

MAKING & LEARNING

Research Meeting

July 21-22, 2014

Children's Museum of Pittsburgh

Pittsburgh, PA

Table of Contents

Introduction	p. 3
Meeting Goals	p. 4
Meeting Agenda	p. 4
The Landscape of Learning Research on Making	p. 7
Emerging Themes of Learning Research on Making	p. 12
Maker Research References	p. 15
Inspiring References for Maker Research	p. 24
Additional Suggested Resources	p. 29
Meeting Participants	p. 31
Continuing the Conversation & Special Thanks	p. 33



Introduction

This report provides a brief summary of a research meeting on making and makerspaces organized by Children's Museum of Pittsburgh and the University of Pittsburgh's Learning Research and Development Center. The meeting took place July 21st and 22nd, 2014 at The Children's Museum.

Motivated by a resurgence of interest in DIY (do-it-yourself) culture and prompted by the introduction of new technologies, physical computing and fabrication, the Maker Movement offers new opportunities for learning experiences that develop creativity and innovation. Making and makerspaces represent an emerging movement in education that integrates hands-on learning experiences with physical and digital tools. Classroom teachers, school administrators, and designers of informal learning environments are seeking funding, building facilities, and sharing strategies for integrating making into formal and informal learning contexts.

While the educational movement has surged ahead and already has many great stories and maker projects to share, the learning research on making and makerspaces is just getting started. Many in the research community are now asking what, exactly, it means to learn through making? What does evidence of learning look like in the context of making activities? What is needed to leverage what are typically hobbyist practices of adults and transform them into designed learning experiences for children, youth and families? How



might we support formal and informal educators in their pursuit to integrate making into learning experiences? What further research is needed to broaden participation in making?

We invited leading researchers who are actively pursuing questions as these to share their work and discuss the future of the field. To complement the researchers' perspectives and to ground the conversations in current practice and policy, we also invited some key practitioners, funders, and network leaders who are leading figures in the educational making world.

Meeting Goals

The three primary goals of the meeting for researchers, practitioners and funders were to:

- Share emerging research efforts on making as a learning endeavor
- Identify points of synergy, collaboration, and gaps in the making research network
- Discuss how to strengthen the field of making research by setting an emergent research road map for the field.

In what follows, we will highlight some of the important themes and shared resources that emerged from our discussions.

Day One Agenda July 21, 2014

9:00am	Breakfast & Networking
9:30am	Welcome to Museum
9:35am	Framing the Meeting
9:45am	Snapshot of the Field
10:00am	Small Group Discussion: Topics <i>Where are we now? Where are we going? What are the core questions for the field? What are the research-practice gaps? What is the low hanging fruit?</i>
11:00am	Share Out of Small Group Discussion
12:00pm	Lunch and Exploration of Museum

- 1:30pm Small Group Discussion: Problems of Practice by Setting
- *Affordances of Context*
 - *What's most important to understand about how this context is changed, influenced and distinguished by making?*
 - *How can the research field productively connect with this setting?*
- 2:15pm Share Out of Small Group Discussion
- 3:00pm Break
- 3:30pm Small Group Discussion: Investment: Systems, Scaling & Assessment
- *What's the broader policy context?*
 - *What do stakeholders expect from making*
- 4:15pm Share Out of Small Group Discussion
- 4:45pm Reflection & Closure
- 5:00pm Happy Hour in MAKESHOP
- 6:00pm Dinner in Studio





Day Two Agenda July 21, 2014

9:00am	Breakfast & Reflections
10:00am	What is making?
12:00pm	Lunch
1:00pm	Shared Vision of the Road Ahead
2:30pm	Reflections



The Landscape of Learning Research on Making

Leading up to the meeting, we surveyed meeting participants to get a sense of their current research on making. In particular, we were curious to map the age-groups and making contexts (e.g., schools, museums, libraries, etc.) that are currently being studied. We also were interested in charting the range of theoretical perspectives that currently serve as lenses in the ongoing research

