Libraries as Emerging Spaces for Computer-Supported Collaborative Learning in Schools and Communities

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Abstract: Libraries are undergoing a reconceptualization in their roles as lifelong learning centers for local communities, with STEM content areas and Maker activities receiving special emphasis. This represents a critical and unique research, design, and partnership opportunity for learning scientists and computer-supported collaborative learning scholars. This symposium brings together project teams from four different locales in the United States that have partnered with libraries to bring about new resources and activities that emphasize computer-supported collaborative learning. These projects represent major urban libraries, special collections, community branch libraries, and school libraries. By bringing together these different teams, this symposium aims to promote dialogue about the affordances and constraints associated with CSCL-oriented activity design in libraries, identify commonalities and differences across region and library types, and ground-truth what specific challenges and solutions have been identified in researcher-library partnerships.

Introduction

A national push has been made for libraries to reconceptualize their role as centers for lifelong learning, with STEM content areas and Maker activities receiving special emphasis (Palfrey, 2015). In response, libraries are beginning to offer new programs, spaces, technologies, and activities that emphasize patron authorship, expression, and exploration. One prominent model of this has been *YouMedia* at the Harold Washington Library in Chicago (Barron, Gomez, Pinkard, & Martin, 2014), which served as a youth-oriented digital media and CSCL space where youth interests, technology-infused practices, and identities were actively explored and promoted. Such models have become aspirational examples that many other libraries now strive to emulate. The image of the library is transforming from a quiet repository of books to a noisy and active learning space.

This represents a critical and unique opportunity for learning scientists, educational technologists, and computer-supported collaborative learning scholars. Libraries have long been one of the most democratic institutions in American society; they provide access to information and space for anyone regardless of background, socioeconomic status, or prior experience. Those ideals are ones that communities would like to see maintained as libraries also take on the role of technologically-enhanced lifelong STEM learning centers. As mentioned above, some aspirational models exist, but learning scientists have long recognized that an aspiration is not enough. Partnerships, informed design processes, and critical reflection are also critical ingredients for enhancing the design of any learning space or experience. This awareness is deeply embedded into the history of the learning sciences and CSCL communities, who have pioneered design-based research as a means for simultaneously understanding and improving existing learning spaces.

In following with the 2017 CSCL conference theme of "Making a difference: Prioritizing equity and access in CSCL", this symposium brings together design-based research teams from four different regions of the

country who have all recognized that libraries are beginning to take on this new role and are welcoming new research and design-oriented partners to pave the way for new kinds STEM learning. Although the contributors to this symposium represent a set of geographically dispersed scholars pursuing different projects, we are all deeply committed to the idea that libraries should remain highly accessible and equity-promoting learning institutions. By coming together for this session, we hope to accomplish several goals. First, through describing our distinct projects, we seek to demonstrate how libraries represent important partners for new lines of computer-supported collaborative learning research. Stated simply, we intend to greatly increase the list of exemplary library-based computer-supported collaborative learning activities and experiences. Second, we seek to highlight commonalities and differences that exist when conducting design-based research with libraries through the juxtaposition of the different library-based projects. Libraries exist in many forms and in many locales, suggesting that there may be some common points of leverage along with specific situation-based considerations that library-based research-practice partnerships must consider. Our goal is to articulate unique affordances of libraries as CSCL spaces. Third, we intend to offer some ground-truth about what challenges exist for researchers and library personnel who embark on design partnerships. While we believe libraries offer clear affordances that differ from other researched learning spaces (such as schools, virtual environments, and museums), we also recognize that libraries have unique constraints such as personnel who may not be trained in STEM areas, limited contact time with patrons, and other existing obligations as a community center. These three goals are discussed by each set of presenters.

