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Learning through making in public libraries: theories, practices, and tensions

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ABSTRACT

This article investigates learning and teaching in library makerspace programs. Given the recent trend for libraries and makerspaces to define themselves in terms of learning, the findings of this article are particularly relevant to current initiatives. The article first reviews pedagogical theories which are referenced in literature connected with makerspaces. Second, the article analyzes interview and observational data from a system-wide public library makerspace program. The analysis compares the pedagogical theories with the realities of teaching and learning in public library makerspaces and indicates tensions emerging from these comparisons. The conclusion highlights ways librarians in makerspaces might consider the affordances of these spaces and ways goals, facilitation strategies, and assessments might draw on a range of pedagogical theories. Rather than approaching makerspaces with a ‘one-size-fits’ all model, librarians can design makerspace learning and teaching to align with a range of structures, styles, and content.

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The maker movement has taken root in public libraries with the provision of a variety of new maker-orientated spaces and programs such as digital design studios, artists-in-residence workshops, and meet-spaces for groups with particular technological interests (see Bagley 2014; Burke 2014). The movement is often associated with ‘do-it-yourself’ approaches to areas such as robotics, woodworking, textiles, and electronics. Halverson and Sheridan (2014) argue that the movement also includes collaborative learning: ‘the *maker movement* refers to the growing number of people who are engaged in the creative production of artifacts in their daily lives and who find physical and digital forums to share their processes and products with others’ (496, original italics).

Librarians writing about makerspaces frequently align maker culture with the tenets of public libraries, emphasizing the learning and sharing aspects of making (see Willett 2016). For example, Batykefer (2013) argues, ‘The maker movement emphasizes peer-to-peer skill sharing, collaborative learning, and hands-on practice, ideas, and techniques that fit into the library’s focus on open education, lifelong learning, and information literacy’ (21). In professional literature written by librarians such as Batykefer, makerspaces in public libraries are framed, on the one hand, as a natural extension of libraries’ traditional role as a provider of educational resources; and, on the other hand, as a new iteration of library programs in which patrons are taught to produce materials rather than simply to consume them. In any case, the focus on collaborative, hands-on, exploratory learning in public library makerspaces raises questions about changes in the role of libraries in relation to the provision of learning opportunities and resources.

Numerous overviews outline a range of learning theories that underpin making activities (e.g., Halverson and Sheridan 2014; Martinez and Stager 2013; Vossoughi and Bevan 2014). According to the literature, particular pedagogical frameworks and practices need to be implemented for makerspaces to live up to their potential as spaces where participants are learning and sharing skills. However, while there are various learning theories evident in literature concerning the maker movement, it is unclear how staff in makerspaces are understanding and implementing these theories. This article first addresses the question: What theoretical frameworks are currently employed in literature about makerspaces to conceptualize and facilitate learning through making? Second, the article analyzes interviews with public librarians and observations of making in library settings. The article addresses two research questions in relation to these data: How do makerspace librarians conceptualize making and learning? What tensions emerge between theories and realities of makerspace learning and teaching? The aim of the article is to identify the implications of learning theories for facilitation in makerspaces, to compare these implications with the realities of public library programming, and to consider the affordances of libraries as resources for making and learning.

1. Literature review: theories of learning through making

Halverson and Sheridan (2014) identify ‘three components of the maker movement – *making* as a set of activities, *makerspaces* as communities of practice, and *makers* as identities’ (2014, 496). This section uses these three components as a framework for discussing the various learning theories referred to across the makerspace literature. In addition to demonstrating ways learning theories underpin the maker movement, this section discusses ways these same theories of have been applied in the field of library and information studies.

1.1. Making as a set of activities

Discussions concerning learning through making refer most prominently to constructivism and constructionism, often providing brief references to theorists such as Dewey, Piaget, Vygotsky, and Papert; with Papert celebrated as the ‘father of the maker movement’ (Martinez and Stager 2013, 17). With reference to these theories, particularly Papert’s (1980, 1993) work, authors contrast learning through making with learning as experienced in schools, which is associated with rote memorization and rigid teacher-led structures. As a student and colleague of Piaget, Papert built on constructivist theories which stressed the importance of learners being given opportunities to construct and reconstruct their knowledge. Papert took constructivist theories further, arguing that cognitive construction is most effective when learners physically construct or make ‘a meaningful product’ – coining the term ‘constructionism’ to refer to pedagogical strategies that rely on learning through making (1980).

Constructivism and meaning making are also at the core of Kuhlthau’s (2004) information search process (ISP), a key theory in the field of library and information studies. Arguing that libraries need to think more about ways individuals seek meaning from information rather than how they locate information, Kuhlthau developed a model to describe the processes individuals go through when faced with a question or problem they want to pursue. Papert and Kuhlthau’s theories focus on individual cognitive processes; however, a key component of makerspaces is their collaborative nature, thus there is a need to look to other theories to understand makerspace learning.