Age Groups Studied By Participating Maker Researchers

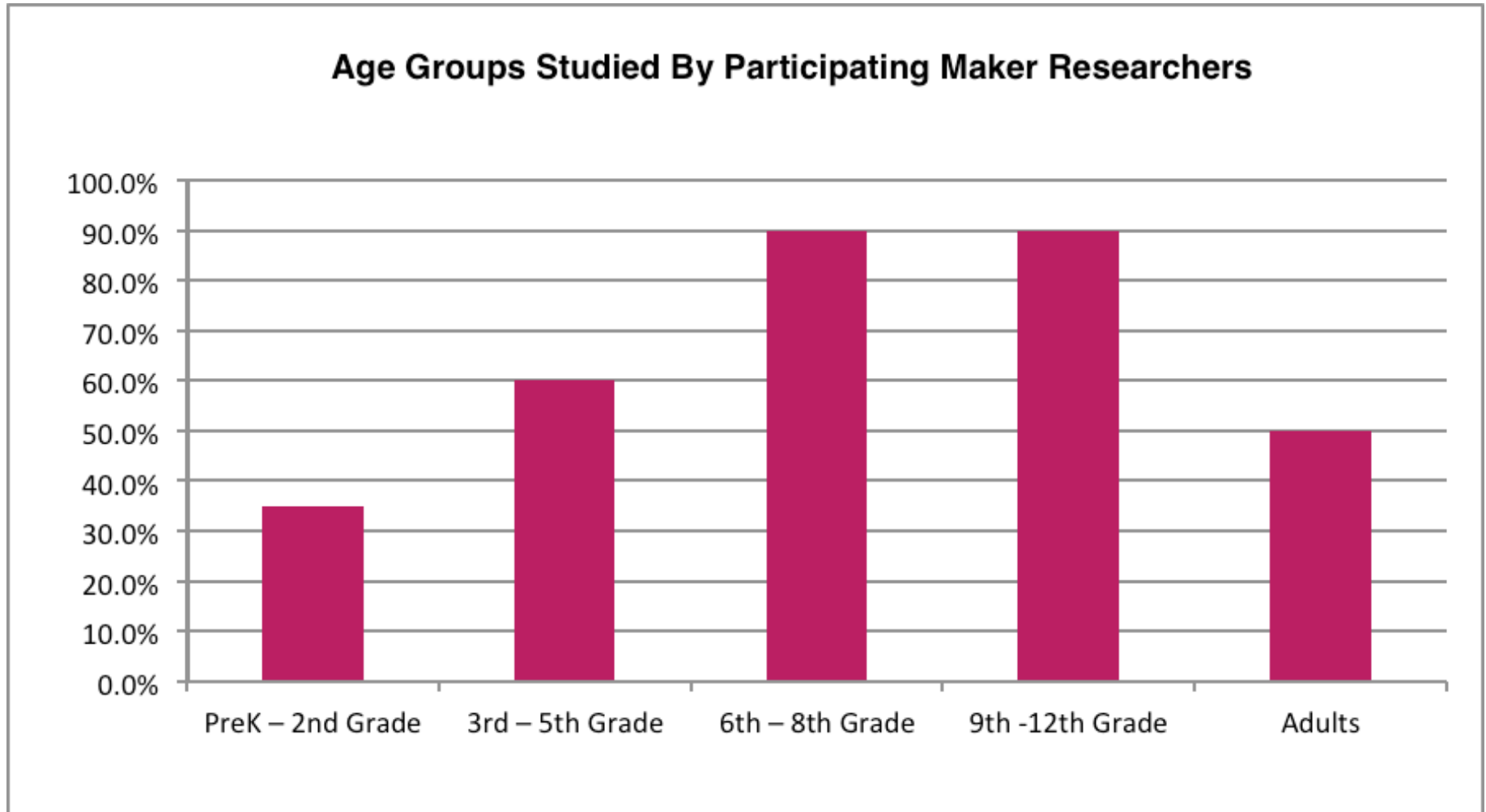
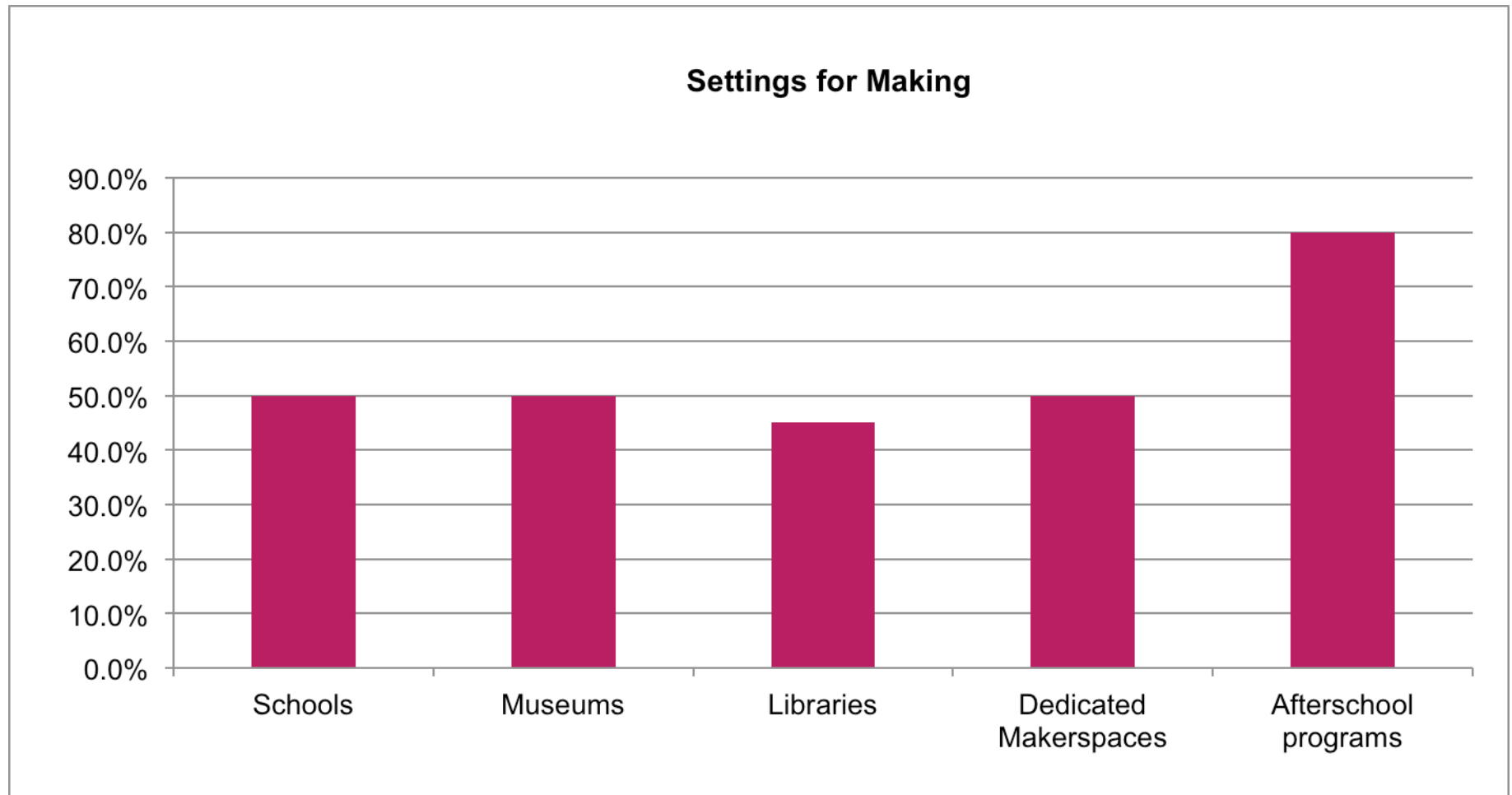
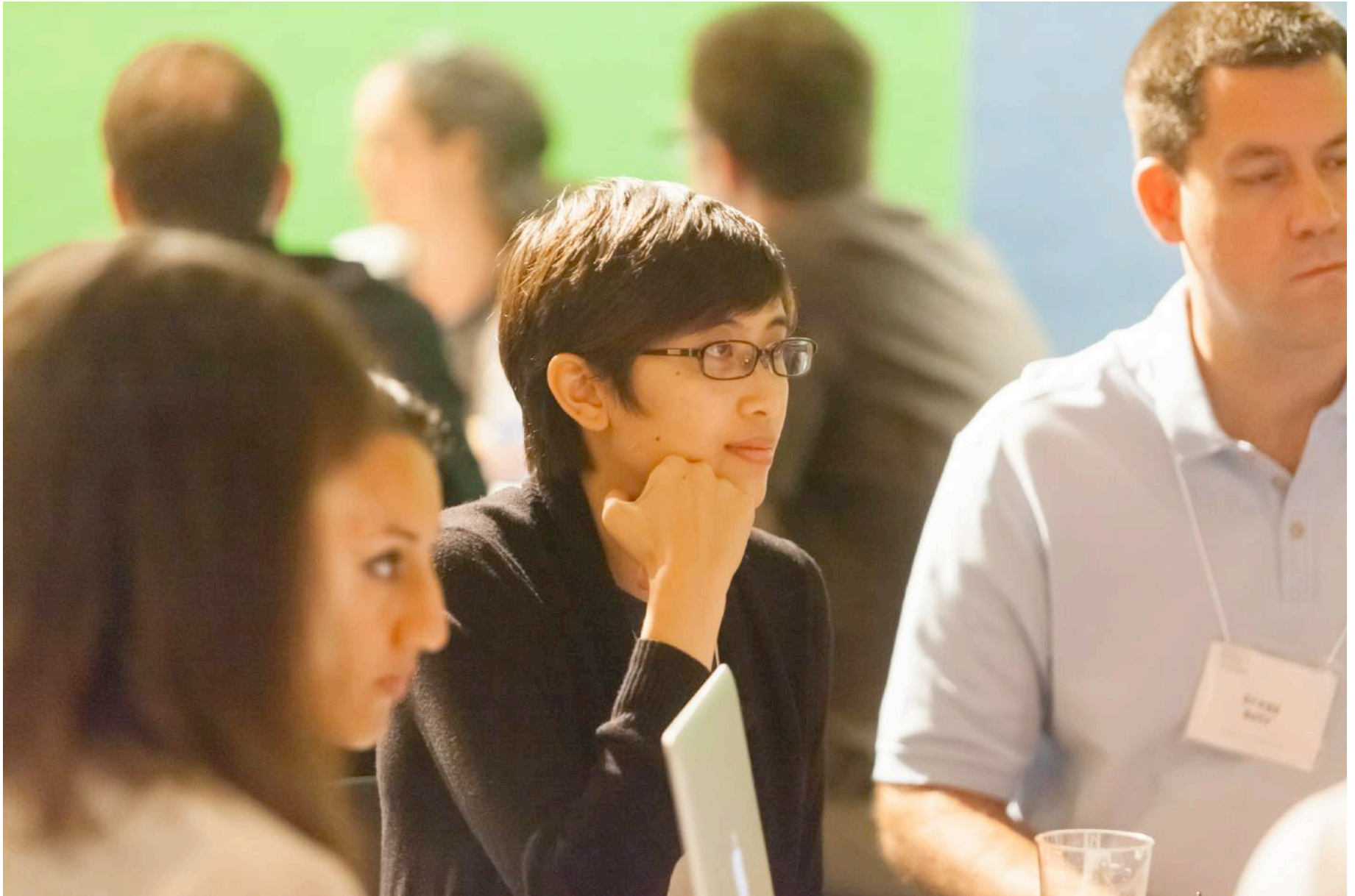