The symposium is organized such that the chair will first give some brief, introductory remarks about the emerging opportunity to conduct learning sciences work with libraries in the United States. Then each of four separate but related talks will describe a specific library partnership and design-based research project. Included in the talks will be explicit discussion of the three goals (illustrating the partnership potential for libraries as sites for CSCL, discussing commonalities and differences across library types and sites, and ground-truthing the specific challenges and workarounds in researcher-library partnerships). The types of libraries represented vary, with two talks focusing on large urban libraries in major metropolitan areas (Tzou, et al.) and one of those emphasizing the Special Collections Division of their library (Kahn & Hall), one talk focusing on various branch offices located in different neighborhoods of a large city (Kafai, et al.), and one talk focusing on middle school libraries (Phillips, et al.). To help synthesize across the talks and to help facilitate discussion, Brigid Barron of Stanford university will serve as a discussant and discussion moderator. Barron is especially suited to this task as her research with the Digital Youth Network (Barron, Gomez, Pinkard, & Martin, 2014) and in looking at learning across contexts (Barron, 2006)) provides her with a valuable complementary perspective to some of the issues that we discuss.

The four talks from the various research and design partnerships are detailed in the text below.

Family-centered social arrangements for Making in library contexts

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The Backpacks for Family Learning Partnership

Our project is a cultural psychological design-based research study (Bang, 2015; Bell, 2004) that involves a research-practice partnership between a large university, a large urban library system, an Indigenous youth organization, and a science center. In this project, we are exploring ways of engaging families from non-dominant communities in a STEAM workshop series focused on learning robotics and programming in the context of an arts/design project approach. We center robotics learning within the context of family histories and stories in an attempt to focus on families as "cultural, historical, and political actors" (Vossoughi et al., 2016).

The Backpacks project invites parents to take on new roles as learners with their children while they learn about programming, engineering design processes, and related science concepts. At the same time, family members are also invited to draw on their own areas of expertise—in traditional practices such as sewing or professional skills such as computer programming. Literature in the study of equity in education indicates the need to tightly interconnect learning that occurs across settings (homes, community settings, and schools) and that "learning is facilitated when the cultural, socio-economic, and historical contexts of learners are recognized, respected, and responded to" (Banks, et al, 2007, p. 25; Bell et al., 2012). The use of the storytelling frame for contextualizing the robotics development project was a deliberate design strategy to: tie into cultural practices around storytelling, connect to families' personal and cultural histories, and leverage the unique professional expertise of librarians (especially youth and children's librarians) in connecting people with stories. We leverage the significant reading and storytelling expertise of librarians while we support them to learn about STEM knowledge and practices.

Family-centered designs for consequential STEAM learning and identification

The overarching design effort is focused on creating a sequence of designed experiences—including robotics development and e-textiles projects—to support families in expansive STEAM learning across workshop events and settings. The project is currently exploring two major design strategies. *First, how can family workshops promote intergenerational STEAM learning?* We developed and enacted family-centered program multiple times in two locations—one community site facilitated by the library and an Indigenous cultural community site facilitated by their program facilitators. *Second, how can a robotics backpack materially support learning across settings between program sessions?* This is a 'material resourcing' design strategy to support family learning and identification between the formal program sessions. In the current workshops, families construct a robotic diorama that animates and communicates a family story of their choosing.

Unique affordances of Making in a library-centered context

Our analysis focused on: (a) *different social and material configurations of families* as they jointly accomplished their robotic dioramas—along with their interactions with facilitators, (b) *reflective practices of librarians* learning to facilitate these sessions. Data sources included ethnographic observations and video recordings of sessions, session engagement surveys, pre/post workshop family interviews, and pre/post workshop surveys were analyzed for this paper. Several findings highlight unique affordances of the library-centered context. *First*, the storytelling and art/design frames on robotics/STEAM learning opened up multiple, oftentimes parallel spaces for families to purposefully explore and play with devices and programming to achieve desired effects—and that family members can pursue their own interests and perceived areas of expertise within the project. It allowed for specialization and collective creation—for example, one child programming a "twinkle" into an LED, one child constructing a cloud, a parent using "fiber optic" plastic to combine all of these to make a "shooting star" effect in a night sky. To this end, librarians were able to leverage their formal grounding in storytelling and literacy practices to frame their teaching and family support in the design work—while learning about STEM, circuit design, programming, etc. *Second*, the reflective practice of librarians was coordinated with the pedagogical reflection practice of the researchers. This developed into a standing practice for librarians to author full session reflections that went far beyond the facilitator reflection sessions instituted by the project. This led to tighter coordination across the partnership and more rapid cycles of pedagogical improvement across sessions than previously documented.