1.2. Makerspaces as communities of practice (CoP)

‘CoP’ is a widely used phrase in the library and information studies field. Work in libraries is aimed at developing learning communities in various contexts, facilitating collaboration and knowledge sharing, and strengthening the role of libraries and museums in communities. ‘CoP’ refers directly to theory developed by Lave and Wenger (1991) and to the social aspect of making and learning. By

studying knowledge sharing in apprenticeship situations, Lave and Wenger devised a theory to explain the development of practices (shared ways of doing things) which incorporate the fostering of relationships and identities in connection to the community. Lave and Wenger use the term ‘legitimate peripheral participation’ to describe ways learners join a community of practice on the periphery and gradually move toward the center of the community as they become more involved in the practices of that community.

Along similar lines, a body of recent research has investigated ‘participatory cultures’, studying ways learners with similar interests and goals come together to support each other and develop informal mentorships (Jenkins et al. 2006). As with CoP, in participatory cultures members feel there is a social connection within the shared practice, and they feel they are making a contribution to that practice. These social theories of learning provide counterpoints to theories based on psychological development and are often used to discuss different structures and motivations in informal learning settings such as makerspaces.

1.3. Makers as identities

Becoming a member of a community of practice overlaps with the third component, ‘makers as identities’. Within makerspace literature, authors sometimes refer to a ‘maker mindset’ when examining the connections between identity and cognition. Makers are described as ‘tinkerers’ who have a ‘playful mindset’ which is embodied in their tinkering activities (Gutwill, Hido, and Sindorf 2015; Petrich, Wilkinson, and Bevan 2013). Along similar lines, Kuhlthau’s (2004) model of the ISP emphasizes the importance of exploration and individual reflection. Incorporating an affective dimension in her model of individual learning, Kuhlthau’s argues that learners become more confident as they progress toward a learning goal, developing greater understanding along with more comfort in their exploration process.

Another term used in conjunction with makers as identities is ‘dispositions’. Project Zero, at Harvard Graduate School of Education, focuses on understanding thinking as more than cognitive ability or particular skills. Instead, intelligence is seen as something that can be learned and thinking as something that can be made visible. Directly addressing making, Project Zero’s Agency by Design project describes dispositions connected with making as ‘a way of being in the world – that is characterized by understanding oneself as a person of resourcefulness who can muster the wherewithal to change things through making’ (Agency by Design 2015, 4). Agency by Design identifies ‘maker empowerment’ as a range of dispositions that result from maker experiences, including a sensitivity to design and an inclination to build, tinker, and hack (Agency by Design 2015, 5).

1.4. Models for learning in makerspaces

There is a small body of literature aimed at practitioners which analyze learning and making and propose distinct learning models for makerspaces. The school-based uTEC Maker Model (Loertscher, Preddy, and Derry 2013) theorizes a progression that individual or groups of makers move through in the process of becoming entrepreneurs, inventors, or producers. Based on developmental learning theories, this model includes four progressive stages of development: using, tinkering, experimenting, and creating. Aligning with Agency by Design’s work, the uTEC Maker Model also suggests dispositions that characterize movement toward creative thinking (e.g., dispositions related to problem-solving, collaboration, and mentorship). The uTEC model has parallels in Kuhlthau’s (2004) ISP model which also describes learning in terms of individual development and progression across different learning dimensions. Although literature on making and learning does not refer to Kuhlthau’s work, the notion of ‘tinkering’ and ‘experimenting’ align with the exploration phase of Kuhlthau’s ISP, and the inclusion of dispositions aligns with Kuhlthau’s affective learning dimension. In contrast, rather than providing a developmental model with stages of progression,

Gutwill, Hido, and Sindorf (2015) identify four dimensions of learning: engagement, initiative and intentionality, social scaffolding, and development of understanding.

The various pedagogical models and theories outlined here suggest different possibilities for the development of library makerspaces in terms of content, structures, and styles of teaching and learning. Library makerspace programs have the potential to facilitate constructionist learning, CoP, and tinkering mindsets. This raises questions about teaching and learning in existing library makerspaces. How do learning theories align with making, makerspaces, and makers in public libraries? What models or theories of learning are being referred to by librarians? What are the implications of learning theories for facilitation and assessment in public library makerspaces? These questions are addressed through analyses of data from a system-wide public library makerspace program.

