/wp-content/uploads/2016/01/jgcc_opportunityforall.pdf.

[6] Rose, R.N. *Survey of Chief Officers of State Library Agencies, 2015.* Report. Accessed November 11, 2016. http://www.ala.org/research/sites/ala.org.research/files/content/coslafy15.pdf.

[7] "State Library Brings Computer Programming to Kids All across Arizona." Arizona Secretary of State. Accessed November 11, 2016. https://www.azsos.gov/about-office/media-center/press-releases/807. And WisCode Literati. Accessed November 11, 2016. http://www.wiscode.org/.

personal and educational purposes. As poverty rates across America remain high, our schools must serve as an "equalizer" to provide all students with equal and equitable access to the resources, support, and instruction necessary to succeed academically and become productive and engaged citizens in a democratic society."[8]

The 2014 ALA Digital Inclusion survey also points to the value libraries bring to the community through access to broadband technology and learning opportunities. With 98% of libraries providing WiFi access, public libraries have a central role to play in making sure that youth have access to the technology they need as a way to learn computational thinking skills and also overcome the opportunity gap. As the ALA report notes, "Libraries act as technologically enabled hubs where people – including librarians, partner organization staff, and community volunteers – offer services to the public. These services include both training on how to make use of new technologies, and assistance with their application to a range of learning, work, health, and government services contexts….This broad range of digital literacy training meets people 'where they are' and builds the skills needed to thrive in the Digital Age."[9] Digital literacy training is not the only focus of libraries when it comes to supporting the learning needs and interests of community members. The report goes on to say, "..many libraries offer various events to enhance social engagement in their communities. 59.8 percent of public libraries host social connection events for young people…."[10]

School and public libraries across the United States house computer labs specifically designed to support technology-based learning for community members. The Institute of Museum and Library Services (IMLS) helped to advance the use of library space for learning purposes through the Learning Labs initiative. Grant funding enabled 30 libraries and museums across the United States to build connected learning spaces for teens. This made it possible for these young people to gain a variety of technology and critical thinking, collaboration, and problem-solving skills. As the final report for the program noted, "For

[8] "American Library Association Every Student Succeeds Act Comments." Emily Sheketoff and Sylvia Norton to Meredith Miller, U.S. Department of Education. July 26, 2016. Accessed November 14, 2016. http://www.ala.org/aasl/sites/ala.org.aasl/files/content/aaslissues/esea/ALA%20-%20ESSA%20NPRM%20Letter%20%287-26-16%29%20FINAL.pdf.

[9] Bertot, John Carlo, Brian Real, Jean Lee, Abigail J. McDermott, and Paul T. Jaeger. *2014 Digital Inclusion Survey: Survey Findings & Results.* Report. October 1, 2015. Accessed November 11, 2016. http://digitalinclusion.umd.edu/sites/default/files/uploads/2014DigitalInclusionSurveyFinalRelease.pdf.

[10] Ibid.

many of the Learning Labs teams, the planning and design process was the impetus for creating new learning pathways that involve youth learning anytime, anywhere, and that transform entire communities into landscapes for learning."[11]

The library also acts as a community hub bringing together stakeholders, community members, elected officials, and local organizations to plan and implement programs and services that support the needs of youth and families. In the 2015 ALA survey of Chief Officers of State Library Agencies, state leaders reported that they are involved with a variety of agencies to support the needs of communities. These agencies include Departments of Education, Offices of Early Literacy and Early Childhood Education, and Offices of Economic Development.[12] These collaborations move local school and public library computational thinking strategies forward while at the same time act as models for local communities to pattern their own efforts after.

Throughout the United States, school and public libraries are often the only places where youth and families have no-fee and high-quality access to the resources required in order for young people to succeed. The access to technology, the staffing that supports learning, the space for collaboration, and the commitment of library staff to support youth learning means they are ideal environments to move computational thinking forward throughout communities.

WHAT ARE THE CHALLENGES?

While the school and public library is perfectly positioned to move youth coding initiatives forward, our research uncovered several challenges libraries can encounter. These speak to what is required to create environments for high-quality computational thinking activities for all youth. They also address the need for libraries to design learning experiences that enable all youth to gain comfort and confidence so that they succeed in life after high school.

SKILLS OF LIBRARY STAFF

> **"Findings from the project challenge us to not only increase coding opportunities for youth but to also use coding to influence the nature of youth learning facilitated by librarians through libraries."[13]**

In interviews and focus groups, library staff noted lack of their own knowledge and understanding of computational thinking which hindered their ability to fully engage in this area. Several library staff members participating in focus groups at the Public Library Association national conference in April of 2016 mentioned that they were trying to understand what skills these types of programs require in order

[11] *Learning Labs in Libraries and Museums: Transformative Spaces for Teens.* Report. October 2014. Accessed November 11, 2016. https://www.imls.gov/assets/1/AssetManager/LearningLabsReport.pdf.

[12] Rose, R.N. *Survey of Chief Officers of State Library Agencies, 2015.* Report. Accessed November 11, 2016. http://www.ala.org/research/sites/ala.org.research/files/content/coslafy15.pdf.

[13] Visser, Marijke. "Libraries Ready to Code: Charting the Course - " District Dispatch. October 24, 2016. Accessed November 11, 2016. http://www.districtdispatch.org/2016/10/libraries-ready-code-charting-course/.

to be successful. One focus group participant stated, "I'm trying to figure all of this out by myself." Figuring it out can range in meaning from learning how to code oneself to knowing how to facilitate this type of learning to being able to articulate to community members why computational thinking activities are important for libraries to invest in. (See sidebar to the right for an overview of skills required.)

Along with comfort in the overall framework and needs of CT activities, many library staff struggle with an ability to facilitate learning in new ways. Library staff find it challenging to jump from the expert role to the co-learner role. Leaving the expert role behind means not having all of the answers always at-hand and at the same time being willing to learn with youth. Staff interviewed often mentioned using a step-by-step approach to teaching coding which is at odds with many of the ideas of informal learning and CT skills development. Those librarians that mentioned lack of ongoing youth interest in coding related activities are frequently the same staff taking this traditional step-by-step approach to learning. On the other hand, those librarians that take a co-learning approach, looking at facilitation of coding as a chance to have a "co-adventure," with youth, show more long-term progress in their computational thinking activities. They achieve this by giving youth the chance to build skills that are foundational to life success. These skills include critical thinking, risk-taking, problem-solving, and the ability to articulate the why, what, and how of any project. All of which are key to quality computational thinking.

Kristen Rocha, the Manager of Early Childhood Education at The New York Public Library addressed the topic in this way, "We are completely re-doing early literacy training. We are working with an outside group to help us with this re-envisioning. The very first thing our contractors said is that the library is in a unique position as a community anchor and in that role we need to act as a facilitator. The Library should capitalize on that and learn with the youth and families to share the knowledge even if staff don't have all of the knowledge. This is a new approach to the work that we do."[14]

Successful CT Engagement Through Libraries Requires

Connected Learning – Designing CT learning opportunities that reflect youth's personal passions and interests; provide for mentorship between youth, peers, and adults; and allow for design and creation of products that demonstrate learning and interest.

Facilitating Learning – Guiding youth in CT activities through challenges, collaboration, trial and error, and reflection.

Outcomes Planning – Knowing what are the benefits of CT activities along with being able to articulate those to colleagues, administrators, stakeholders, community partners, policy makers, and elected officials.

Youth Voice – Providing youth the opportunity to have a say in the structure and focus of CT activities.