Challenges for Making in a library-centered context

Expert librarians have deep expertise in supporting the culturally diverse public with their information requests, but they do not consider themselves to be teachers—and they are, in general, adverse to being positioned as such. This introduces a deep enactment tension in the project in that facilitators need to interpret and shape learning processes of families using pedagogical principles and practices—as expert teachers do. A second challenge relates to the strong structuring of public librarians (e.g., fixed schedules and responsibilities; union contract strictures) relative to the flexibility needed to schedule program experiences for youth from non-dominant communities. The tension can be managed, but it is an ongoing implementation tension that we discuss in our presentation.

Connected messages: Mentor support of youth agency in designing interactive community murals in local branches of public libraries

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As public libraries are expanding their mission beyond books and computer access to include youth programming and maker activities (Subramaniam, Ahn, Fleischmann, & Druin, 2012), they are facing additional challenges of serving the specific needs, interests, and community involvements in their local branches. Most library maker activities promote projects where youth work on individual designs while being in the library space. Few activities have been designed to leverage the existing network of multiple branch libraries to foster collaboration between makers. We present the design and implementation of *Connected Messages*, an interactive community mural at branches of The Free Library of Philadelphia, as an example of a computer-supported collaborative maker environment. We examined youth agency and mentor support in accessing, participating, and expressing their community ideas and concerns by asking the following questions: (1) What impacts youth participation in and expression of community themes at different library branches? And (2) How can mentors support youth voice, making, and technical learning in community-relevant designs?

The Connected Messages project

In the *Connected Messages* project we provided augmented community displays that were local to their branches but controllable via the Internet by others across the city. Each of the five participating library branches received a physical mural that was made out of a piece of foam core with a grid of copper tape (see Figure 1). This created a DIY circuit board, which allowed for the placement of 64 individual cardboard boxes. Each box had a transparent top decorated by youth with messages relevant to them and their community. The youth also assembled the circuit on the bottom of the box that, once placed on the grid, allowed others via a web interface to turn on or off a LED placed in the middle. These boxes that each youth made individually were used to create the larger interactive community mural (Figure 1). A total of 1,036 youth, between ages 6-19 years, participated in the project over a two-month time period, their daily participation fluctuating from three to thirty participants, in five Free Library locations in underserved neighborhoods across North and West Philadelphia. The mural activities were led by five Maker Mentors, a team that consisted of three men and two women, ages 21-31, with backgrounds as working artists and undergraduate students. Field notes and photographs served as primary means of documenting artifacts and interactions.

Figure 1. (1) Color pencils used for individual designs, (2) Single box prototype with LED light and decorative drawing, (3) Boxes mounted on the foam board, (4) Electric imp, copper tape connections, and LED matrix controller, and (5) Five boards connected to a mural with some LEDs turned on each board.

Findings and features of the library branch settings

We found that youth participation, access, themes, and completion of the community mural designs for *Connected Messages* project differed substantially at neighborhood branches and illustrated some of the challenges in implementing such collective projects across different locations of the public library, albeit located in the same city. For example, the theme at one branch was "City of Brotherly Love and Sisterly Affection." The themes of many boxes of these youth reflected daily conversations about crime, violence, and society that are prominent and near-daily events in their neighborhoods: "I wrote this PEACE sign and I wrote we all are brothers and sisters and I wrote it because so we can stop violence and shootings" as well as the importance of self-acceptance "LOVE yourself". This branch had 15-16 regular participants, ages 13-19, as part of an intervention program.