2. Methodology

This article discusses data which were collected as part of a project focusing on the development of Madison Public Library's maker-focused program, the Bubbler located in Madison, Wisconsin. Madison is a medium-sized city (population approximately 235,000) with a large state university and the following ethnic/racial mix: 79% white, 7% African-American, 7% Asian, and 7% Latino. Launched in 2013, the Bubbler offers programming for all ages at nine neighborhood libraries and various outreach locations in Madison and includes programmed events (e.g., workshops, themed evening parties, and drop-in sessions), an artist-in-residence program, gallery spaces, and programs for specific groups outside the library (e.g., schools, the Juvenile Detention Center). There are two dedicated Bubbler staff members (a manager and a media specialist), and 19 Bubbler representatives (two representatives in each library plus an additional teen services librarian). In terms of space, the largest library, located in the downtown area, has a dedicated Bubbler room and a media production laboratory, and it also houses portable equipment such as screen printing materials, a circuit block kit, animation studios, and iPads. The Bubbler was the brainchild of a teen services librarian and an artist/ library assistant, therefore, the programming has a strong focus on outreach services to teens and arts-based programs.

The research project includes a variety of qualitative data gathering techniques: informal observations and conversations, bi-weekly meetings with Bubbler representatives, and formal observations and interviews. Our overarching research questions are as follows: What does a system-wide approach to making look like? What does learning through making look like in library programs? This article draws on two data sets: 23 semi-structured interviews with three managers and all librarians and library assistants involved in the Bubbler program; and 35 observational fieldnotes from 'making' programs across nine library locations. For the purpose of this article, it is relevant to note that most interviewees had training in the field of library and information studies, rather than in education, with some exceptions. Our research team consisted of two senior researchers and one project assistant (respectively, Erica Halverson, Rebekah Willett, and Alexandra Lakind) who were all involved in data collection and analysis. For the interviews, we followed a semi-structured protocol constructed by our team of researchers. Interviews took place from February to May 2015, approximately 18 months after the Bubbler program was officially launched. The set of observational fieldnotes covers 35 different programs in an attempt to capture the range of making activities in the library system. We observed all Bubbler programs (repeated programs were only observed once) that ran in the summer of 2015, and in addition, we observed programs that included some form of 'making' such as knitting and Lego construction. To structure the observations, we took notes on various agreed upon categories such as room set up, duration of program, demographics of participants (noticeable age, gender, and ethnicity), instructional methods, and learning arrangements (such as how work is used and shared and how expertise is distributed). In addition, we wrote step-by-step descriptions as the program progressed, noting the actions and verbal interactions of the facilitators and participants when possible.

For the interviews, Project Assistant, Alexandra Lakind, and I started the analysis process by reading and rereading transcriptions. Each of us created one page of hand-written notes per interview in which we summarized responses and started to look for broad categories such as ‘who is involved in making’ and ‘what is making’. With these notes, we could read across the 23 interviews more easily; we then took further notes on repetitions, similarities and differences, and absences across the interviews (Ryan and Bernard 2003). After discussion of these notes, we formed a set of initial categories that had emerged from this process (e.g., ‘learning and teaching’, ‘community connections’, and ‘descriptions of programs’). We broke the categories down into subcategories in order to develop a preliminary list of codes. For example, ‘learning and teaching’ had subcategories of ‘what is being taught/learned’, ‘how is learning described’, and ‘how is teaching described’. Next, we coded a sample of transcripts separately, and then came together to compare, discuss, and revise the codes. After repeating this process until a consensus was reached on how codes were understood and applied, we coded transcripts individually, using NVivo to organize and code the data. The final analysis stage involved individual work of rereading data related to each code in order to identify themes running across codes in relation to particular research questions. For this article, I reread data coded ‘learning and teaching’ to consider ways librarians were discursively constructing pedagogy in relation to making.

The analysis of the fieldnotes focused on mapping the range of the programs we observed. Using Wardrip, Brahm, and Coupland’s (in press) framework which was developed in relation to the makerspace in the Pittsburgh Children’s Museum, we categorized each of the programs along five dimensions: activities, learners/participants, tools/materials, space, and facilitation. We then identified properties that characterize each dimension and mapped those properties on continua. For example, in terms of facilitation, we categorized each of the 35 program observations in relation to how much of the content was taught in a direct and formal way (using categories of light, medium, or heavy to describe the facilitation style), and whether or not the program resulted in a product, was focused more on the process, or included both product and process. For the ‘learners/participants’ dimension, we categorized the group of learners as primarily amateur, expert, or as constituting a range of expertise; as primarily young children, teens, adults, or as a range of ages; and as primarily seeking skills, dispositions, or both. This analysis helped us to identify diversity within each of the five dimensions.

3. Analysis

In the analysis which follows, I consider the three pedagogical frameworks addressed in the literature review above: constructionism, CoP, and the development of a maker mindset. I explore each of these three frameworks with reference to our interview data and observational fieldnotes.

3.1. Constructionism

The dominant framework librarians referred to in the interviews in terms of pedagogical theory aligns with constructionist ideas. The analysis of the interviews reveals the following repeated phrases and words to describe Bubbler activities: ‘learning by doing’, ‘exploratory’, ‘experiential’, ‘playful’, and ‘hands-on’. Several of the librarians qualified their descriptions of activities by emphasizing the learning component. For example, one interviewee said that Bubbler programs are about ‘having a fun experience with an embedded learning goal’.