Figure 2: We surveyed the meeting participants about the age groups that they were investigating or that were engaged in making at their research and design sites. Participants were able to mark as many age groups in the survey as were appropriate. Middle and high-school aged children was the most common target of research, although both younger children and adults were also represented in participant responses.

Figure 3: We asked the meeting participants about the settings in which they were designing and investigating making. Participants were able to mark as many settings as were appropriate to their research and programs. We made the intentional distinction of afterschool programs separated from the other settings since we knew that many of the studies were happening in places like Boys and Girls Clubs. Note that the settings were more or less equally represented, which is was one of the goals of the meeting.





Emerging Learning Research Areas in Making

Based on discussions, reflection, and consensus process at the meeting, we identified six general categories of research questions that characterize the current state of the field. The questions reflect the ongoing research of meeting participants, but also are based on critical gaps we identified that will need to be addressed in order to further the development of maker programs and makerspaces for learning.

1. *What are the characteristics of powerful making spaces and do those characteristics depend on the specific physical setting of the maker space (museums, libraries, schools, etc.)?*

The design of the space in which the maker program takes place as well as how the making activity is arrayed and supported through design can play a substantial role in participants' learning. This is significant both for formal learning environments as well as informal environments, although the designs and activity may be different in important ways based on institutional priorities as well as the goals the maker program is attempting to address.

2. *What's the connection between becoming a maker and being engaged in STEM pathways? What other educational outcomes are potentially impacted by making?*

This is a significant question considering the current educational policy environment that often seeks to link maker experiences with STEM content and skills. Therefore, these outcomes may address a specific disciplinary connection that may exist between making and STEM, as well as be associated with specific STEM pathways that might lead a young learner towards a

STEM career. However, there are non-content-related skills that may also be cultivated through participation in making. These include the development of an interest related to making, building an identity around some aspect of making, the growth of self-efficacy tied to maker-related tasks, as well as increased motivation and engagement linked to maker-related and program-related tasks. Finally, important outcomes may also be developed around creativity and innovation, among other 21st century skills; important areas policymakers point to as catalysts for career readiness and entrepreneurial ventures.

3. *What are the core practices of making? How can we assess the practices and impact of making experiences?*

A focus on learning practices as an area of research can serve at least three goals. First, some researchers noted that engagement in learning practices of making could be a means for defining what constitutes an ambitious making experience. Second, practices can serve as analytic tools for observing making as a learning process.

Taking seriously the cliché that we know making when we see it, practices can serve as guideposts for assessing maker experiences and noticing shifts in behavior over time. Third, similar to the educational outcomes, identifying the disciplinary practices embedded in maker activities can both offer opportunities to document learning related to content areas such as science and engineering and provides a stronger empirical argument for the value of making as strongly tied, potentially, to content area practices identified by formal educational objectives and standards. . However, the equity conversation needs to address more than just availability. It will also be important to design for the ways in which making and makerspaces are sensitive to different cultural practices related to making, or perhaps presently unrecognized by making and maker culture as it is currently understood. In addition, it is important that making, as an educational innovation, will not just reproduce some of the values and practices that have marginalized certain populations in the past.

6. *How do we create accessible and equitable maker experiences for all children?*

As the maker movement builds and educators seek to create powerful learning experiences for children, a challenge will be to ensure that these experiences are available to all. However, the equity conversation needs to address more than just availability. It will also be important to design for the ways in which making and makerspaces are sensitive to different cultural

practices related to making, or perhaps presently unrecognized by making and maker culture as it is currently understood. In addition, it is important that making, as an educational innovation, will not just reproduce some of the values and practices that have marginalized certain populations in the past.

4. *What are the ways that making experiences fit into broader learning ecologies and pathways? How can do research that traces longitudinal pathways for learning as making?*

A current notion in learning research is to view learning as taking place within a network or ecology of experiences and places. As these spaces and experiences become linked, they can potentially create more in-depth learning experiences through making. What are the ways that making fits within a learning ecology? What does it mean to have maker experiences that provide greater and greater depth and breadth for the learner and learning community?

5. *How do we create a professional development community to engage and develop educators who facilitate making?*

A consensus among the participants of the meeting was that productive making experiences include human facilitation. Making is certainly a material-based activity, but the human-infrastructure that supports making is crucial. What does it mean to effectively facilitate making experiences? Are there important differences among the roles of different kinds of



facilitators (teachers, informal educators, mentors, e.g.)? How does the physical context influence facilitation? What knowledge and skills should facilitators have to be effective? And what experiences should be created to prepare facilitators of making?