In contrast, at another branch in North Philadelphia, youth aged 7-15 participated in making the message boxes around themes of positive things in the community, and things that youth like to do during the summer in their neighborhood. The board was completed within one week and displayed prominently on the library main floor to generate curiosity and interest by the library community and staff and would be "something that they can be proud of and see and that will last." At a different branch the board was locked in a conference room and youth ages 6-16 were only able to populate it with message boxes when the mentor came around three times a week. Message themes focused on community, friends and family. With no repeat visits to this site, many message boxes ended up not being connected to the board.

In our presentation, we will discuss how working with different branches made salient how libraries within the same system differ in how they appropriate a project like *Connected Messages*. Local neighborhood features and how different branches manage access to resources for youth both represent important considerations for CSCL work even when a single library system has been established as an overarching project partner.

Data wrangling and family storytelling at the city public library

Jennifer Kahn and Rogers Hall, Vanderbilt University

We describe design-based research developed in partnership with the Special Collections Division of the City Public Library in Nashville. Special Collections' mission is to record a public history that is both inclusive and representative of the city's increasingly diverse demographics. They regularly bring youth into library spaces to engage in critical, transdisciplinary inquiry projects (i.e., spatial analysis and modeling of historical phenomena at multiple social scales). Our partnership with the Special Collections Division seeks to design and study innovative learning activities through which youth come to view themselves as participants and contributors to

the city's living public history. We report a cycle of design-based research in which youth build and tell "family data storylines" at the library. Youth curated personal family history while exploring public, large-scale socioeconomic datasets using online, data visualization tools. In our presentation, we report on how we investigated the ways in which integrating local and family history with aggregate data invited the telling of powerful stories about oneself and society, and how the library provided a unique space for transdisciplinary, computer-supported collaborative learning (CSCL).

Large-scale data sets in libraries

Large-scale datasets (LSDS), also known as "big data", comprise a sociotechnical phenomenon that has advanced the interdisciplinary fields of data science, analysis, and visualization (Busch, 2014). With the growth of open big data and digital tools, the cost of modeling with LSDS has decreased and consequently generated new practices for analyzing and tackling socioeconomic and scientific problems (Venturini, Jensen, & Latour, 2015). Our collaboration with the City Public Library has been committed to creating opportunities for youth to develop and deepen relations to the city and relevant LSDS through storytelling, mapping, and modeling activities. The library was an important site because it serves as a place for family and community gathering. Libraries are also amenable to a "pop up" model, making many aspects of programs designed in one library replicable to other libraries and public community spaces.

Our project approached modeling as storytelling about society (Becker, 2007), drawing on critical social theories of pedagogy (Friere, 1970) that view narrative as a medium for amplifying voices and leveraging the lived experiences of historically marginalized and underrepresented communities (Milner & Howard, 2013; Solórzano & Yosso, 2001). The library and Special Collections staff had been an important partnership because it similarly shared commitments to strengthening and providing public outlets for community voices—and, in particular, the voices of historically underrepresented community members. This made for an opportune partnership.

Design and data collection activities

Our design study asked: *How does scaling personal experiences into aggregate data facilitate learning to critically model and tell stories about oneself and society?* Our focus on the relationship between local, personal experiences, and aggregate trends draws from an earlier design study iteration (Kahn & Hall, 2016) that found that *getting personal* with the data in modeling activity—shifting across scales of time, space, and social life in discourse and model animation—facilitates critical perspectives towards the social, economic, and historical issues described by the big data.

Figure 2. Two teens using SocialExplorer to lead their parents in exploring US Census Data at the City Library.

In order to learn more about how getting personal could foster critical inquiry and youth learning to model and tell stories about society with big data, our design study of experimental teaching at the library explicitly framed the activity around a relation between the individual and the aggregate. This past summer, we asked (N=17) diverse middle and high school youth (ages 10–16, with six sibling pairs) in a free workshop (2–4 days, 5 hours each day) at the City Public Library over 3 weeks to assemble *family data storylines* to explore reasons for migration nationally and globally (i.e., "What moves families?") and personally (i.e., "What moved *my* family?"). Participants used one of two online, public modeling tools: Gapminder.org, a free, web-based dynamic data visualization tool that uses public global socioeconomic data, or SocialExplorer.com, a historical thematic mapping tool that accesses US demographic (US Census) data, authorized by the public library (Figure 2). Participants assembled their family data storylines in Microsoft PowerPoint, which were then displayed in a community exhibit to their families. We video and audio recorded all workshop activities; all student work on computers was recorded with screen capture software. Participants also contributed oral histories about their family mobility histories or *geobiographies* to the library's archives.