We might expect ‘learning by doing’ discussions to connect with models of teaching that involve establishing exploratory environments, supplying materials to scaffold learning, and being prepared with prompts. However, when asked about *teaching*, the interviewees focused on formal styles of teaching and learning. In the interviews, all librarians discussed formal structures of teaching in relation to Bubbler programs such as ‘showing people the basics’, talking through processes, and modeling a skill. These teaching techniques are the antithesis of Papert’s (1980, 1993) model of learning in which participants learn through their own exploration of materials rather than having an instructor tell them how something works. Analysis indicates that interviewees described Bubbler programs as

constructionist in terms of learning, but more formal in terms of style of teaching. This speaks to the diversity of Bubbler programs in terms of audience and mode of program: some programs are for children others are for adults, some are exploratory and others have more formal instructional structures. In analyzing the range of programs we observed, we can consider the ‘facilitation’ dimension as an indicator of constructionism, with lightly facilitated programs and programs that focus on processes more likely to follow a constructionist approach. Of the 35 programs we observed, we categorized 17 as lightly facilitated and only 7 as heavily facilitated; and 14 as focused primarily on the process with another 13 focused on both process and product. This indicates that well over half Bubbler programs most likely have a constructionist component to them. While some programs have a central focus on constructionist styles of teaching and learning, others are very clearly taught through more formal instructional techniques with an ‘expert’ talking participants through processes. The following is an example of a program that we labeled light in facilitation with a focus on process. We can see this as primarily constructionist in approach, but it includes elements of a more didactic style of teaching and is used here to raise questions about constructionist teaching in action.

3.1.1. Observation of constructionist programming

‘Circuit Blocks’ was a one-off circuitry workshop which rotated to different neighborhood libraries. This program contained a mixture of informal learning (through exploration) and more formal types of teaching (direct teaching of concepts). Geared toward children ages 5–11, this hour-long workshop primarily consisted of participants experimenting with connecting wires to ‘circuit blocks’. Circuit blocks were components of circuits such as batteries, switches, light bulbs, buzzers, and small motors which were secured to wooden blocks (see [Image 1](#): Circuit blocks). There was one facilitator in these sessions (a guest who specializes in informal STEM education) as well as several adults (care givers and library staff). The session started with a 10-minute interactive instructional session which included a brief explanation of a basic circuit and things not to do when building a circuit in order to prevent light bulbs from burning out. During this introduction period, participants made a basic circuit with battery, light bulb and wires; and when everyone had done that, they were given a switch to include in their circuit along with an explanation of how switches work. Participants then were given

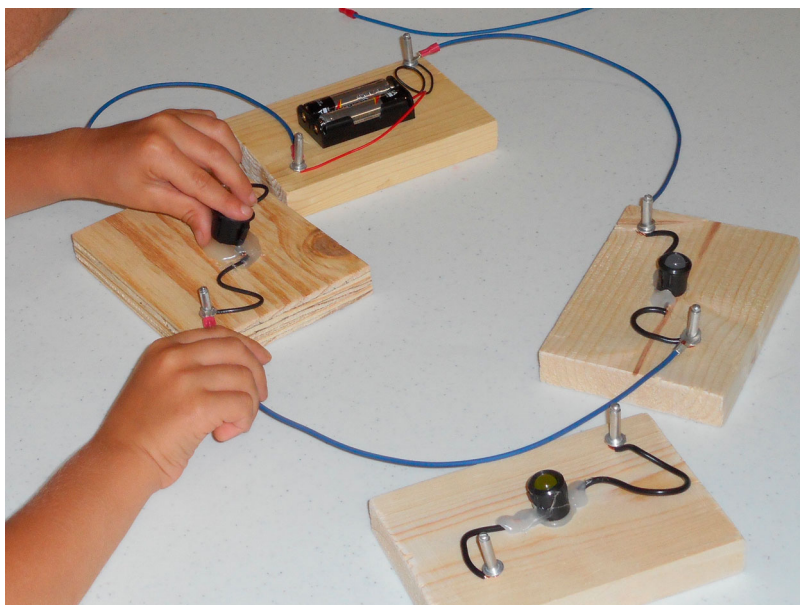


Image 1. Circuit blocks.

the remaining 50 minutes to experiment with making circuits out of the available materials. In our observations, we saw children creating complex parallel and series circuits with multiple components (buzzers, light bulbs, motors, and switches). We observed children doing trial and error by connecting different components through wires. Specific components of the circuit (buzzer, light bulb, or motor) provided some immediate feedback in relation to whether a circuit was complete or not; although there were many reasons a buzzer, light bulb, or motor might not be getting power from a battery. With adult facilitation (from care givers and the STEM facilitator), concepts such as amperage and conductivity were discussed. One of these discussions was sparked by a child commenting that a light went dimmer when he added a buzzer to the circuit. During the exploratory component of this circuit program, the participants asked the facilitator questions, and she provided technical explanations, often with diagrams, as a way of directly teaching about the topic.