Design Thinking – Following a process that allows for designing CT products that solve a singular or community problem and that incorporates research, empathy, prototyping, testing, reflection, and iteration.

Community Engagement – Working with community partners to design and implement CT activities enables libraries to bring in experts that support youth's specific connected learning needs and interests and demonstrate the role the library has in supporting CT for and with youth.

[14] "Ready to Code Virtual Focus Group with Kristen Rocha." Online interview by author. July 28, 2016.

Taking on a co-learner role also requires that library staff become skilled and comfortable with a focus on youth interests rather than on what the library thinks is of interest to youth and/or what the library thinks youth need to learn. This supports the connected learning approach formulated by researchers at the University of California at Irvine. Through connected learning, youth are given opportunities to connect with others to learn from and with and use technology to support the learning and creation of materials related to that learning.[15] Within a library environment however, our research discovered that for many library staff when it comes to computational thinking activities the focus is less on what youth are interested in and more on what library staff have access to in terms of technology resources (for example Hour of Code and Scratch) or what library staff themselves are interested in or familiar with. More than one focus group participant stated something very similar to this, "What sparked my interest is that I took some basic coding when I got my MLS and I have a basic understanding of how important this is."

Within the context of self-driven library staff interest in coding is another missing piece to many of the coding activities libraries provide; the missing component of connecting to community partners and experts. One focus group participant stated "We'd like to be more deliberate about our programming rather than relying on volunteers." This shows there is a continued need for library staff to see the value in bringing in outside experts. The libraries that open up these programs to facilitation by others in the community, and realize the value of that, note that in these environments community members are more engaged with the library overall and that youth have expanded potential to lead and mentor peers, and connect with their own mentors and coaches.

[15] Connected Learning. Accessed November 11, 2016. http://connectedlearning.tv/.

Achieving Success: Library Staff Skills

"I wish there were more PD [professional development] workshops on the topic of hosting coding programs, on how to start from beginning to end. And I wish more library and information science classes in graduate school gave me the background I needed."

– Virtual focus group participant

Many library staff think, "I can't design and implement CT activities in my library because I don't know how to code." One of our interviewees spoke specifically to this when she said, "I don't see how this is not valuable. When we tell people what we are doing they say this is amazing and it sounds so hard. It's not hard at all…..You're going to use it in the near future everyone's going to use it."

In order to progress with library staff and help them to improve and update skills, it is imperative that iSchools with library science programs; graduate schools offering library information science degrees; state, regional, and national library associations; and state library agencies develop flexible and responsive professional learning experiences that reflect the current needs of pre-service and in-service library staff. This requires re-thinking the

curriculum of these programs and re-envisioning what applicants are best qualified and have the mindset needed to provide services required by youth in libraries today. The "Re-envisioning the MLS: Findings, Issues, Considerations" report states, "Neither a love of books nor a love of libraries is enough for the next generation of information professionals. As expressed strongly throughout the Re-Envisioning the MLS process, future information professionals need to thrive on change, embrace public service, seek challenges that require creative solutions, and be change agents…"[16]

This is not the first time that academic institutions, professional associations, and libraries have re-envisioned library staff skills. Library services have always evolved and now is the time for another evolution. It is an evolution that focuses on the current learning needs of youth and is an evolution that needs to happen rapidly as technology, and the ways youth interact with it, evolves rapidly. Youth need skills now to reflect the world that they currently live in and the one they will be a part of in the future.

The YX (Youth Experience) program (http://yx.umd.edu) at the University of Maryland iSchool lays a strong foundation for the work ahead. This certificate program, funded for three years by IMLS, focuses on creating a curriculum that provides practicing librarians with the academic and practical foundation they need to facilitate the type of library programs and services required in order to succeed in life after high school in the 21st century. While the program is not focused specifically on CT, the curriculum framework built around participatory design and design thinking, supports much of the mindset and capabilities library staff need in order to design and implement quality CT experiences with and for youth.

To support pre-service and in-service library staff all curricula need to focus on strategies for:

- Connected learning - including how to facilitate learning.
- Developing outcomes - with a focus on what youth gain as a result of library coding activities.
- Connecting with community - integrating the work of community members and organizations by developing strong and sustainable partnerships in order to achieve success.

Within each of these areas library staff must learn how to understand youth interests, be comfortable with trial and error, build in time for reflection, and use the traditional skills of a librarian in new ways that support expanded CT opportunities for youth.

SCHOOL AND PUBLIC LIBRARY CONTINUUM

> **"We are trying to build partnership so the community sees the public resource and the partnership between the school and public library as beneficial to youth and to the entire county."**
>
> ***– Virtual focus group participant***

Not all school systems provide youth with the possibility to gain coding skills during the school day. As a matter of fact, a majority of those interviewed noted that the school system in their community is not providing a strong level of support for learning coding and computational thinking. This is the moment for library staff to take the lead in this type of learning. The library should model for the school system the value of teaching coding and provide concrete examples of

[16] Bertot, John Carlo, Lindsay C. Sarin, and Johnna Percell. *Re-Envisioning the MLS: Findings, Issues, and Considerations.* Report. August 1, 2015. Accessed November 11, 2016. http://mls.umd.edu/wp-content/uploads/2015/08/ReEnvisioningFinalReport.pdf.

Tim is in fourth grade and throughout his elementary school years he has exhibited behavioral problems. Teachers frequently gave him "behavioral referrals." In other words the principal had to sit down and talk with him about his classroom attitude on a regular basis. However, nine weeks into the 2016 school year Tim's classroom and overall school conduct changed. What's different for Tim this year? His teacher is working with the school librarian to develop and implement coding activities that connect to student interests. Students are making games with Scratch and Tim is interested in that very thing. As a result he is learning how to code and he's becoming a better overall student and school citizen.

outcomes that support the K-12 Computer Science Standards,[17] Next Generation Science Standards,[18] and the Common Core State Standards.[19]

When coding is taught in schools, one of the important opportunities for bringing coding to library activities is the expanded and enhanced capability for the library to build on, augment, and further the learning that's happening in the classroom. As one focus group participant noted, "Lab time in school is limited - touch on it in the classroom and then spend more time in the school or public library." However, library staff often see their role as needing to focus on something completely different than what's being covered in the classroom. As one virtual focus group participant noted, "When planning check with the STEM teacher - you don't want to overlap/double-up on what is already being taught in the schools."

This was often reflected in our research via comments noting that youth tend to be "bored" when library activities are too much like school. A refrain heard many times in our focus groups and interviews was that library activities have to be "fun." The implication often being that learning is not fun and something reserved solely for a school classroom environment. There is an inability of many library staff to see that fun and learning go hand-in-hand. The focus on "fun" limits the library's ability to advocate for coding programs as leading to outcomes that support building of CT skills, and does not easily enable strong connections between in-school classroom-based and out-of-school learning.

The fun construct also limits the ability of library staff to implement the ideas of the CS + X framework. CS + X gives students the chance to integrate the study of computer science and humanities. An example of CS + X is the National Science Foundation funded project, "Coding for All: Interest-Driven Trajectories to Computational Fluency."[20] This project brings the Scratch programming application and hip-hop together and shows how fun, connected learning, and computational thinking intersect to support youth skills acquisition.

Library staff that are able to connect fun and informal learning together have the ability to:

- Build relationships with teachers and other school personnel.

[17] CSTA K-12 Computer Science Standards, Accessed November 20, 2016. https://csta.acm.org/Curriculum/sub/K12Standards.html.