Current analysis and findings

Interaction analyses (Jordan & Henderson, 1995) of video records and field notes indicate that participants viewed data tools as useful for discovery. Participants performed a range of comparisons that involved scaling time, space, and social life. To do this, they engaged with *data wrangling*, practices that manage multiple datasets and measures in order to align the family story with the aggregate data. The broad accessibility of the library space for extended family members became an important resource for youth learning. As youth began to develop family data storylines, they negotiated co-telling with siblings, many of whom were in the workshop, and parents—via phone calls, parent visits during the workshop day, and at-home conversations over intervening nights and days. We also have found that scaling personal stories to the social aggregate is richly complex. While telling their personal family histories, the teens' contrasted their experiences with that of their parents or grandparents; however, that distance appears to collapse as the teens, their siblings, and their older family members become a singular unit for comparison with the social history described by the data. Ongoing analysis further examines how modeling with census data affects one's understanding of the family and how the teens' accounts of their family history and broader social history compare to those of their parents when youth and parents jointly gather at the library.

Librarians in transition: Investigating CSCL potentials within the school library

Abigail Phillips, Victor R. Lee, Jennifer Hansen, and Mimi Recker, Utah State University

Of the nearly 120,000 libraries in the United States, the vast majority of them (over 98,000) are school libraries (American Library Association, 2015). As with other types of libraries discussed in this symposium, school libraries are reconceptualizing what kinds of learning activities should take place (e.g., Preddy, 2013), including an emphasis on leveraging them as environments for open-ended STEM learning activities (Subramaniam, Ahn, Fleischmann, & Druin, 2012). Yet we know little about how school libraries will also be able to evolve into spaces that support computer-supported collaborative learning. In contrast to other forms of brick-and-mortar libraries (e.g., public community libraries, academic libraries), those housed in schools focus exclusively on providing services and resources for youth at their immediate site. That specificity provides a unique opportunity for focused programming and learning experiences that cater to a common age group and align with ongoing classroom-based instruction. At the same time, school librarians work in uniquely challenging environments because they typically have at most a single staff person managing all operations and are bound by a rigid class schedule that necessarily limits contact time between the librarian and any visiting youth. Furthermore, a tension exists between the role of librarian as facilitator of student-led learning activities and the librarian as another adult instructor employed by the school.

Studying and supporting school librarians with Making

With an overall goal of fostering library-based computer-supported collaborative learning activities associated with Making (Bequette et al, 2013)., we have embarked on a multi-year research-practice partnership (Coburn et al. 2013) that seeks to understand and engage with the challenges faced by library professionals when they experience an organizational push to support new forms of Maker-oriented learning in their spaces. Because school libraries are an understudied facet of a complex formal educational system, our first task has been to understand the problems of practice faced by librarians and jointly envision new opportunities and practices toward improvement. We report on analyses of written observation and audiorecorded interview data from all the middle school librarians working in a single rural school district (N=4, district population approximately 16,000).

Themes and tensions related to school libraries as spaces for Making

From examination and qualitative coding of our data, we have identified the following themes and tensions as they relate to envisioning libraries as CSCL learning environments:

- *Tension 1: Where tool expertise resides with respect to a school library*. We observed that some librarians viewed one aspect of their job as providing a space for youth who already patronize their library and know much more about new technologies and new software environments than they do. These librarians find this advanced knowledge to be an enabler of youth-driven collaborative learning. Their expectation is for the youth to teach each other when new activities or resources are added. If existing youth experts were not already accessible, then the librarians would charge student aides to become advanced novices so that new technologies could still be used and appropriated by youth. As conceived, one librarian saw her primary job as publicizing the availability of new tools or software and then letting the youth shape how interaction norms will take place. On the other hand, some librarians felt they must

be accountable for knowing how any new tool works and did not want to introduce activities that use these tools until they themselves are adequately proficient. New technologies that appeared complicated or required significant overhead, even though they may be a rich enabler of computer-supported collaborative learning, were less preferred or otherwise faced resistance.