Maker Research References

We surveyed the participants ahead of time and asked them to provide citations for writings they have engaged in that is relevant to research on making and makerspaces. We list citations here, but the most updated list will always be available at [http://makingand learning.org](http://makingandlearning.org).

- Bevan, B., Gutwill, J. P., Petrich, M., & Wilkinson, K. (in review). Building Theory, Building Practice: Collaborative Research in the Informal Setting. *Science Education*.
- Bowler, L. (2014). Creativity through “Maker” experiences and design thinking in the education of librarians. *Knowledge Quest: Journal of the American Association of School Librarians*. 42(5), May-June, pp. 59-61.
- Brahms, L.J. & Werner, J. (2013). Designing makerspaces for family learning in Museums and science centers. In Honey, M., & Kanter, D. E. (Eds.). *Design, make, play: Growing the next generation of STEM Innovators*. (71-94). New York: Routledge.
- Brahms, L. J. (2014). *Making as a learning process: Identifying and supporting family learning in informal settings* (Doctoral dissertation, University of Pittsburgh).
- Brahms, L., & Crowley K. (in submission). Making Sense of Making: Defining Learning Practices in MAKE Magazine .
- Brahms, L. & Crowley, K. (in submission). Making in the Museum: The Role of Maker Facilitators and Family Members in Becoming a Maker.
- Brahms, L. & Crowley, K. (in submission). Families Who Make Together: Locating and Tracing Learning in the Context of Informal Family Activity
- Brennan, K., Valverde, A., Prempeh, J., Roque, R., Chung, M. (2011) More than code: The significance of social interactions in young people’s development as interactive media creators. *World Conference on Educational Multimedia, Hypermedia and Telecommunications (ED-Media)*. Lisbon, Portugal.
- Buechley, L., Peppler, K. A., Eisenberg, M. & Kafai, Y. B. (2013) (Eds.). *Textile Messages: Dispatches from the Word of Electronic Textiles and Education*. New York: Peter Lang Publishers.
- Burke, Q.. & Kafai, Y. B. (in press). DIY Zones for Scratch Designs in Class and Club. *International Journal of Learning and Media*.
- Chan, J., Fu, K., Schunn, C. D., Cagan, J., Wood, K., & Kotovsky, K. (2011). On the benefits and pitfalls of analogies for innovative design: Ideation performance based on analogical distance, commonness, and modality of examples. *Journal of Mechanical Design*, 133, 081004-1-11.

- Chan, J., Paletz, S., & Schunn, C. D. (2012). Analogy as a strategy for supporting complex problem solving under uncertainty. *Memory & Cognition*, 40, 1352- 1365.
- Chan, J., & Schunn, C. D. (In press). The impact of analogies on creative concept generation: Lessons from an in vivo study in engineering design. *Cognitive Science*.
- Christensen, B. T., & Schunn, C. D. (2007). The relationship of analogical distance to analogical function and pre-inventive structure: The case of engineering design. *Memory & Cognition*, 35(1), 29-38.
- Christensen, B. T., & Schunn, C. D. (2009). The role and impact of mental simulation in design. *Applied Cognitive Psychology*, 23, 327-344.
- Christensen, B. T., & Schunn, C. D. (2009). Setting a limit to randomness [or: 'Putting blinkers on a blind man']: Providing cognitive support for creative processes with environmental cues. In K. Wood & A. Markman (Eds.), *Tools for Innovation*.
- DiSalvo, B., Roque, R., Stevens, R., Takeuchi, L., and Taylor, K. (2014) Learning with technology: Different perspectives from low-income families. *Symposium for American Education Researchers Association (AERA)*. Philadelphia, PA.
- Dorph, R. & Cannady, M.A. (2014). *Making the Future: Promising Evidence of Influence*. A report submitted to Cognizant Technologies by The Research Group, The Lawrence Hall of Science. University of California, Berkeley.
- DuMont, M., & Lee, V. R. (2012). Material Pets, Virtual Spaces, Isolated Designers: How Collaboration May Be Unintentionally Constrained in the Design of Tangible Computational Crafts. *Proceedings of the Tenth International Conference for Interaction Design and Children (IDC)* (pp. 244-247). Bremen, Germany: ACM.
- DuMont, M.* & Fields, D. A. (2013). Hybrid shmybrid: Using collaborative structure to understand the relationship between virtual and tangible elements of a computational craft. In N. Rummel, M. Kapur, M. Nathan, & S. Puntambekar (Eds), *To see the world and a grain of sand: Learning across levels of space, time, and scale: CSCL 2013 Conference Proceedings*, Volume 2, Short Papers, Panels, Posters, Demos & Community Events. International Society of the Learning Sciences: Madison, WI, 233-234.
- Fields, D. A., Kafai, Y. B., Searle, K. A.* & Min, H. S.† (2012). Debuggems to assess student learning in e-textiles. *Proceedings of the 43rd ACM technical symposium on Computer Science Education*, p. 699.

Fields, D. A., Searle, K. A., & Kafai, Y. B. (2012, July). Functional aesthetics for learning: Creative tensions in youth e-textile designs. *Proceedings of the Tenth International Conference of the Learning Sciences*, Sydney, Australia.

Fields, D. A. & King, W. L.* (2014). "So, I think I'm a programmer now." Developing connected learning for adults in a university craft technologies course. In Polman, J. L., Kyza, E. A., O'Neill, D. K., Tabak, I., Penuel, W. R., Jurow, A. S., O'Connor, K., Lee, T., and D'Amico, L. (Eds.). (2014). *Learning and Becoming in Practice: The International Conference of the Learning Sciences (ICLS) 2014, Volume 1*. Boulder, CO: International Society of the Learning Sciences, pp. 927-936.

Fu, K., Chan, J., Schunn, C. D., & Cagan, J. (2013). Expert representation of design repository space: A comparison to and validation of algorithmic output. *Design Studies*, 34(6), 729-762.

Fu, K., Chan, J., Cagan, J., Kotovsky, K., Schunn, C., & Wood, K. (2013). The meaning of "near" and "far": The impact of structuring design databases and the effect of distance of analogy on design output. *Journal of Mechanical Design*, 135(2), 021007.

Egan, P. F., Cagan, J. C., Schunn, C. D., & LeDuc, P. R. (2013). Design of complex biologically-based nanoscale systems using multi-agent simulations and structure-behavior-function representations. *Journal of Mechanical Design*, 135(6), 061005.

Gutwill, J. P., Hido, N., & Sindorf, L. (in review). An Evidence-based Framework for Observing Learning during Tinkering Activities. *Curator*.

Honey, M., & Kanter, D. E. (Eds.). (2013). *Design, make, play: Growing the next generation of STEM Innovators*. New York: Routledge.