[18] Next Generation Science Standards. Accessed November 11, 2016. http://www.nextgenscience.org/.

[19] Common Core State Standards Initiative. Accessed November 11, 2016. http://www.corestandards.org/.

[20] "PAA Partners with MIT Media Lab." PAA News. March 9, 2015. Accessed November 11, 2016. http://www.paalive.org/news/?p=191.

- Articulate the reasons that the work they do can and does support learning outcomes and as a result demonstrate value of the library to the community.
- Act as partners in curriculum development that spans learning in in-school and out-of-school environments.

Ultimately, when library staff are able to support a continuum of learning between in-school classroom-based learning and out-of-school time, youth and families benefit. The library and the community provide a swath of opportunities for gaining skills that can lead to lifelong success along with economic vitality within the community. Youth that have computational thinking skills have a much greater ability to have a positive impact on the strength of the community in which they live.

Achieving Success: The Classroom, School Library, Public Library Connection

In order to have a continuum of learning between the classroom, the school library, and the public library all of those involved need to connect with the work of one another and understand each other's knowledge and skills (for example what level of professional development do teachers receive in the area of coding and computational thinking[21]), goals, and challenges. The Research + Practice Collaboratory (R+P) exhibits how partnering across institutions is beneficial. As the R+P website notes, "Too frequently, educational research is conceived and designed in isolation from practice. We need more collaborative approaches that engage formal and informal educators, researchers, and students to jointly discuss and design opportunities for improving STEM education."[22]

While the R+P is focused on collaborations between academic researchers, school and/or out-of-school time personnel, the framework and process developed by the Collaboratory provides a model for school and public library staff to

[21] Menekse, Muhsin. "Computer Science Teacher Professional Development in the United States: A Review of Studies Published between 2004 and 2014." *Computer Science Education* 25, no. 4 (2015): 325-50. Accessed November 21, 2016. doi:10.1080/08993408.2015.1111645.

[22] Research + Practice Collaboratory. Accessed November 11, 2016. http://researchandpractice.org/.

Senait began attending Harvard University in the fall of 2016. During her last year of high school she realized her school offered limited CS classes and overall there weren't technology oriented activities for teens in her community. Not only that, Senait thought something needed to be offered that would help girls to connect with computers and technology. She took it upon herself to change that. What did she do? She went to her local public library and asked if she could start a computer club for girls. The library said, "Yes." Senait wrote a grant to purchase laptops, since newer devices weren't available. She learned as she went along teaching how she likes to learn and connecting her own interests to the teaching and learning experience. Now, even though Senait is away at college, the club continues. She trained other teen girls to lead the program. Senait's Girls Just Want to Compute club at the public library helped teens in her community, and benefits her in her college years. The skills Senait gained working with public library staff and administration, and with teens in the community, helped her gain the social emotional intelligence and the critical thinking, problem solving, and collaboration skills required to succeed in college and beyond.

build partnerships that embed youth CT learning across institutions. Inherent in this framework is the need to be intentional in this work. Staff across institutions need to:

- Formally set-up teams to work together on building CT activities across schools and public libraries.
- Identify what the needs are for youth related to CT.
- Build a project plan that specifically sets outcomes, deliverables, roles, timelines, and budget.
- Spend time in each others spaces and be a part of one another's learning environments so to understand the barriers and potential that exist.
- Involve students in designing CT learning experiences across institutions and in the community.
- Reflect individually and as a team on the needs of youth and the ways in which the work of the team supports those needs or requires re-envisioning to support those needs.
- Engage with the greater community to inform them of the work, challenges, and value of embedding the approach and CT itself into youth learning experiences.
- Seek funding as required.

The approach outlined above is not different than what already takes place in individual institutions - schools and public libraries. The public library may have project teams that use a similar process. Classroom teachers and school librarians no doubt have similar project teams that work on curriculum-oriented planning. However, in order to effectively support youth's CT needs across institutions, it is imperative to build joint teams that focus on the full continuum of in-school and out-of school time learning. It is only through this intentional cross-sector collaboration that public library, school library, classroom, and administrative staff across institutions can build relationships required to develop high-quality in-school and out-of-school learning that will support youth's CT needs in K-12 and beyond.

LIBRARY CAPACITY

Our research demonstrates that for libraries to support computational thinking activities in their communities a re-thinking of library policies, space, funding, staffing models, and technology integration is required. Repeatedly those interviewed for this project spoke to these as barriers to success.

1. Access to Technology

> **"Q: What's making this difficult?"**
> **A: Lack of equipment - we have only one laptop - we do have desktops but those are not useful for this program."**
>
> ***– Virtual Focus Group Participant***

Access to digital tools came up in a number of instances and in a number of ways. One focus group participant when talking about access stated, "WiFi is our biggest problem. Almost everyone has internet at home though a pocket does not. The library's networks are overburdened and the library does not have reliable WiFi in the building. We had to take over the public computers because of lack of WiFi and our WiFi is not robust enough overall." This sentiment was repeated by others we talked with and rang true for small and rural libraries as well as suburban and urban libraries. Connectivity issues become a concern in particular when using well-reviewed and popular block programming software such as Scratch or focusing on the activities that resources such as Hour of Code make available. This is particularly problematic as these types of tools and resources are most often noted by library staff

as their go-to for getting started with coding library activities. And, as a result, are sought out by library staff as they first plan and implement their own activities.

It is also common for library staff to note that local library IT staff are not supportive when it comes to the computational thinking activities of youth staff. These staff often set-up barriers - frequently unintentionally - that have an impact on collaboration and content creation. For example, policies related to how many people can sit at a computer at one time limits collaboration options. Similarly, policies focused on downloading software and saving files minimize the ways in which youth can work with coding software and save what they created for use at home or when they return to the library. Library administration, IT, and youth staff must collaborate in designing coding programs so that all youth have the chance to participate as needed in order to access high-quality ELOs.

Time limits on computers also setup another unintentional barrier particularly for those youth that do not have computer and/or internet access in the home. In libraries where there are maximum time limits for computer use each day, youth may use up those limits without finishing their coding work. As a result, youth that have access in the home can easily continue from outside of the library. However, those youth that only have access via the library have to wait for perhaps one or more days to continue their work. Similarly, youth that are using smartphones or tablets do not necessarily have the level of access needed to participate in coding activities outside of the library. As a result they can fall behind in skill development and even lose interest in the project and process.

2. Funding

When discussing what is required in order to succeed in supporting youth acquisition of coding skills, library staff note that funds for tools that support teaching of those skills are often lacking. Staff are interested in purchasing hardware and supplies such as Sphero robots, Cubelets, and LEGO Mindstorms, but frequently do not have access to the funds to do so. One notable component of this need for hardware is that the desire to purchase these tools is based on what others say about what works for computational thinking activities with and for youth. Or, what is considered "cool" to use at the moment.

Computational Thinking Unplugged

Many school and public libraries include analog learning experiences for youth along with technology-based activities. These "unplugged" activities focus on foundational concepts of coding such as algorithms, and syntax and open opportunities for facilitating learning without the need for specific technological tools. For example, youth learn about algorithms and debugging through writing and testing out a set of directions. Unplugged activities are a low-stakes entry point for library staff just learning how to integrate computational thinking activities. They lay important groundwork and, together with the technology enhanced activities, are a part of a full-range of coding experiences for youth.