- *Tension 2: How the school library overlaps with what takes place in classrooms.* In one interview activity, the librarians assessed the feasibility and imagined use of new Maker technologies by youth in their spaces. A few librarians recognized some technologies (e.g., the Sphero programmable robot-ball) as being ones that other faculty and staff (e.g., computing education teacher) at their school already owned. This raised concerns about how to avoid imposing on others' "territory". In some cases, the librarians envisioned partnerships with those subject matter teachers such that structured learning activities would take place in the classroom under the instructional plans of that teacher and then extended within the library. Additional duplicates of materials and learning resources would then reside at the school library. Youth would come in during lunch and afterschool to teach one another and 'mess around' (Ito, et al., 2010) beyond what their classroom teachers allowed. In other cases, while some novel activities involving overlapping technologies could be imagined, the librarians expressed concern that they did not want to offend other school employees and preferred not to have such resources or activities in the library so as to not be perceived as usurping what instructional innovations another teacher was introducing.
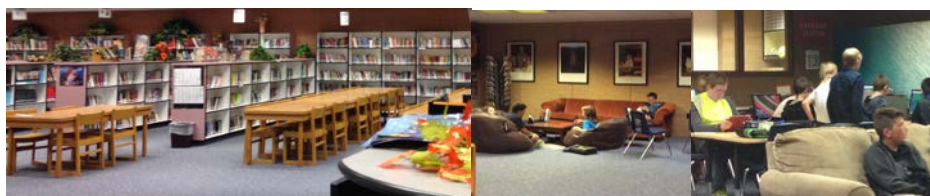

Figure 3. Some school libraries have opted to maintain orderly arrangements (left) while others are encouraging smaller gathering spaces (center) and encouraging gaming and recreational device and computer use (right).

- *Tension 3: How students should behave in the library.* Libraries are traditionally conceived as quiet spaces with books. We observed some spaces that were designed to be orderly and open (Figure 3), with ample long tables and seats within clear view of the librarian to ensure that youth were quiet and refrained from disrupting the experiences of other youth patrons. Other librarians seemed to design their libraries as a sort of "third place" for youth (Oldenburg, 1999). This involved having smaller enclaves, comfy couches, and providing access to secluded rooms so friends could gather, put their feet up, use mobile devices, and "game". One librarian of this disposition explicitly stated that in her view, her school library should be "a noisy place".

These tensions represent just a sampling of how school librarians organize the spaces that they occupy and how they envision learning activities for the future. Given that school libraries are expected to transform themselves as learning spaces and follow the lead of innovative public library CSCL media spaces, these tensions begin to establish regions in the design space for school libraries. We posit that school librarians that already expect that they will host distributed youth expertise, collaborations with teachers, and some inherent disorder will have the easiest transition. However, that remains to be understood and clarified as our partnership with school libraries continues to develop and moves into iterative implementation phases in the future.

References

American Library Association. (2015). Number of libraries in the United States. Retrieved from http://www.ala.org/tools/libfactsheets/alalibraryfactsheet01.

Bang, M., Faber, L., Gurneau, J., Marin, A., & Soto, C. (2015). Community-Based Design Research: Learning Across Generations and Strategic Transformations of Institutional Relations Toward Axiological Innovations. *Mind, Culture, and Activity*. doi:10.1080/10749039.2015.1087572

Banks, J. A., Au, K. H., Ball, A. F., Bell, P., Gordon, E. W., Gutierrez, K., Heath, S. B., Lee, C. D., Lee, Y., Mahiri, J., Nasir, N. S., Valdes, G. & Zhou, M. (2007). *Learning in and out of school in diverse environments: Life-Long, Life-Wide, Life-Deep*. Seattle, WA: UW Center for Multicultural Education & The LIFE Center.