As described in part one of this article, in constructionist theory, learning of concepts occurs through the processes of making and tinkering rather than through direct teaching. Martinez and Stager (2013) describe three processes involved in makerspace learning: making, tinkering, and engineering. The engineering process is when participants ‘extract principles from direct experience. It builds a bridge between intuition and formal aspects of science ...’ (32). This sets up a dichotomy between learning skills through formal teaching versus learning through experimentation. However, in practice, as documented in the Circuit Block program, making involves both formal and informal styles of teaching and learning to different degrees. The Circuit Block program involved a formal introduction as well as direct teaching of concepts as children asked questions and made observations. This indicates a mismatch between theory and practice when describing learning through making as entirely exploratory.

3.1.2. Making and social constructivism

A more accurate theory to describe makerspace learning might be social constructivism, a model of learning based on Vygotsky’s ideas which emphasizes the important role of a more advanced peer or teacher in assisting a learner’s development. Using Vygotsky’s (1962) terms, each child actively participates in learning within his or her ‘zone of proximal development’, that is, the distance between the real and potential levels of development. According to Vygotsky, as the child engages in his or her learning, and with assistance, modeling of actions, and pointing out of discrepancies, particularly through verbal interactions with a more advanced learner (peer or teacher), the child internalizes desired actions. Bruner (1987), whose work is based on Vygotsky, used the term ‘scaffolding’ to describe the interactions whereby structures are put in place to support the learner in mastering a task.

These theories seem a better fit for makerspace learning as observed in the Bubbler; however, the role of social interactions is sometimes ignored when makerspace design discussions focus on exploration of and tinkering with materials. While librarians might instinctively know the importance of social interaction and scaffolding in learning, drawing on discourse around making and learning, our interviewees did not articulate these ideas in relation to Bubbler programs. For librarians who are accustomed to facilitating learning in programs through social interactions and scaffolding, a focus on tinkering with tools can be disempowering. Librarians’ skills in facilitating learning might go unrecognized, and instead a need to acquire skills and knowledge connected with new technologies might feel more pressing. One question this raises is about skill sets: Should librarians/facilitators bring skills related to the tools and materials in the space, or should they bring skills related to teaching and learning? In constructionism, *skills for designing* making and tinkering experiences are vital; however, as described next, in a model based on CoP, expert *knowledge related to particular skills or content* is a crucial component of the learning community.

3.2. Communities of practice

As described in part one of this article, a CoP model takes account of the roles of experts in the community for sharing knowledge, establishing relationships, and defining and modeling identities

related to the community. Many Bubbler programs involved bringing in outside experts to share their skills (including 18 of the 35 programs we observed), and when discussing these expert-led maker programs, librarians' ideas align with a CoP model. For example, describing the role of Bubbler programs, one librarian we interviewed said, 'We are teaching people new skills and creating things and sharing. Not only information. But sharing the community space. And people get to meet other people in their neighborhood.' Another interviewee mentioned the role of outside experts was 'not just to promote themselves and what they care about', rather it was to 'connect with people in the community so that [Bubbler participants] know ... what kind of value they place on what they're doing and why they're there'. These two interviewees illustrate the focus on facilitating community connections as well as skill sharing. However, in these expert-led programs, even more extended artist-in-residence programs, we did not observe the development of a CoP in which there was sustained practice through which novices were working with experts and gradually taking on the identity of that community. In categorizing our observations, we only noted four programs in which we observed a range of experts and amateurs; the other 31 programs were primarily attended by amateurs with one expert facilitator. However, experts introduced participants to a CoP that were available outside of the library (various hobby groups, for example). This raises questions about the applicability of the CoP model within library spaces. The following example illustrates the affordance of libraries to foster CoP and is followed by a discussion of the limitations of Bubbler programs to develop CoP.

3.2.1. Knitting circle as a community of practice

We observed a weekly knitting program that involved making but was not labeled 'Bubbler', as it was a long-standing library program that did not involve bringing in outside experts. The 'Knitting Circle' had been running for over six years and perhaps longer (six years was the longest any of the members had participated). The group met weekly for 1.5 hours from 3.00 p.m. to 4.30 p.m. in a neighborhood library located near a middle school (children ages 11–14). The group was open to all ages, and materials were provided (yarn, needles, crochet hooks, gauges, markers, and so on), although most people brought their own projects and materials. The local school runs a knitting club on a different day, and the school referred knitters to the library Knitting Circle. In our observation, the group attracted a wide age range including children as young as five, mothers with infants, a nanny, a young woman who wanted to knit something for a friend's new baby, and two retired women. The day we observed (during schools' summer vacation), the group had two informal leaders (older women), and a librarian who primarily organized materials, reserved the space, and assisted children. One of the leaders had attended for six years and learned to knit through this circle, as had the librarian. Another leader was the recognized expert in the session we observed and had been attending for 1.5 years. The leaders said they attended this group for 'fellowship' and as part of their weekly routine, and also because they could walk to the library. They particularly like attending because of the informal nature of the group and contrasted this with other knitting clubs that had formal structures including dues and officers.