Concentrating on the "stuff" of learning rather than learning outcomes is problematic. This focus shows that library staff are less likely to acknowledge the learning accomplished through these activities than the tools that are used in the learning. A more holistic approach that focuses on learning and outcomes is needed. When library staff are able to tie the use of the materials purchased to learning outcomes then access to funding sources will undoubtedly increase. This includes funding from a school system's or public library's own operational budget. The more capable library staff are in exhibiting the value of computational thinking activities within the context of learning and CT

skill development, the more able administrators will be to make budgeting for coding a priority and funders will be able to see the value of the monies they may supply.

Several staff interviewed for this project noted the friends of the library as a supportive funder of coding programs and a few interviewees mentioned local foundations, state library agencies, and local businesses (particularly those needing coders as a part of their workforce) as supportive in this area as well.

3. Staffing Models

> **"When hiring staff we look for learners. We look for someone who is comfortable taking on learning challenges for themself."**
>
> ***– Virtual focus group participant***

As library staff focus more on informal learning and specifically supporting youth acquisition of coding skills, it becomes necessary to consider library staffing models. For many public libraries the focus is on staffing a retail operation that requires librarian to be "on the desk" at regularly scheduled times. For school library staff the hours in the day are often filled with schedules that are fixed. As a result many youth staff in school and public libraries struggle with finding the time to:

- Learn about coding and effective models of coding programs.
- Develop the skills needed to provide strong computational thinking activities.
- Build relationships with community partners, stakeholders, and elected officials.
- Build relationships with youth and families.
- Develop, test, and revise curriculum.
- Seek out and connect to experts and volunteers.
- Become an active member of a coding-oriented community of practice.

Without a change in staffing models, library staff will continue to struggle to implement coding programs that support CT skill development and outcomes. In order to be effective in this area libraries need to:

- Test new models of staffing that support bringing in non-librarians to manage and implement activities.
- Re-think skills needed by library staff.
- Re-work the percentage of time library staff working on computational thinking activities are required to support a facility-based model of operation.

Ultimately, library staff need to be able to leave their buildings in order to embed themselves in the community and build relationships with community partners, stakeholders, elected officials, and youth and families.

Achieving Success: Library Capacity

No matter what libraries are trying to achieve, capacity is often the biggest stumbling block. Building capacity takes a range of resources including time, and time is often easy to fill in other ways, particularly when integrating a new way of thinking or a new set of services. In order to be effective in supporting youth learning in the area of CT, a library therefore needs to make a commitment to that activity. It needs to be a commitment throughout the library. All staff must understand and be able to articulate where the inherent value lies; ensuring that youth have the skills they need in order to succeed in life after high school.

To build library capacity to support youth CT activities, libraries must work with community partners, including schools, to understand the gaps in what youth currently have access to. All partners must understand how the library, in

partnership with other local stakeholders, can help fill in existing gaps. This will also allow library staff and community members to better understand the assets that they bring to the community and how those can be leveraged to support CT and youth.

CodeVA and CodeRVA are examples of the educational and community commitment required to build CT learning for youth. In Virginia educators heard employers saying "we can't find people to fill the jobs that we have." (Virtual focus group participant) That led the superintendents from five counties in the state, along with educators and business leaders, to join together to build a hybrid high school focused on CT and on providing teens with the chance to take part in internships that will give them what they need to succeed once they graduate. As stated on the CodeRVA website, "CodeRVA differs from 'traditional' high schools by providing each student with a career coach. Career coaches will assist in developing an individualized college and/or career pathway. Mentors from CodeRVA partners will share their experiences, insights, and provide students with perspectives from the workplace."[23]

As CodeRVA has an online component and requires students to have access to technology, telecommunications companies are supporting the program and increasing access for those students not otherwise able to connect at home or easily within the community. Similarly, the program plans to make sure that students know where free access is available, including public library access.[24]

It is these types of partnerships that need to be formed to provide public and school libraries with the opportunities required to build capacity related to CT. CodeRVA had champions in communities both in the private and public sector. It is not uncommon for library staff to feel uncomfortable seeking out champions from other sectors, however in order to progress and build an understanding of the value of the library in CT development, this is an essential need. Champions are found anywhere in a community and help build capacity in multiple ways. Library staff must think outside the traditional funder and partner box and look deep into the community to make connections to others that are working towards the same goals.

When building capacity and engaging with champions to build CT activities for youth, libraries must:

- **Localize:** While some aspects of supporting the CT needs of youth are the same from community to community, finding out what is needed specifically to achieve success in the local community gives library staff the chance to connect with champions in ways that will best use local resources and assets.
- **Think Big:** Often library staff think about traditional funders and supporters of library programs and services for youth. This is a time to think big picture and about a broad array of champions in the community.
- **Be Outcomes-Based:** Library staff building champions in order to expand capacity need to be clear on what skills activities support and be able to articulate the impact their work will have on youth and the community as a whole. Outcomes should be the driving force in decision making related to CT and capacity should be built around that decision-making.
- **Focus on Access:** Libraries are a cornerstone for providing access to those that do not have it. If an outcome is to

[23] CodeRVA. Accessed November 11, 2016. http://coderva.org/.

[24] "Ready to Code Interview with Lori Donovan." Online interview by author. September 21, 2016.

The Onondaga Free Public Library in Syracuse, New York and a nearby Middle School demonstrate the power of partnerships in coding activities for youth. The library staff in each location work together to develop activities that support youth's computational thinking needs. The librarians applied for grants together and hosted two well-received Geek Squad Academies with their corporate partner Best Buy. Because of the success of the first Geek Squad Academy (in the summer of 2015), the next year (summer 2016) librarians moved the event from the public library to the school in order to accommodate the large program sign-up.

make sure that youth who do not have access to out-of-school time CT activities do have that access, It is essential to work with champions who can help guarantee that that access and that outcome is achievable.

OPPORTUNITIES FOR MOVING FORWARD

> "We want to destroy the stereotype of who can code. Everyone can code. Doesn't matter their race, socio economic scale, age."
>
> *– Virtual focus group participant*

In communities around the nation it is imperative for all community members to work together to provide youth with the skills they need to succeed now and into the future. There are numerous ways that library staff, professional associations, stakeholders, and elected officials can turn this need into a reality. It is not expected that any one sector can accomplish all aspects of the work itself. But, individuals can take steps to move the work forward as can those working together in institutions.

It is essential to recognize that each community needs to customize and localize their approach to this work. Analyzing and reflecting on who key stakeholders in the community are and designing ways to connect with those stakeholders to explore computational thinking possibilities must occur in order to achieve success moving forward.

SCHOOL AND PUBLIC LIBRARY STAFF WORKING WITH YOUTH

- Seek out opportunities to gain skills to support young people's acquisition of CT skills.
- Work with community members to better understand the needs of all youth in the area of CT.
- Take on a leadership role in building support for and coalitions around development of youth CT skills.
- Advocate for the value of the library as a provider of CT activities for youth.
- Build existing or initiate new relationships with a variety of community members and CT experts to increase the development of CT skills among youth.
- Create opportunities for mentoring and coaching among peers and youth and adults.
- Know what the research says about youth and CT.
- Understand the policies that can have an impact on progressing in supporting youth CT skills.