Humphrey, T., & Gutwill, J. P. (Eds.). (2005). *Fostering Active Prolonged Engagement: The Art of Creating APE Exhibits*. Walnut Creek: Left Coast Press.

Jang, J., & Schunn, C. D. (2012). Physical design tools support and hinder innovative engineering design. *Journal of Mechanical Design*.

Kafai, Y. B., Peppler, K. A., & Chapman, R. (2009) (Eds.). *The Computer Clubhouse: Constructionism and Creativity in the Inner City*. New York: Teachers College Press.

Kafai, Y., Roque, R., Fields, D., Monroy-Hernandez, A. (2011) Collaboration by choice: Youth online creative collabs in Scratch. *International Conference on Computers in Education (ICCE)*. Chiang Mai, Thailand.

Kafai, Y. B., Fields, D. A., & Searle, K.A.* (2012). Making learning visible: Connecting crafts, circuitry & coding in e-textile designs. In van Aalst, J., Thompson, K., Jacobson, M.J., & Reimann, P. (Eds.), *The Future of Learning: Proceedings of the 10th International Conference of the Learning Sciences (ICLS 2012), Volume 1, Full Papers*. International Society of the Learning Sciences: Sydney, NSW, Australia, 188-195.

Kafai, Y. B., Fields, D. A., & Searle, K. (2013). Making connections across disciplines in high school workshops. In L. Buechley, K. A. Peppler, M. Eisenberg, & Y. B. Kafai, (Eds.), *Textile Messages: Dispatches from the World of Electronic Textiles and Education*. New York, NY: Peter Lang Publishers.

Kafai, Y. B. & Burke, W. Q. (2014). *Connected Code: Why children need to learn programming*. Cambridge, MA: MIT Press.

Kafai, Y. B., Searle, K. A., Fields, D. A., Lee, E., Kaplan, E. & Lui, D. (2014). A Crafts- Oriented Approach to Computing in High School: Introducing Computational Concepts, Practices and Perspectives with E-Textiles. *Transactions on Computing Education*. 14(1), 1-20.

Kafai, Y. B., Searle, K., Martinez, C., & Brayboy, B. (2014, March). Ethnocomputing with Electronic Textiles: Culturally Responsive Open Design to Broaden Participation in Computing in American Indian Youth and Communities. *Proceedings of the SIGCSE meeting in Atlanta, GA*.

Kafai, Y. B. & Peppler, K. A. (2014). Transparency reconsidered: creative, critical and connected making with e-textiles. In M. Boaler & M. Ratto (Eds.), *DIY Citizenship: Participatory Practices of Politics, Culture and Media* (pp. 300- 310). Cambridge, MA: The MIT Press.

Kafai, Y. B., Fields, D. A., & Searle, K. A., (in press). Electronic Textiles as Disruptive Designs: Supporting and Challenging Maker Activities in Schools. *Harvard Educational Review*.

Lee, V. R., & Fields, D. A. (2013). A clinical interview for assessing student learning in a university-level craft technology course. *Paper presented at the III Digital Fabrication in Education Conference (FabLearn 2013)*, Stanford, CA.

Levine, M. & Santo, R. (2013). Upgrading Afterschool: Common Sense Shifts in Expanded Learning for a Digital Age. In Peterson, T. (Ed.) *Expanding Minds and Opportunities: Leveraging the Power of Afterschool and Summer Learning for Student Success*. Available at: <http://www.expandinglearning.org/expandingminds/article/upgrading-afterschool-common-sense-shifts-expanded-learning-digital-age> *Library As Incubator Project*, posts about The Labs @ CLP: <http://www.libraryasincubatorproject.org/?tag=the-labs-clp>

Linsey, J., Tseng, I., Fu, K., Cagan, J., Wood, K., & Schunn, C. D. (2010). A study of design fixation, its mitigation and perception in engineering design faculty. *Journal of Mechanical Design*, 132.

Making Thinking Happen blog: <http://makingthinkinghappen.wordpress.com/>

Mehalik, M. M., & Schunn, C. D. (2006). What constitutes good design? A review of empirical studies of the design process. *International Journal of Engineering Education*, 22(3), 519-532.

Norris (2014). Make-her-spaces as hybrid places: Designing and resisting self- constructions in urban classrooms, *Equity & Excellence in Education*, 47:1, 63-77.

Paletz, S. B. F., & Schunn, C. D. (2010). A social-cognitive framework of multidisciplinary team innovation. *Topics in Cognitive Science*, 2, 73-95.

Paletz, S. B. F., Schunn, C. D., & Kim, K. (2011). Intragroup conflict under the microscope: micro-conflicts in naturalistic team discussions. *Negotiation and Conflict Management Research*, 4, 314-351.

Paletz, S. B. F., & Schunn, C. D. (2011). Assessing group level participation in fluid teams: Testing a new metric. *Behavior Research Methods*.

Paletz, S. B. F., Kim, K., Schunn, C. D., Tollinger, I., & Vera, A. (2013). The development of adaptive expertise, routine expertise, and novelty in a large research team. *Applied Cognitive Psychology*, 27(4), 415–428.

Paletz, S. B. F., Schunn, C. D., & Kim, K. (2013). The interplay of conflict and analogy in multidisciplinary teams. *Cognition*, 126(1), 1-19.

Peppler, K., Gresalfi, M. Salen, K., & Santo, R. (in press, 2014). *Soft Circuits: DIY Crafting with E-Fashion*. Cambridge, MA: MIT Press.

Peppler, K., Gresalfi, M. Salen, K., & Santo, R. (in press, 2014). *Short Circuits: DIY Crafting with E-Puppets*. Cambridge, MA: MIT Press.

Peppler, K., Santo, R., Gresalfi, M. & Salen, K., (in press, 2014). *Script Changers: Digital Storytelling with Scratch*. Cambridge, MA: MIT Press.

Roque, R., Kafai, Y., and Fields, D. (2012) From tools to communities: Designs to Support Online Creative Collaboration in Scratch. *Short paper to the 11th International Conference on Interaction Design and Children (IDC)*. Bremen, Germany.

Roque, R., Rusk, N., Blanton, A. (2013) Youth roles and development of leadership in an online creative community. *Computer Supported Collaborative Learning (CSCL)*. Madison, WI.

Roque, R., Rusk, N., Beck, L., Chen, X. (2014) Family creative learning: Engaging parents and children as learning partners in creative technology workshops. *Short paper to the 11th Annual International Conference of the Learning Sciences (ICLS)*. Boulder, CO.

Salen, K., Gresalfi, M., Peppler, K., & Santo, R. (in press, 2014). *Gaming the System: Designing with Gamestar Mechanic*. Cambridge, MA: MIT Press.

Santo, R. (2013). Towards hacker literacies: What Facebook's privacy snafus can teach us about empowered technological practices. *Digital Culture & Education*, 5:1, 18-33.