During our observation, a young woman came for the first time, and said she knew a little about knitting and had a pattern, yarn, and needles, but she wanted help getting started. One of the leaders talked through following a pattern, saying 'I take it one step at a time'; and as the young woman progressed over the time period, the leader showed her how to use a gauge and markers. Children frequently asked for advice and were given 'just-in-time' help by the three leaders who were distributed around the circle. Children's projects included simple finger-crocheting, a loom project someone had brought, and beginning needle knitting. One of the leaders explained to a child, 'The first time you come you're learning the basics, practicing. So next time you come you can start a project.' The leaders mentioned a girl aged 9 who had been coming for a year, and one leader said 'she now has an identity as a knitter'. At one point, the 9-year-old brought along a friend who had seen her knitting and asked her where she learned. Other knitters in the circle we observed worked on projects and occasionally asked the leaders for specific points of advice; and one caregiver asked about getting

her 4-year-old started on a project. The recognized ‘expert’ leader mentioned that a more expert person had attended for a few months while being unemployed and had taught her how to use four needles; however, the person got a job and was no longer able to attend, therefore, her four-needle project was stalled.

The Knitting Circle reflects various aspects of a CoP, particularly the element of ‘legitimate peripheral participation’ where experts are sharing their knowledge and processes, and apprentices are joining the activities on the periphery and gradually moving toward the center (as is the case with two of the leaders who learned to knit through this Circle). Further, the aspect of identity is clear in this community, with leaders seeing this as part of their weekly routine and some members taking on the identity of a knitter after spending time in this CoP.

3.2.2. Applicability of CoP model in public libraries

In our observations, most programs did not align as well with the CoP model as the Knitting Circle, particularly because there were few sustained communities focused on making. This was also reflected in the interviews with the librarians. More frequently the library programs were described as introductory and as a way of ‘sparking’ an interest. For example, this is one librarian’s description of some guest-led programs: ‘you get to learn something that we didn’t know before about how things happen’. This same librarian indicates the introductory nature of the programs:

whether or not they’re going to remember exactly how to make a stop motion movie with iMovie from one time to the next doesn’t really necessarily matter, the fact that they have had that experience gives them some building block of going forward to learn from the next experience in a little bit better way.

In terms of skill development, interviewees described Bubbler programs as a way to introduce participants to skills and concepts and to connect people to resources they might pursue after participating in Bubbler. This aligns with the description of Chicago Public Library’s Maker Lab as ‘an ‘on-ramp’ to making’ or an entry-point into arts communities and tech incubators in Chicago (Urban Libraries Council 2015, n.p.). This indicates a unique role for public libraries in terms of introducing patrons to existing CoP and draws on the basic tenet of public libraries as spaces for providing access to resources for learning.

3.3. Maker mindset

One of the dominant ideas from the interviews concerning what participants learn through Bubbler programs focused on dispositions or a ‘maker mindset’. Interviewees mentioned a range of dispositions: ‘seeing the world differently’, ‘seeing different ways of doing things’, ‘thinking about their own creativity’, feeling empowered, and feeling excitement about learning. Maker-focused programming was also seen as a way of providing a ‘gateway to further exploration’, in one librarians’ terms, and a way of encouraging lifelong learning. A further category of comments from the interview data set focused on participants learning about themselves as learners – interviewees said that Bubbler allowed people to reflect on their learning interests, styles, and preference, for example. Ideas about making as a way of developing certain dispositions focus on the individual as a learner and align with ideas about a ‘maker mindset’ and with work from Project Zero as described in the first part of this article.

This aspect of learning is difficult to observe and document as it develops over long periods’ time and is often an internal feeling rather than something that is readily displayed. To understand the affordances and limitations of documenting ‘maker mindset’, this section discusses two examples where this model of learning is evident. These examples are unusual in our data set, given the challenges of documenting changing dispositions. To collect systematic data on changing dispositions, we would need to do a longitudinal study on particular participants and/or have participants reflect on their dispositions. We did not follow individual participants as part of our data collection, partly because our interest was in mapping the variety of programming (which meant we rarely saw the same participants twice). On the whole, we did not intervene in programs in order to collect data

such as self-reflections, and very few programs included this component with the exception of teen programming described below.