SCHOOL AND PUBLIC LIBRARY ADMINISTRATORS AND DISTRICT LEADERSHIP

- Include youth library staff in the planning for and implementation of CT activities for youth.
- Support youth library staff acquisition of new skills so they can better support CT activities in the library.
- Work with youth library staff to build library capacity so to support the CT needs of youth, specifically those in underserved communities
- Build relationships with community members to increase opportunities for youth to gain CT skills.
- Support the value of working with community members as CT experts and mentors for youth.
- Review staffing models and patron policies as they relate to the CT activities needed for youth and revise in order to support the implementation of those activities.
- Seek out funding and budget for building staff knowledge and developing resources that support CT activities.
- Champion the library's role in supporting youth acquisition of CT skills.
- Actively support local, state, regional and federal initiatives focusing on CT skill-building.

STATE LIBRARY AGENCIES

> **"We think this is an opportunity for all our libraries so the state has to introduce it and also support it."**
>
> ***– Virtual focus group participant***

- Research the CT needs of youth in the state and develop a plan for supporting library staff acquisition of skills to support those needs.
- Recognize the need for libraries to re-envision capacity in order to support CT activity development and provide ways (funding, training, and program development) to move forward in this area.
- Develop alternatives for library staff to build communities of practice related to CT and youth.
- Highlight best practices within the state by publishing toolkits, articles, blog posts, etc.

- Leverage funding to support libraries in the development of CT activities for youth.
- Build partnerships within the state that can effectively support the CT activities of libraries.
- Build partnerships across state agencies that can effectively support the CT activities of libraries.
- Support the need for libraries to serve the digital equity needs of all youth through library policies, staffing, programming, and community engagement.
- Advocate for the library's role in supporting youth acquisition of CT skills.

STATE AND REGIONAL LIBRARY ASSOCIATIONS

- Provide professional development, to all levels of staff, that supports provision of CT activities for youth.
- Develop opportunities for library staff to build communities of practice related to CT and youth.
- Highlight best practices within the state by publishing toolkits, articles, blog posts, etc.
- Build partnerships within the state that can effectively advance the CT activities of libraries.
- Advocate for the library's role in supporting youth acquisition of CT skills.

LIBRARY AND INFORMATION SCHOOL/iSCHOOL FACULTY

- Publish research on the value of the library supporting CT acquisition.
- Actively support and implement research to practice partnerships that will help

library staff build skills and design successful programs.
- Develop curriculum that focuses on the needs of youth beyond traditional models and support the ideas of connected learning, participatory design and design thinking, and outcomes-based assessment.
- Take a critical look at the profile of students entering youth services fields and determine if that profile meets the needs of youth being served in public and school libraries in the current day.
- Advocate for the value of re-envisioning librarian education in order to better support the needs of today's youth.
- Support the professional development needs of library staff within the area of CT.

LOCAL/STATE/REGIONAL HIGHER EDUCATION INSTITUTIONS

- Develop relationships with library staff as a way to better understand the value and role of the library in the community.
- Create opportunities for faculty and students to offer their expertise in support of CT activities for youth.
- Build professional development for library staff to support their ability to facilitate CT activities.

- Work with library staff to develop curricula in the area of CT.
- Take part in coalitions and community activities that advances the ability of youth to develop CT skills.
- Champion the library's role in supporting youth acquisition of CT skills.

OUT OF SCHOOL TIME ORGANIZATIONS

- Work with library staff serving youth to research the CT needs of young people.
- Build coalitions to reach collective impact outcomes in the area of CT and youth.
- Include library staff in communities of practice and professional development as they relate to CT skills and youth.
- Offer expertise, when appropriate, to act as CT experts and mentors for youth.
- Champion the library's role in supporting youth acquisition of CT skills.

COMMUNITY MEMBERS

- Offer expertise to support the acquisition of youth CT skills.
- Champion the library's role in supporting youth acquisition of CT skills.

FUNDERS

- Learn about the role that libraries play in supporting the CT needs of youth.
- Develop and support funding options that lead to library staff capacity and program building so they provide quality CT experiences in the community.
- Support coalitions that bring community members together, including library staff, in order to better prepare youth for life after high school.
- Champion the library's role in supporting youth acquisition of CT skills.

BUSINESSES/CORPORATIONS

- Learn about the role that libraries play in supporting the CT needs of youth.
- Provide opportunities for employees at all levels to mentor and coach youth in their CT skill development.
- Develop and support funding options that result in library staff capacity and program building so they provide quality CT experiences in the community.
- Support coalitions that bring community members together, including library staff, in order to better prepare youth for life after high school.
- Champion the library's role in supporting youth acquisition of CT skills.

GOVERNMENT GROUPS

- Include libraries in reports, research, and funding opportunities related to computer science education.
- Learn about the role that libraries play in supporting the CT needs of youth.
- Support research that investigates the role that libraries play in supporting youth CT skill development.
- Support coalitions that bring community members together, including library staff, in order to better prepare youth for life after high school.
- Champion the library's role in supporting youth acquisition of CT skills.

ELECTED OFFICIALS AND POLICY MAKERS

- Include libraries in issue briefs, policies, and funding related to computer science education.
- Develop relationships with library staff to gain an understanding of their value and role in the area of CT skills acquisition.
- Consult with experts in the library field when developing policies, budgets, and issue briefs related to computer science education.
- Champion the library's role in supporting youth acquisition of CT skills.

ALA (INCLUDING YOUTH DIVISIONS AND THE OFFICE FOR INFORMATION TECHNOLOGY POLICY)

- Continue to support research on youth, technology, and CT.
- Promote collaboration among offices and divisions so to better support youth CT needs.
- Take advantage of funding options that expand library staff ability to work with youth on CT skills.
- Develop professional learning curricula so that library staff can better understand and value the need to support CT in their community.
- Work to build national coalitions and partnerships that will help to move CT in libraries forward.
- Advocate for the library's role in supporting youth acquisition of CT skills.

CONCLUSION

"We have a need for talented individuals to teach this stuff to the kids...."

– Virtual focus group participant

What will success look when the above barriers are overcome and opportunities are leveraged?

- Library staff will have the skills and knowledge required to move CT activities in their communities forward.
- Public and school libraries and public and school library staff will understand that CT is not the purview of one institution or one curriculum area, but that it is something that all members of a youth's learning community should be involved in.
- Communities will be fully engaged in CT activities through mentoring and coaching and teaching youth CT skills.
- School and public libraries will have increased fiscal, technological, and human capacity for implementation and design of CT activities.
- Through libraries, youth and families will have increased exposure and interest in CT activities.
- Through libraries, youth and their families will understand the value that CT can play in their lives.

Overall, when libraries across the United States support the computational thinking learning needs of youth, communities will see young people who are ready to take on their futures, who have strong career options, and who are able to support and improve the economic and social vitality of the cities, towns, and reservations in which they live.

APPENDICES

A - METHODOLOGY

The Libraries Ready to Code project team used the following methods of data collection:

- Public and school libraries were invited to participate in a survey focusing on the types of coding activities sponsored by libraries and the age group for which the activities were focused. 80 libraries participated in the survey and respondents worked in small, rural, tribal, urban, and suburban settings.
- A literature review providing an overview of how libraries are integrating coding into their initiatives and the philosophy behind the activities sponsored was conducted. (See appendix F.)
- Focus groups were conducted at the Public Library Association conference in Denver, CO in April 2016. 25 library staff members from a variety of public and school libraries and in a variety of positions including children's, teen, technology support, and administration participated in the focus groups.
- Virtual focus groups with 27 library staff in small, rural, tribal, urban, and suburban public libraries around the nation were conducted. All participants in the virtual focus groups participated in a pre-survey that provided details on how coding activities were being implemented in their libraries.
- Virtual interviews were also held with staff at the Arizona State Library and the Division of Libraries and Technology at the Wisconsin Department of Public Instruction.
- 50 school library staff submitted a survey about coding activities sponsored by their school library and a library administrator from Virginia was interviewed about the coding working taking place in her school system.
- Site visits and observations took place at four public libraries and one school library. Along with the observations staff and youth were interviewed at these sites.