Santo, R. (2012). Hacker Literacies: User-Generated Resistance and Reconfiguration of Networked Publics. In J. Avila & J. Zacher-Pandya (Eds.) *Critical Digital Literacies as Social Praxis: Intersections & Challenges*. Edited volume in the New Literacies and Digital Epistemologies series. New York: Peter Lang.

Santo, R. (2012). Hacker Literacies: Synthesizing Critical and Participatory Media Literacy Frameworks. *International Journal of Learning and Media*. Vol. 3, No. 3, Pages 1-5

Schunn, C. D., Lovell, M. R., Wang, Y., and Yang, A. (2008). Measuring Innovative Apples & Oranges: Towards More Robust and Efficient Measures of Product Innovation. *Paper presented at the Studying Design Creativity conference*. Aix-en-Provence, France, (March, 2008).

Schunn, C. D. (2010). From uncertainly exact to certainly vague: Epistemic uncertainty and approximation in science and engineering problem solving. In B. Ross (Ed.), *Psychology of Learning and Motivation* (Vol. 53).

Searle, K., Fields, D. A., Lui, D. & Kafai, Y. B. (2014). Diversifying high school students' views about computing with electronic textiles. In *Proceedings of International Computing Education Research*, ACM.

Sheridan, K., Clark, K. & Williams, A. (2013). Designing games, designing roles: A study of youth agency in an informal education program. *Urban Education*, 48 (5), 734-758.

Sheridan, K., Halverson, E., Litts, B., Brahms, L., Jacobs-Priebe, L & Owens, T. (in press). Learning in the making: A comparative case study of three makerspaces. *Harvard Educational Review*.

Titus, N., Schunn, C. D., Walhall, C., Chiu, G., & Ramani, K. (2008). What design processes predict better design outcomes? The case of robotics design teams. *Proceedings of the Tools and Methods of Competitive Engineering Conference*, Izmir, Turkey, (April, 2009).

Vaseduvan, V., Davis, R. Kafai, Y. B., & Lee, E. (2013, June). Joystick Designs: Middle School Youth Crafting of Game Controllers. In Ochsner, A. & Dietmeier, J. (Eds.), *Proceedings of the Games + Learning + Society Conference*, Madison, WI.

Vossoughi, S., Escudé, M., Kong, F., & Hooper, P. (2013). Tinkering, learning & equity in the after- school setting. Paper presented at Fablearn 2013: Digital Fabrication in Education Conference. October 27, 2013; Stanford, CA.
<http://fablearn.stanford.edu/2013/wp-content/uploads/Tinkering-Learning-Equity-in-the-After-school-Setting.pdf>.

Vossoughi, S. (Under Review). What does the camera communicate? The politics and possibilities of video research on learning.

Vossoughi, S. & Bevan, B. (2014). Making and Tinkering. White Paper Commissioned by the Committee on Successful Out-of-School STEM Learning. Washington, DC: National Research Council.

Wardrip, P.S. & Brahms, L. (forthcoming). Making goes to school. In Peppler, K., Halverson, E. & Kafai, Y. (Eds.) (in press). *Makeology: Makers as Learners (Volume 1)*. New York, NY: Routledge.

Wilkinson, K. & Petrich, M. (2014). *The Art of Tinkering*. San Francisco, CA: Weldon Own.

Wyld, J. blogs.oregonstate.edu/freechoicelab/author/wyldj/ <http://blog.iste.org/author/jwyld/> a prezi on Make and Montessori-
<http://prezi.com/rte4k2rykrkt/montessori-and-make/> and another coming out tomorrow about Make on this blog (7/17).





Inspiring References for Maker Researcher

We also asked the research participants to provide citations for writings outside of maker research that have been helpful to their work or that have inspired them in their work. The following citations were provided.



- Anderson, C. (2012). *Makers: The New Industrial Revolution*. New York: Random House.
- Bamberger, J. (1991). The laboratory for making things: Developing multiple representations of knowledge. In D. A. Schon (Ed.), *Reflective turn: Case studies in and on educational practice* (pp. 37-62). New York: Teachers College Press.
- Barron, B., Martin, C. K., Takeuchi, L., & Fithian, R. (2009). Parents as learning partners in the development of technological fluency. *International Journal of Learning and Media*, 1(2), 55–77.
- Booth-Sweeney, L. (2012). Learning to connect the dots: Developing children's systems literacy. *Solutions for a Sustainable and Desirable Future*, 5(3), 55–62.
- Crowley, K., & Jacobs, M. (2002). Building islands of expertise in everyday family activity. *Learning conversations in museums*, 333-356.
- Dewey, J. (2007). *Experience and education*. Simon and Schuster.
- DiSalvo, C. (2012). *Adversarial design*. Boston: The MIT Press.
- Dourish, P., Finlay, J., Sengers, P., & Wright, P. (2004). *Reflective HCI: Towards a critical technical practice*. CHI 2004. April 24-29, 2004. Vienna, Austria.
- Duckworth, E. (2006). *"The Having of Wonderful Ideas" and Other Essays on Teaching and Learning (Third Edition ed.)*. New York: Teachers College Press.
- Dweck, C. (2006). *Mindset: The New Psychology of Success*. New York: Random House.
- Eisenberg, M., & Buechley, L. (2008) Pervasive Fabrication: Making Construction Ubiquitous in Education, *Journal of Software*, 3(4), pp. 62-68.
- Engeström, Y. (2001). Expansive learning at work: Toward an activity theoretical reconceptualization. *Journal of Education and Work*, 14(1), 133-156.
- Falk, J. H., Dierking, L. D., & Dierking, L. D. (2000). *Learning from museums: Visitor experiences and the making of meaning*. Walnut Creek, CA: AltaMira Press.