The examples are used here to indicate possibilities and raise questions about applying a ‘maker mindset’ model in library spaces. The examples come from a Bubbler program for underserved teens, in which one of the key components is to provide experiences in which teens have a feeling of agency and empowerment. One project culminated in a photography exhibit at the public library and featured life-sized portraits of the teens (created by the teens) as well as ‘Artists Statements’ that were displayed through audio and printed text as part of the exhibit. Finesse,¹ an African-American teen, said in an interview with program facilitators:

‘Direct Message’ is literally a direct message to all the people with the misconception of us minorities and the stereotypical perceptions and how people portray us. There’s more to us ... And you know, people don’t really try to go in too deep into why we do this or why we do that. How we act. You know, why we act the way we act. Where we come from. People just go based off what they see when truly they really don’t know. And I just feel like ‘Direct Message’ is a way for us to have our voice be heard.

In this excerpt, Finesse expressed his sense of disempowerment as a minority teen, but also a sense of empowerment the Bubbler photography project gave him. The photography project allowed the library to document these contrasting viewpoints and also record teens’ dispositions that accompanied the creation of the portraits and the exhibition of the portraits in a prominent public space.

Another project aimed particularly at giving teens voice features music composition and recording sessions, described on the Teen Bubbler website as ‘Local musicians challenging Madison teens to express themselves in a positive manner through lyrics and music’ (Teen Bubbler, n.d.). In one recording session we observed, KD, a 12-year-old African-American girl recorded herself rapping for the first time. KD was staying with relatives in Madison over the summer and regularly brought her younger cousins to the library. She was invited to the music workshop by the teen services librarian, because the librarian had heard her doing an impromptu rap while waiting at the reference desk. KD had not recorded herself with a beat before, although she had taken part in poetry slams at school in her hometown of Chicago. During the session, the librarian helped KD choose a beat from a variety of recordings created by a Bubbler artist-in-residence; they recorded two raps, created a SoundCloud account and posted the raps, and emailed the recordings to KD’s mother in Chicago with the message ‘Your daughter is a rapper!’. One rap was about the importance of staying in school; in her words, the rap was ‘preparing kids for back to school, telling them what they need to be focused on’. KD directly addressed the narrative of high dropout rates for minority high schoolers. The second rap was about her home in Chicago, known as Chiraq, a reference to the high rates of violent deaths in Chicago (similar in statistics to deaths during the war in Iraq). The rap starts, ‘I’m from Chiraq, and it’s every day, I’m from the south side, out here we don’t play.’ At the end of the session, KD asked for paper and a pencil to take home in order to work on another rap. KD recorded three more raps in the Bubbler over the next week before returning to Chicago; and several months later, she returned to the area to visit family and recorded another rap which she posted on her SoundCloud account.

What does this example indicate in terms a ‘maker mindset’ or a change in KD’s disposition? KD’s lyrics indicate that she is exploring powerful narratives as she gives voice to her position as a young African-American woman living in the south side of Chicago. She is actively resisting the narrative of academic failure and giving voice to her different kinds of childhood, a childhood situated in a place known for its violent deaths and where children ‘don’t play’. Although KD came to the library with these raps in her head, the act of recording the rap with a beat and publishing these recordings online were new experiences. Through this, KD clearly saw herself in a new light, as indicated in her email to her mother with the news that her daughter was a rapper, expressing a desire to share her product with her mother and to identify herself as a musician. Further, KD continued to

create and post raps online, demonstrating her continuing interest in exploring narratives and expressing herself through this genre.

These examples show the potential for some making programs to address maker mindsets. KD's rapping experience indicates that she has the 'inclination and capacity to shape [her] world', as Agency *by* Design describes, although we might ask how much agency she genuinely has to 'shape her world' in the face of powerful and systemic structures that create inequalities experienced by African-American teens in the south side of Chicago (amongst other places). Arguments related to maker mindsets also view particular dispositions as key to successful making, and certainly KD's interest in rapping helped her to continue to write and record her raps. However, KD came to the Bubbler with these dispositions; Bubbler can be seen primarily as a facilitator rather than a place where KD learned the desire to tinker with words and music. We could argue that her sense of agency might have increased, and this created a greater interest in rapping; however, it is not clear that her desire to tinker changed. Further, in the examples from both Finesse and KD, it is imperative to critically analyze ways we are framing their making and learning. The promise of the maker movement to provide teens with agency or to become innovators ignore ways some teens are historically marginalized and ways cultural, political, and economic forces create situations whereby some making is valued more than others (Vossoughi, Hooper, and Escudé 2016).