Data gathered through these research activities was analyzed and synthesized into this report.

B - PROJECT PROPOSAL SUMMARY

Libraries Ready to Code: Increasing CS Opportunities for Young People
American Library Association Office for Information Technology Policy
February 2016

In January 2016, The American Library Association's Office for Information Technology Policy (OITP) began a yearlong project to better understand the extent that libraries are engaged in computer science (CS) related programs and activities for young people. *Libraries Ready to Code: Increasing CS Opportunities for Young People* will investigate current programs in libraries through a combination of an environmental scan, interviews and focus groups with librarians, and site visits to libraries in diverse communities. *Ready to Code* aims to:

- Increase library capacity to incorporate computer science related activities, such as coding, as a core service for young people with particular attention on libraries that serve underrepresented groups in computer science and related fields.

- Identify best practices to assist libraries in developing innovative and effective approaches to informal learning opportunities that promote computational thinking and other computer science skills among young people.

Overview

This project consists of two parts, which will 1) identify the current state and scope of CS-related activities in libraries and 2) provide the foundation for developing a scope and sequence approach for libraries to implement developmentally appropriate, innovative, and engaging programs in CS and computational thinking, building on the findings of part one. Particular attention will be paid to addressing challenges and opportunities for underrepresented groups in CS and related fields (e.g., Hispanic, Native American, African American, and girls). The project is supported by Google Inc.

Part 1: Establish a baseline and explore best practice

This part involves scanning current library services and activities that promote CS and computational thinking to include three distinct age ranges: early childhood, elementary level, and teen and young adult programs in public libraries and school libraries to identify best practices and gaps in CS programming. In addition to resources targeted to specific age groups, the scan will identify programs and resources geared toward underrepresented demographics in CS and related fields. The scan will include basic web searches and a literature review— including reviewing library websites, published studies and/or reports, and informal written or media-based materials.

The project team will identify a representative sample of libraries to conduct site visits (3-5 regions) to observe programming in action and engage local practitioners. Criteria for library site visits will include geographical location (i.e., rural, urban, and tribal; regional diversity across the U.S.) as well as diverse populations and age ranges served. The project team will also conduct several focus groups, at regional site visits as well as at conferences, and virtual interviews of library staff engaged in CS, coding, and related activities.

A researcher from the project team will compile the results of this work and develop an initial analysis with findings for further intervention and engagement to broaden the reach and scope of library programming.

Resources identified during the scan will be compiled and vetted for dissemination to the library field and others. Dissemination will be through The Connectory (http://theconnectory.org/), an online portal for STEM programs, and other avenues to maximize exposure to the identified resources. Participation in The Connectory will encourage the building of a peer network for librarians with other stakeholders which is an important contribution to building capacity for the library community to provide CS programs.

Part 2: Develop concept models and test assumptions

The comprehensive scan will serve as a foundation for a scope and sequence approach for libraries to implement developmentally appropriate, instructional programs in coding and computer science. An analysis of the interviews, site visits, and focus groups will be completed to provide additional insight into programs that work as well as where gaps in services need to be addressed.

This information will guide the development of an outline for best practice approaches to developing scalable programming for libraries generally and specifically for those that serve the targeted youth demographics. Additionally, information will be used to outline a foundation for concepts necessary to develop a scope and sequence approach to providing CS programming in libraries.

Project Findings

Dissemination of project findings and recommendations to the library community and non- library stakeholders (e.g., relevant associations, federal agencies, and policy groups) to support OITP's Youth & Technology program is a key component of the project. Project findings will inform the Youth & Technology policy portfolio and assist in identifying priorities for future efforts. Dissemination will occur at ALA and other library conferences but will also include non- library venues. It will include traditional outlets (e.g., blog posts and articles) as well as virtual opportunities such as webinars or virtual conferences.

C - PROJECT TEAM AND ADVISORY COMMITTEE MEMBERS

Libraries Ready to Code Core Team

- Project oversight, Dr. Alan Inouye, Director, OITP
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- Strategic oversight, Roger Rosen, Youth & Technology Senior Advisor, Rosen Publishing Group

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- Mara Cabrera, Teen Librarian, Santa Monica Public Library, Pico Branch, CA
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D - FOCUS GROUP/INTERVIEW PARTICIPANT COMPOSITION AND INTERVIEW PROTOCOLS

Focus Group/Interview Participant

The Libraries Ready to Code team spoke with librarians and library staff from the following types of libraries and institutions:

- Public library staff in urban, suburban, small, rural and tribal libraries
- Children's teen, adult, education, and technology staff working in public libraries
- School library staff in suburban school districts
- School library district administration
- Public library and school library staff that are and are not already implementing coding activities
- State library agency staff

Focus Group/Interview Protocols

The following provides an overview of the questions asked in face-to-face and virtual focus groups and interviews.

School Library Staff

1. What do you find most exciting in the area of supporting computational thinking activities in your school?
2. How are you integrating computational thinking/coding into the work you do in your school?
3. How are you working with the public library on these types of learning opportunities?
4. How are you working with others in the community on these types of learning opportunities?
5. What outcomes are you working towards as a part of these activities?
6. What challenges do you face in supporting these types of activities in your school and with the public library?
7. How are you tracking outcomes of the coding activities that you host?
8. What next steps would you like to take with your activities of this type?
9. What else do you think we should know about what makes your activities of this type successful?

Public Library Staff

The project team facilitated two levels of focus groups and interviews with public library staff. The first level was for those who had no or little experience with coding activities and the second was with those who had some experience. The following are the questions asked of those with no or limited experience in the area:

1. To get started, imagine you are giving a short overview of your activities for youth for a new library director, what would you tell him her about your program?
2. What have you heard about library coding activities/activities occurring in libraries?
3. What are the barriers to hosting library sponsored coding oriented activities?
4. What do you think sounds exciting about library coding activities?
5. What professional learning resources do you want to have available to help you get started with a coding program?
6. What would you like to find out from someone who is already doing coding activities about their work in this area and how to get started?

Questions for public library staff with coding activity experience:

1. What is an example of a successful coding activity that is/was sponsored by your library?
2. What were the factors that made that activity successful?
3. How do you learn about what youth need in the area of coding and computational thinking in your community?
4. How are you working with your local schools on these types of activities?
5. How are community members involved in activities of this type?
6. How do you talk about the goals you are trying to achieve through these activities with community members, colleagues, et al.?
7. What outcomes do you think youth gain as a result of this activity?
8. How are you tracking outcomes of the successful coding activities that you host?
9. What next steps would you like to take with your activities of this type?
10. What else do you think we should know about what makes your coding activity successful?

E - SITE VISIT LOCATIONS AND SITE VISIT PROTOCOL

Observations were held at four public libraries and one middle school library:

- Gaithersburg (MD) Public Library - Girls Just Want to Compute club

- Los Angeles (CA) Public Library, Exposition Park Branch - Scratch program
- Orlando (FL) Public Library, Edgewater Branch - Camp Savvy
- Scarborough (ME) Public Library - Robot and Minecraft Coding
- Silver Spring (MD) International Middle School - Multiple activities in small groups

The following is the protocol used during these visits adapted from the David P. Weikart Center Program for Youth Program Quality, "Youth Program Quality Assessment® and School Age Program Quality Assessment."