- Feder, M. A., Shouse, A. W., Lewenstein, B., & Bell, P. (Eds.). (2009). *Learning Science in Informal Environments:: People, Places, and Pursuits*. National Academies Press.
- Freire, P. (2000). *Pedagogy of the oppressed*. Bloomsbury Publishing.
- Gauntlett, D. (2011). *Making is connecting: The social meaning of creativity, from DIY knitting to YouTube and Web 2.0*. Cambridge, UK: Polity Press.
- Gershenfeld, N. (2008). *Fab: the coming revolution on your desktop--from personal computers to personal fabrication*. New York: Basic Books.
- Grotzer, T. (2012). *Learning causality in a complex world: Understandings of consequence*. Lanham, MD: Rowman & Littlefield Education.
- Hawkins, D. (2007). *The informed vision: Essays on learning and human nature*. Algora Publishing.
- Holland, D., Lachicotte Jr., W., Skinner, D., & Cain, C. (1998). *Identity and agency in cultural worlds*. Cambridge, MA: Harvard University Press.
- Honey, M. & Kanter, D. E. (2013). *Design, Make, Play: Growing the Next Generation of STEM Innovators*. New York: Routledge.
- Igoe, T. (2007). *Making things talk: Practical methods for connecting physical objects*. Canada: O'Reilly Media, Inc.
- Ito, M. et al. (2010). *Hanging Out, Messing About, and Geeking Out: Kids Living and Learning with New Media*. Cambridge, MA: MIT Press.
- Ito, M., Gutiérrez, K., Livingstone, S., Penuel, B., Rhodes, J., Salen, K., . . . & Watkins, S.C. (2013). *Connected Learning: An Agenda for Research and Design*. Irvine, CA: Digital Media and Learning Research Hub
- Kafai, Y. & Harel, I. (1996). Learning through design and teaching: Exploring social and collaborative aspects of constructionism. In (Kafai, Y. & Resnick, M.) *Constructionism in practice: Designing, thinking, and learning in a digital world* (pp.85-110). Mahwah, NJ: Lawrence-Erlbaum Associates, Publishers.
- Karlin Associates. (2012). *Maker market study: An in-depth profile of makers at the forefront of hardware innovation*. Sebastopol, CA: Make.

- Kolodner, J.L. (2002). Facilitating the Learning of Design Practices: Lessons Learned from an Inquiry into Science Education. *Journal of Industrial Teacher Education*, Vol. 39, No. 3, pp. 9-40.
- Lareau, A. (2003). *Unequal childhoods: Class, race, and family life*. University of California Press.
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. Cambridge: Cambridge University Press.
- Martinez, S. L., & Stager, G. (2013). *Invent to Learn: Making, Tinkering, and Engineering in the Classroom*. Constructing Modern Knowledge Press.
- Moll, L. C., & Greenberg, J. B. (1992). 14 Creating zones of possibilities: Combining social contexts for instruction. *Vygotsky and education: Instructional implications and applications of socio-historical psychology*, 319.
- Moll, L. C., Tapia, J., & Whitmore, K. F. (1993). Living knowledge: The social distribution of cultural resources for thinking. *Distributed cognitions: Psychological and educational considerations*, 139-163.
- Nasir, N.S. (2012). *Racialized identities: Race and achievement among African American youth*. Stanford, CA: Stanford University Press.
- Papert, S., & Harel, I. (1991). *Situating constructionism*. Retrieved from www.papert.org/articles/SituatingConstructionism.html
- Paris, D. (2012). Culturally Sustaining Pedagogy: A Needed Change in Stance, Terminology, and Practice. *Educational Researcher*, 41:3
- Peppler, K. A., & Kafai, Y. B. (2009). Gaming fluencies: Pathways into participatory culture in a community design studio. *International Journal of Learning and Media*, 1(4), 45-58.
- Perkins, D. N. (1986). *Knowledge as design*. Hillsdale, NJ: Erlbaum and Associates.
- Perkins, D. N. (1993). Beyond ability: A dispositional theory of thinking. *Merrill-Palmer Quarterly* 39(1), 1–21.
- Petrich, M., Wilkinson, K., & Bevan, B. (2013). It looks like fun but are they learning? In M. Honey & D. E. Kanter (Eds.), *Design, Make, Play: Growing the Next Generation of STEM Innovators* (pp. 240). New York: Routledge.
- Rahm, Jrene. (2010). *Science making at the margin: A multisited ethnography of learning and becoming in an afterschool program, a garden and a math and science upward bound program*. Boston: Sense Publishers.

- Resnick, M. & Rosenbaum, E. (2013). Designing for tinkerability. *Design, Make, Play: Growing the Next Generation of STEM Innovators*, (163-181). New York: Routledge.
- Renninger, K. A. (2010). Working with and cultivating interest, self-efficacy and self-regulation. In D. Preiss & R. Sternberg (Eds.), *Innovations in Educational Psychology: Perspectives on Learning, Teaching and Human Development* (pp. 158-195). New York: Springer
- Rogoff, B. (1994). Developing understanding of the idea of communities of learners. *Mind, Culture and Activity*, 1(4), 209–229.
- Rose, M. (2005). *The Mind at Work*. London: Viking Penguin.
- Sefton-Green, J. (2013). Mapping Digital Makers New York Hall of Science
- Sengers, P., Boehner, K., David, S., & Kaye, J.J. (2005). *Reflective Design*. CC'05 Proceedings of the 4th Decennial Conference on Critical Computing: Between Sense and Sensibility. August 21-25, 2005. Aarhus, Denmark, pp. 49-58.
- Usher, E. L., & Pajares, F. (2006). Sources of academic and self-regulatory efficacy beliefs of entering middle school students. *Contemporary Educational Psychology*, 31, 125-141.
- Vygotsky, L. S. (1980). *Mind in society: The development of higher psychological processes*. Boston: Harvard university press.
- Vygotsky, L.S. (2004). Imagination and creativity in childhood. *Journal of Russian and East European Psychology*, 42(1), 7-97.
- Worsley, M. & Blikstein, P. (2012). *A framework for characterizing changes in student identity during constructionist learning activities*. Paper presented at Constructionism 2012, Athens, Greece.
- YALSA (2014) The Future of Library Services for and With Teens: A Call to Action

Additional Suggested Resources

Generated and shared through discussion:

The work of the Maker Effect Foundation --
<http://www.themakereffect.org/maker-mindset>

The Connected Learning Group –
<http://connectedlearning.tv/what-is-connected-learning>

Maker Effect Foundation –
<http://www.themakereffect.org/maker-mindset/>

DML Connected Learning Group –
<http://connectedlearning.tv/what-is-connected-learning>

Tinkering Studio Framework—
<http://www.tinkering.exploratorium.edu/learning-and-facilitation-framework>

Fundamentals of Tinkering Coursera Class—
<https://class.coursera.org/tinkering-001>

ASTC's Community of Practice - Making and Tinkering in Museums—
<http://tinyurl.com/kyyj7z8>

Kids DIY Media project— <http://Kidsdiymedia.com>

Maker Education Initiative, Resource Library
<http://makered.org/resources>

Maker Ed, Teacher Discussion Group—
<http://makered.org/Community>

Build in Progress, from Lifelong Kindergarten Group—
<http://buildinprogress.media.mit.edu/>

Informal Science.org Wiki—
<http://informalscience.org/research/wiki/Making-and-Tinkering-Programs>, search with "Maker" and "Tinker"

Children's Museum of Pittsburgh & Institute for Museum and Library Services Makerspaces in Museums and Libraries Project— www.makingandlearning.org

Learning Activation Lab: <http://www.activationlab.org/>

MIT Media Press, Books from the John D. and Catherine T. MacArthur Foundation Series on Digital Media and