4. Discussion and conclusion

Public libraries are increasingly defining themselves as learning institutions (Gross 2013), therefore questions of pedagogy in these settings need to be considered. Although Kuhlthau's ISP model is widely applied in various library settings and has overlaps with models of learning in makerspaces, the model is largely concerned with individual cognition in relation to making meaning when searching for information. As discussed in the literature review, pedagogical models and frameworks are in existence for school and museum makerspaces for children. However, learning in public libraries is an entirely different context than learning in school or museum makerspaces with potentially different purposes and audiences. These different makerspace contexts have affordances as well as constraints. For example, in schools, educators are able to develop curricula that are dependent on participants attending regularly to work on projects and develop skills, knowledge, and attitudes over time. Children's museums feature fairly homogeneous audiences (compared with public libraries) who are in the space for a limited amount of time, often with dedicated staff who design and sometimes lead learning experiences. Library makerspaces are less predictable in terms of attendance, and frequently feature a range of one-off, drop-in, and passive programs for all ages and different interests. Further, librarians have freedom to think about different models of learning that are not tied to formal educational structures, as in schools. Whereas schools are required to focus on pupil development, one of the affordances of libraries is that they are not tied to this specific goal. Identifying pedagogical models that align with the goals of public library programs can help structure the design of programs as well as to identify what counts as success.

The three pedagogical frameworks discussed in this article each align with a different set of goals and therefore different measures of success. Constructionist models emphasize a progression of individual skills, moving from tinkering with items through to creative production (e.g., Loertscher, Preddy, and Derry 2013). A CoP model is focused on facilitating knowledge sharing amongst novices and experts, as well as participants' identities as members of a particular community. A focus on particular dispositions involves the development of particular mindsets such as persistence, empowerment, and constant questioning. One starting point for considering which model is most relevant for a public library makerspace program is to consider the goals of the program and its participants. However, as with Bubbler, even within one library system, public library makerspaces and maker programming vary enormously and have different goals. One-off programs for children, such as Bubbler's Circuit Block program, might have a specific knowledge-centered goal (e.g., participants will learn about different components of a completed circuit); whereas a knitting circle might

have a longer term goal connected with the development of a community of knitters; or an artist-in-residency program might focus on connecting an artist to a community, encouraging novices to identify as beginner artists, and facilitating the sharing of expert knowledge.

These varying goals have implications for the role of the library, librarians, and facilitators; the designs of sessions; and ways making and learning is assessed. For example, for programs that align with constructionist principles, facilitators might focus primarily on the materials in the space, ways that materials allow for progression of skills; and assessment might focus on those moments when the participation in making leads to cognitive understanding of a particular concept. For programs aimed at developing CoP, librarians might consider access and membership issues: what libraries can do to facilitate access to a range of participants, ways for newcomers to enter, and ways for leadership roles to develop. This framework might also help librarians think about different kinds of maker communities that might be ignored in current discussions – knitters, for example. Further, a community of practice model might help librarians ask questions about how best to provide access and safe spaces for learning. Focusing on dispositions turns the purpose of the program toward longer term goals connected with changes in mindset. Librarians might ask in what ways maker programs encourage ‘a sensitivity to the designed dimension of objects and systems, along with the inclination and capacity to shape one’s world through building, tinkering, re/designing, or hacking’ (Agency by Design 2015, 5). For assessment, the challenge is to document these dispositions as they develop within public library spaces.

The data analyzed in this article indicate that different models of learning and teaching are being considered and implemented across a range of makerspace programs within the Bubbler. Rather than seeing library makerspaces as informal out-of-school spaces that sit in contrast to in-school spaces, we can see a range of learning and teaching styles and structures. Importantly, there is no ‘one-size-fits-all’ model of learning and making, even within a single system-wide program. One of the key affordances of public libraries as out-of-school spaces is flexibility: the purpose and materials can change depending on the people available as facilitators and participants; mobile maker programs can be devised in order to provide maker resources in underserved areas; ways of measuring success of a program can be tailored to participants and can address any number of program goals. Rather than emphasizing the out-of-school style of teaching and learning that might be possible in public libraries, the analysis in this article indicates that the strength of public library makerspaces is in the range of possible structures for teaching and learning. Importantly, librarians are making decisions which determine particular structures (e.g., establishing a particular purpose, providing certain materials, and hiring outside experts). The analysis in this article highlights ways these decisions might be informed by existing theories and models of learning and making and suggests benefits of having some training in these areas for librarians and makerspace facilitators. Theories and models can help guide programs as librarians consider key elements of makerspaces such as goals, materials, facilitation methods, intended participants, and assessment practices. Public libraries have a role to play in shaping the maker movement. Libraries are in an ideal position to highlight ways making and learning are framed in sociopolitical ways. In designing programs, librarians can be asking whose knowledge and mindset is being valued, what counts as tinkering or innovation, and on whose terms are we defining and valuing making (Vossoughi, Hooper, and Escudé 2016). In the process of defining themselves as learning institutions, public library makerspaces need to capitalize on their strength of flexibility and the tenet of providing resources for their communities.

Note

1. Names of participants are anonymized for publication.

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