Environment

Item				Comments
Welcome	No youth are welcomed when they arrive	Some youth are welcomed when they arrive some are not	All youth are welcomed when they arrive	
Setup	The room is not setup at all when youth arrive	The room is being setup as youth arrive	The room is completely setup when youth arrive	
Setup	The room is not setup well for the activities that are going to take place	It is obvious that staff tried to setup the room in a way that would work for the activities, but it isn't conducive to the learning that needs to take place	The room is setup in a way that makes it easy for youth to actively engage in the activities for the day	
Start/End	The activity starts and ends late	The activity begins or ends 10 or more minutes late	The activity starts and ends on time	
Pacing	There is not enough time for participating youth to take part fully in all of the activities and have time to explore and practice	There is not enough time for participating youth to take part fully in some of the activities and have time to explore and practice	Participating youth have time to take part in all of the activities and explore the ideas presented fully	
Materials	There are not enough materials for <50% of the youth attending to take part in the activities fully	There are enough materials for at least 50% of youth attending to fully take part in the activities	There are enough materials for all youth to take part in all of the activities	
Thoughts:				

Staffing/Facilitation

Item				Comments
Staff/Mentor Support	There are not enough library staff, mentors, or experts available to support youth in their learning	There are a good number of staff, mentors, and experts available but they aren't able to support the youth as they need to be supported	Youth have the number and quality of support during the program that is needed	
Activity Explanations	None of the activities are explained clearly to participating youth	Some of the activities are explained clearly to participating youth	All of the activities are explained to participating youth	
Learning Outcome	Participating youth don't have a clear indication about what the goal of the activity is	Participating youth know the goal of the activity but it is not really tied to what's actually developed/ worked on	Participating youth know the goal and by the end of the activity it is clear how that goal developed and was achieved	
Meaningful Conversation	There are no opportunities for youth to converse with adults and/ or facilitators about what they are doing and learning	There are limited opportunities for youth to converse with adults and/ or facilitators about what they are doing and learning	The activity includes opportunities throughout - formal and informal - for youth to converse with adults and/ or facilitators about what they are doing and learning	
Opportunities for youth to get to know each other	There is no time provided during the activity in which youth can get to know each other - talking among youth is discouraged	There are informal opportunities for youth to get to know each other	There are structured opportunities for youth to get to know each other - ice-breakers, small group discussions, etc.	
Opportunities for youth to reflect on what they did during an activity	There are no opportunities to reflect on the activity	Staff engage some children in reflecting on what they did during the activity	Staff engage all children in intentional reflection on the activity	
Opportunities for youth to engage with materials	The activity gives youth no chance to engage with materials and ideas - activity involves only waiting, listening, watching, repeating	The activity provides time for guided practice - <50% of the session	>50% of the activity gives youth the chance to practice, test, refine, etc.	

Opportunities for Choice	Participating youth do not have any type of choice in content or process	Participating youth have concrete choices for content and process - specific choices are given	Participating youth have at least one opportunity for an open-ended choice in both content and process	

Thoughts:

Computational Thinking

Item				Comments
Skill Modeling	There is no modeling of skills by adults and/or program facilitators	Some youth have skills modeled by adults and/or facilitators - but not all youth have that opportunity	Skills are modeled for all participating youth by adults and/or facilitators	
Computational Thinking Concepts	There is no support or encouragement for youth to gain practice with Computational Thinking concepts that the activity relates to	Staff informally and infrequently encourage and support youth in practice and understanding Computational Thinking concepts associated to the activity	Staff intentionally and formally support youth understanding of the Computational Thinking concepts associated with the activity	
Computational Thinking Connections	Participating youth do not have opportunities to connect learning with personal experience or prior Computational Thinking knowledge	Participating youth have very limited opportunity - once during the session at most - to connect learning with personal experience or prior Computational Thinking knowledge	Frequently there is a chance for youth to connect what they are learning to Computational Thinking-based interests and/or prior knowledge	
Computational Thinking in a Broader Context	Participating youth do not have opportunities to connect learning to current Computational Thinking issues and events	Participating youth have very limited opportunity - once during the session at most - to connect learning to current Computational Thinking issues and events	Frequently youth have opportunity to connect learning to current Computational Thinking issues and events	

Computational Thinking Careers	Participating youth do not have opportunities to connect learning to Computational Thinking career opportunities	Participating youth have very limited opportunity - once during the session at most - to connect learning to Computational Thinking career opportunities	Frequently youth have opportunity to connect learning to Computational Thinking issues career opportunities	
Computational Thinking Interconnectedness	Participating youth do not have opportunities to consider connections in Computational Thinking concepts across disciplines	Participating youth have very limited opportunity - once during the session at most - to consider connections in Computational Thinking concepts across disciplines	Frequently youth have opportunity to consider connections in Computational Thinking concepts across disciplines	
Thoughts:				

F - LITERATURE REVIEW

Libraries and Coding for Children and Teens: Key Conclusions (Spring 2016)

Introduction

The ALA Office for Information Technology Policy's Program on Youth and Technology has spent several weeks collecting anecdotal data on library coding instruction programs and activities for children and teens. The proceeding analysis distills several key takeaways from the data program staff has collected thus far. Data comes from a basic web search for library coding activities, a scan of the official blogs of the ALA youth divisions, and a SurveyMonkey survey soliciting information about libraries and coding, which was pushed out to several ALA listservs.

Librarians should be confident in their preparedness to teach coding

Despite the acceleration of coding programs and activities in libraries in recent years, many librarians are still intimidated by the thought of integrating coding into a library program. These individuals cite their own lack of experience with coding and the programs that facilitate its instruction as the principal source of their intimidation. However, the fact is that librarians are well suited to coding instruction, whether or not they are proficient in coding languages themselves.

Reference is a bedrock skill of the library profession. Thus, if a librarian is stumped by a patron's question while leading a coding program or activity, that librarian should be confident in his or her skills to find the answer. By finding the answer, he or she not only boosts patron understanding of the concept at hand, but also the library's capacity to teach it. Jami Schwarzwalder of the Pierce County Library System in Tacoma, Washington speaks to this directly in an article on YALSABlog – one of the Young Adult Library Services Association's (YALSA) two official blogs – when she explains, "I was worried at the beginning that I wouldn't have the knowledge or skills the students would need,

but I've been learning along with them and having so much fun that when we don't know the answer I just help them learn how to find it, just as if it was any other reference question." (http://yalsa.ala.org/blog/2014/10/02/coding-in-your-library/) Thus, librarians should approach coding programs and activities as learning opportunities not just for their patrons, but also for themselves.

Furthermore, new tools have emerged in recent years that facilitate basic coding instruction. At Tufts University, a research group called DevTech has developed a hands-on programming language called CHERP. CHERP allows users to create programs by arranging simple icons on a digital screen or by manipulating wooden blocks and using a scanner to convert the arrangement of the blocks into a program. Similarly, the Media Lab at the Massachusetts Institute of Technology (MIT) has developed Scratch – another "drag-and-drop" program. Designed for children ages 8-16, Scratch allows users to create programs by joining digital blocks together to create strings of code. Scratch is already being integrated into library programming with success. In Michigan, the Flint Public Library offers a coding club twice-per-month, through which teens use Scratch to build basic coding skills; in Minnesota, the St. Paul Public Library holds weekly 2-hour Scratch animation workshops for children led by teen interns from the local science museum; and in the nation's capital, the Southeast branch of the D.C. Public Library held a contest last November challenging children to make a game, music video or animation using the Scratch program.