Barron, B. (2006). Interest and Self-Sustained Learning as Catalysts of Development: A Learning Ecology Perspective. *Human Development, 49*(4), 193-224.

Barron, B., Gomez, K., Pinkard, N., & Martin, C. K. (2014). *The digital youth network: Cultivating digital media citizenship in urban communities*. MIT Press.

Becker, H. S. (2007). *Telling about society*. University of Chicago Press.

Bequette, M., Brah, L., Fields, D. A., Halverson, E., Kafai, Y., Litts, B., Owens, T., Peppler, K., Santo, R., & Sheridan, K. (2013, June). The MAKE movement and connections to the CSCL community. Panel at the 10th International Conference of Computer Supported Collaborative Learning (CSCL 2013). Madison, WI.

Bell, P. (2004). On the theoretical breadth of design-based research in education. *Educational Psychologist*, *39*(4), 243-253.

Bell, P., Tzou, C., Bricker, L. A., & Baines, A. D. (2012). Learning in diversities of structures of social practice: Accounting for how, why and where people learn science. *Human Development*, *55*(5-6), 269-284. doi:10.1159/000345315

Busch, L. (2014). A dozen ways to get lost in translation: Inherent challenges in large-scale data sets. *International Journal of Communication*, *8*, 18.

Coburn, C.E., Penuel, W.R., & Geil, K.E. (2013). Research-practice partnerships: A strategy for leveraging research for educational improvement in school districts. William T. Grant Foundation, New York, NY. Retrieved from: http://learndbir.org/resources/Coburn-Penuel-Geil-2013.pdf

Friere, P. (1970). *Pedagogy of the oppressed*. NY: Continuum Publishers.

Itō, M. (Ed.). (20.10). *Hanging out, messing around, and geeking out: kids living and learning with new media*. Cambridge, Mass: MIT Press.

Jordan, B., & Henderson, A. (1995). Interaction analysis: Foundations and practice. *The Journal of the Learning Sciences*, *4*(1), 39-103.

Kahn, J., & Hall, R. (2016, April). Getting personal with big data: Stories with multivariable models about global health and wealth . Paper presented at the American Education Research Association 2016 Annual Meeting, Washington D.C.. Available in the AERA Online Paper Repository.

Milner IV, H. R., & Howard, T. C. (2013). Counter-narrative as method: race, policy and research for teacher education. *Race, Ethnicity, and Education*, *16*(4), 536-561.

Oldenburg, R. (1999). *The great good place: Cafes, coffee shops, bookstores, bars, hair salons, and other hangouts at the heart of a community*. New York, NY: Marlowe & Company.

Palfrey, J. (2015). *BiblioTech: Why libraries matter more than ever in the age of Google*. Basic Books.

Preddy, L. (2013). *School library makerspaces*. Santa Barbara, CA: Libraries Unlimited.

Solórzano, D. G., & Yosso, T. J. (2002). Critical race methodology: Counter-storytelling as an analytical framework for education research. *Qualitative Inquiry*, *8*(1), 23-44.

Subramaniam, M. M., Ahn, J., Fleischmann, K. R., & Druin, A. (2012). Reimagining the role of school libraries in STEM education: Creating hybrid spaces for exploration. *The Library Quarterly, 82*(2), *161-182.* https://doi.org/10.1086/664578

Venturini, T., Jensen, P., & Latour, B. (2015). Fill in the gap. A new alliance for social and natural sciences. *Journal of Artificial Societies and Social Simulation*, *18*(2), 11.

Vossoughi, S., Hooper, P. K., & Escudé, M. (2016). Making Through the Lens of Culture and Power: Toward Transformative Visions for Educational Equity. *Harvard Educational Review*, *86*(2), 206-232.

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