<http://mitpress.mit.edu/books/short-circuits> - E-Puppetree

<http://mitpress.mit.edu/books/soft-circuits> - E-Textiles

<http://mitpress.mit.edu/books/script-changers> - Digital Storytelling with Scratch

<http://mitpress.mit.edu/books/gaming-system> - Game Design with Gamestar Mechanic

The Framework Institute—
<http://frameworksinstitute.org/toolkits/dml>



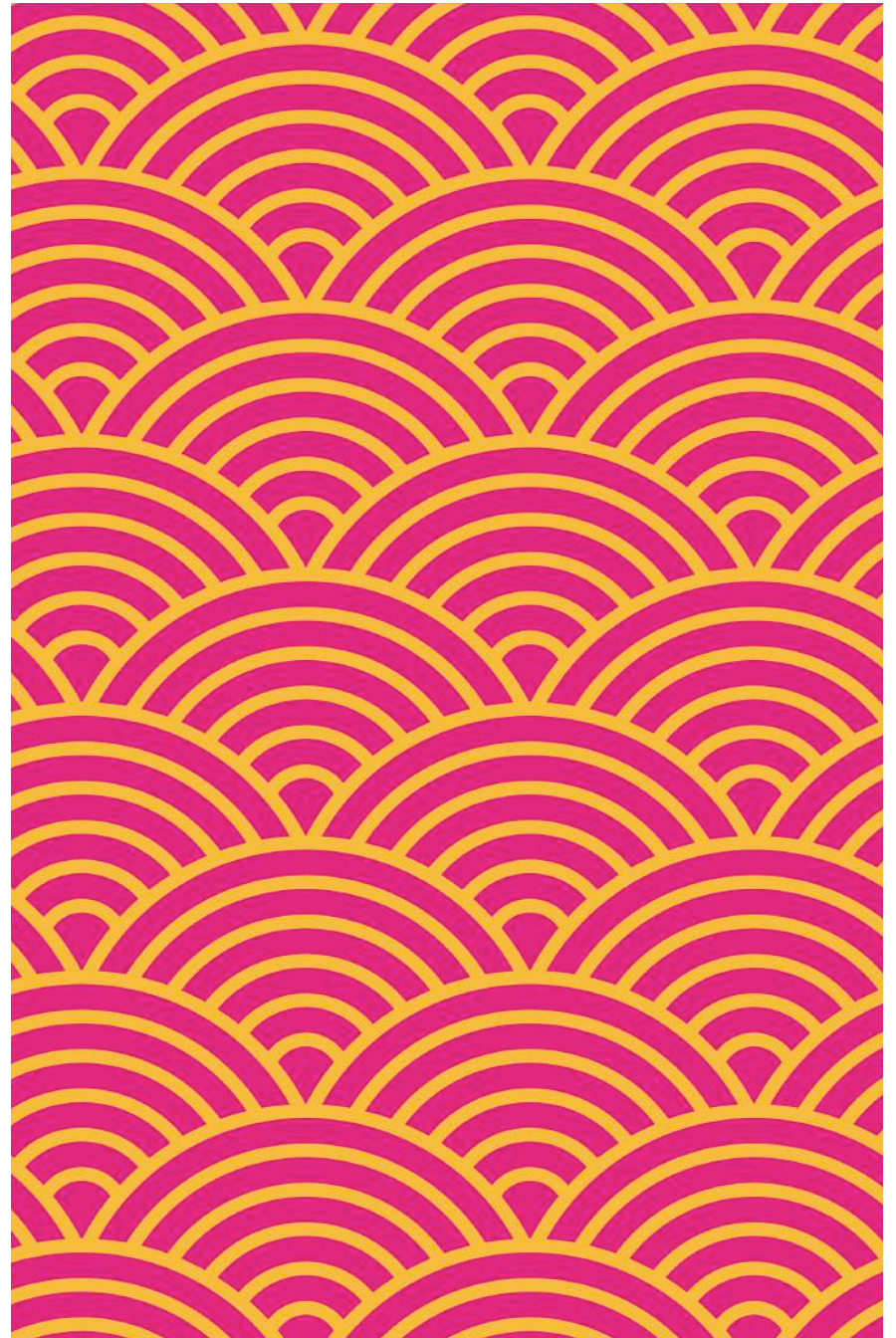
Meeting Participants

We sought to invite a diverse group of people involved in a program of research on making or makerspaces. The following is a list of the people who participated in the meeting

Ugochi	Acholonu	DePaul University
Tom	Akiva	Learning Research and Development Center / University of Pittsburgh
Gregg	Behr	Grable Foundation
Jamie	Bell	CAISE
Marjorie	Bequette	Science Museum of Minnesota
LeAnn	Bowler	University of Pittsburgh
Lisa	Brahms	Children's Museum of Pittsburgh
Mac	Cannady	Lawrence Hall of Science
Edward	Clapp	Project Zero/Harvard University
Kevin	Crowley	University of Pittsburgh
Drew	Davidson	Entertainment Technology Center/Carnegie Mellon University

Jim	Denova	Claude Worthington Benedum Foundation
Rena	Dorph	Lawrence Hall of Science
Deborah	Fields	Utah State University
Claudia	French	Institute of Museum and Library Sciences
Brian	Gravel	Tufts University
Josh	Gutwill	Exploratorium
Yasmin	Kafai	University of Pennsylvania
Victor	Lee	Utah State University
Breanne	Litts	University of Wisconsin, Madison
Aaminah	Norris	The Representation Project
Kylie	Peppler	Indiana University
Mike	Petrich	Exploratorium
Lisa	Regalla	Maker Education Initiative
Adam	Rogers	North Carolina State University Library
Ricarose	Roque	MIT
Andrea	Saenz	Chicago Public Library
Rafi	Santo	Indiana University

Janet	Sarbaugh	Heinz Endowments
Chris	Schunn	Learning Research and Development Center / University of Pittsburgh
Kim	Sheridan	George Mason University
Eric	Siegel	New York Hall of Science
Ana	Tilton	Grant Makers for Education
Shirin	Voussoughi	Exploratorium/Northwestern University
Peter	Wardrip	Children's Museum of Pittsburgh / University of Pittsburgh
Janella	Watson	New York Hall of Science
Jane	Werner	Children's Museum of Pittsburgh
Karen	Wilkinson	Exploratorium
Corey	Wittig	Carnegie Library of Pittsburgh
Jen	Wyld	Oregon State University



Special thanks to



children's museum[®]
PITTSBURGH

UNIVERSITY OF
PITTSBURGH

LRDC
Learning Research &
Development Center

Continue the Conversation:

**MAKING +
LEARNING**

www.makingandlearning.org

caise | center for advancement of
informal science education

www.informalscience.org

All photographs by Renee Rosensteel