Additionally, from Montclair, New Jersey to Homer, Alaska, libraries are integrating Scratch into broader coding instruction programs by combining it with other coding tools available through free online platforms like code.org – which offers the "Hour of Code" program – and CS First. A broad range of libraries also now utilize equipment that demystifies the coding process by "blending the digital and physical worlds." (http://venturebeat.com/2015/01/10/the-tiny-ozobot-robot-can-teach-young-kids-programming/) For example, the Highland Public Library in Michigan has offered a coding program this year that uses Circuit Scribe, a roller ball pen that allows people to draw circuits instantly. Similarly, the Chestnutwold Elementary School Library in Pennsylvania offers a course on coding with Ozobots: robots that follow patterns on the digital or physical surfaces they roll over. Other such equipment now in use in libraries includes Sphero – a robotic ball gaming device that you control with a tilt, touch, or swing from your smartphone or tablet; the Finch Robot – a robot designed by Carnegie Mellon University that supports over a dozen programming languages and environments.

Some in the STEM and education communities feel that the use of simple "drag-and-drop" languages and tactile programming equipment in formal and informal education environments oversimplifies coding and thus detracts from the ability of learners to grasp complex programming concepts. However, these tools are gateways into –not substitutes for – the suite of tools that facilitate more advanced programming instruction. By embracing them, librarians can quell their own unease about teaching coding, as well as inculcate their students with a basic appreciation for computational thought.

Library coding activities/programs should focus on building skills for the future

In advocating for making computer science education universal, Weili Dai – President and co-founder of the Marvell Technology Group – recently called computer code "smart English," and "the language that facilitates our lives." (http://www.districtdispatch.org/2014/04/libraries-expanding-frontier-digital-technology/) Dai understands that the drive of coding instruction in early education needs to be greater than teaching children and teens a new skill; it must be to prepare children and teens to take the reins of leadership over a world that is continually growing "smarter" as a result of the ever

expanding frontier of digital technology. In devising programming and activities involving coding, librarians need to understand this as well.

In a recent post for YALSABlog, Linda Braun of Libraries and Educators Online (LEO) suggests that one of the keys to making coding instruction for children and teens in libraries about building skills and competencies for the 21st century is focusing such instruction on design thinking. She exhorts librarians: "Instead of focusing on learning to code as the end all and be all of the experience, work with teens on a project that embraces the ideas of design thinking. [Participants] can then go through the design thinking process of researching the problem, talking with others about the problem, brainstorming solutions, prototyping solutions, testing solutions, and so on." (http://yalsa.ala.org/blog/2016/01/28/my-problem-with-hour-of-code/) ALA's program on Youth and Technology echoes this exhortation. At the 2016 ALA Midwinter Meeting in Boston, program staff held a workshop to develop a library-centric definition of computational thinking. ALA believes that by coming to a working understanding of computational thinking, librarians can build programming that primes children for lifelong engagement with STEM topics.

To date, coding programs that have taken this sort of design/computational thinking approach have been successful. In Tennessee, the Clarksville-Montgomery County Public Library offers a Game Design club and a Junior Coding club. These two groups – the game design club (for ages 10-18, and the Junior coders club (for ages 5-9) – meet every Saturday at the library for workshops that instill game design skills. Bridget Cloud, the founder of these groups, explains that these groups build practical skills, as well as self-assurance: "By learning to create games, children learn to think logically. They learn communication skills by working in teams, as this is how games are developed. And they learn confidence by creating something they can be proud of." (http://clarksvillenow.com/local/free-computer-coding-classes-for-children-teens-at-the-library/)

In Illinois, the Zion-Benton Public Library holds Story Time for Teens, a recurring program that uses Scratch programming to teach computer game creation to tweens and teens. Instructors teach the basics of Scratch software, as well as how to how to design a game. Participants plan out their game and then use Scratch to bring their designs to life. This grounds them in the logical and sequential thinking skills that are in-demand in the modern economy. Librarians still considering establishing coding programs and activities should follow the lead of Clarksville-Montgomery and Zion-Benton and encourage the systematic design and creation of outputs creators can take pride in. These sorts of programs build critical skills and encourage continued cultivation of those skills.

Library coding programs/activities should reach out to communities underrepresented in STEM Currently, the proportion of women in the STEM fields is well below that of men at all degree levels. Furthermore, since 2000, the proportion of underrepresented minorities in engineering and the physical sciences has remained flat, and the proportion of these cohorts in mathematics and statistics has diminished. Coding skills are a building block for a career in STEM. Thus, a concerted effort must be made to bring more women and underrepresented minorities into the STEM fields, and coding instruction must be at the heart of this effort. Libraries are well positioned to lead the effort to build interest in STEM among women and minorities through coding instruction. A number of libraries are already engaged in this effort. Washington, D.C.'s Martin Luther King, Jr. library recently hosted Black Girls Code D.C. – a half-day event that included talks by African American women in the STEM fields across the public and private sectors; various branches of the Public Library of Cincinnati held coding workshops for girls between the ages of 11 and 14 as part of its summer "Maker and Technology" programs; and recently, the Willingboro Public Library invited the non-profit organization Techgirlz – a

non-profit organization dedicated to closing the gender gap in technology – to host coding workshops for middle school-aged girls.

Libraries everywhere should follow the example of these institutions and build similar coding activities and programs. Additionally, libraries should leverage their existing coding instruction for girls and minorities to create initiatives with a broader footprint. For example, ALA or some other national library entity might consider drawing upon existing library relationships with Girls Who Code, Black Girls Code, TechGirlz and similar organizations to create a national-level initiative.

Conclusion

The analysis offered in this document is intended to be a jumping off point for an ALA-led, robust exploration, taxonomy and assessment of library coding activities and programs for young people. In the coming months, the ALA Program on Youth and Technology will conduct research, consult with technology and education experts and speak directly to children's and teen librarians and library administrators. ALA hopes that that this work will enhance the quality of library services to children and teens across the American library community.

G - COMPUTER SCIENCE RESOURCES FOR GETTING STARTED

As a part of the Libraries Ready to Code project, a list of resources, compiled by Kristen Batch (OITP Senior Research Associate) to help library staff implement coding programs in their communities was developed. These resources are provided as a jumping off point. Library staff should plan on customizing lesson plans and step-by-step guides to meet the needs of their particular community. You can access the list at http://bit.ly/cs_resources_rtc. (Please note this list is current as of November 15, 2016.)

A set of videos to help library staff get started with coding is currently in production. These videos will be available in the spring of 2017. A Libraries Ready to Code advocacy video for library staff to use when meeting with decision makers is available at www.districtdispatch.org/2016/12/new-libraries-ready-to-code-video/.

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ABOUT THE AUTHORS

Linda W. Braun works with youth serving educational institutions to help them design the best learning experiences possible for youth and families. She is a past president of the Young Adult Library Services Association (YALSA) and a columnist for VOYA and American Libraries and the co-author of "The Future of Library Services for and With Teens: A Call to Action."

Marijke Visser knows every kid has a spark and is most excited when the spark starts to take shape. She thinks libraries are the place to help kids make their interests come alive and through her work as director of OITP's Youth & Technology portfolio and associate director, she focuses on making that happen for all youth, regardless of their background.

ABOUT OITP

The Office for Information Technology Policy advocates for public policy that supports and encourages the efforts of libraries to ensure access to electronic information resources as a means of upholding the public's right to a free and open information society.