PROGRAM EVALUATION AND RESEARCH GROUP

CIMBLE/Math in the Making Summative Evaluation Report

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INTRODUCTION

The project

The Conference on Integrating Mathematics in informal Building Learning Environments (CIMBLE), or Math in the Making, as it has come to be known, is a project funded by a National Science Foundation Advancing Informal Science Learning (AISL) grant. The primary activity of Math in the Making was an invitational two-day workshop in the spring of 2016 of researchers and practitioners in out-of-school mathematics and making at the New York Hall of Science. The goals of the workshop were to:

- advance the field's understanding of how to highlight and enhance mathematics in making experiences
- develop tools and resources for informal educators
- foster collaboration for future efforts
- frame a research agenda on mathematical reasoning and attitudes toward math in the making and design environments.

In addition, Math in the Making developed resources shared online, convened a preworkshop on-line forum, and facilitated a post-workshop online discussion.

The evaluation

A team from the Program Evaluation & Research Group (PERG) has served as external evaluators for CIMBLE/Math in the Making. Working with the conference leadership team, PERG evaluators' focus included how well the workshop has achieved its goals as stated above.

The evaluation team:

- participated in and monitored planning activities;
- worked with project leaders to identify questions and develop strategies for collecting data/ documenting activities;
- obtained approval from the Endicott College IRB;
- monitored the pre-conference on-line forum;
- reviewed key documents;
- observed and conducted informal interviews at the conference at the NY Hall of Science in April-May 2016;
- conducted a survey of participants after Day 1 of the conference to get a real-time read on their thinking;
- monitored a post-conference online forum;
- conducted a follow up online survey with participants; and
- carried out reflective interviews with a small sample of participants in early 2017.

An evaluation design matrix is included in Appendix A. Quantitative data were analyzed descriptively, given the small number of participants. Qualitative data were initially analyzed using a constant-comparative method, and themes were then identified through

more formal coding. Formative feedback was provided as data were available, and an interim report was prepared in the fall of 2016. This summative report includes a look back at the project from the start, a review of products, and concluding interviews with a small sample of participants.

FINDINGS

Planning and pre-conference activities

Project leaders and the conference committee carried out a thoughtful planning process, refining the agenda to reflect the challenges and questions posed by the conference committee and others they consulted. With careful consideration, they invited suggestions and compiled a list of invitees that represented a diverse mix of members of the mathematics and maker communities.

Two foundational documents, a <u>goals and values document</u> and a <u>literature review</u>, were developed and shared with invitees, as well as a <u>resource list</u> including links to several videos. Many of the invitees engaged in a pre-conference online forum posted on the CAISE <u>website</u>. Participants introduced themselves and a lively discussion took place in response to three prompts posed by the project team: 1) Is there math in the making? Do you believe math is integral to making and tinkering experiences? If so, give examples/If not, why not? 2) [Regarding the Shared Goals and Values document] what aspects resonate with you and your work? What seems to be missing or needs work? What other ideas and questions does this document suggest to you? And 3) How important is it that learners recognize the math in making and tinkering experiences?

In describing their work and backgrounds, many mentioned ways in which they seek to address issues of access and equity. Mathematicians and makers tended to hold differing perspectives on starting points and emphases in considering the relationship of math and making.

The following quotes are but a small sample of the rich conversation that provides a prequel to the face-to-face conversations that followed at the workshop.

Yes, math needs to be made explicit in making. It is important for helping people who might not see themselves as people who do math to identify as actually doing math. Participation changes identity.

I've found for many makers, especially artists, making is an intuitive process... their mindsets can be at odds with the analytical mindset associated with formal math.

How can we help makers "pull back the curtain" on the math they engage in? How can we help them use this type of reflection to ... reposition themselves relative to math and/or redefine their identity related to math?

One of the co-PIs commented on the exchange that "there is a tension among our goals as educators, the audience we are trying to reach, and our approach to the explicitness of the math... depending on whether folks are coming from a making/tinkering perspective or a math perspective."

During the conference

Participants were excited to be together, and they were deeply engaged in exploring the questions and active challenges posed. They found the keynotes, activities, and discussions pushed their thinking and fostered conversations they hadn't had before, either within the making or math communities or across.

The welcome and keynote by NYSCI staff set the stage for the exploration that would take place over the next two days. Participants were eager to get to meet each other in the "speed dating" getting-acquainted activity, which quickly forged a sense of community.

Participants found the observations in the Design Lab and the hands-on experiences very provocative and worthwhile.

In debriefing their observations in the Design Lab, participants shared what they had seen and the questions that had arisen in their groups.

We mostly talked about how this is very hard. We thought about the paper folding activity, what was mathematical, relationships between what we wanted to transfer, the relationship of tinkering as a disposition and what we want kids to learn... there's a lot to be said about the design of the activity in supporting various elements, kinds of understanding. What help could be offered to attune kids to the math?

What kinds of pre-math experiences should people be having before coming to an experience like this? And iteration—what can be learned when there's time for multiple iterations?

We talked a lot about geometry, 2D to 3D, about the dowels...unexpected qualities of made things that may become apparent when you try to take a mathematical lens to something. We were struck by the shadows cast by the dowels, the negative space.

We also talked about age and objectives. A two-year-old holding a triangle is being introduced to a shape. A 15-year-old is different...is having a triangle enough? If your objective is to make a sturdy structure, your approach is more intentional.

In the making activities after lunch, participants were deeply engaged in groups as they constructed inflatable sculptures and experimented with Lego "scribbling machines." The "<u>Math-Eyes</u>," (mathematical observers who, after viewing making activities, identified the mathematical concepts embedded within them and examples of mathematical strategies used by participants) raised all sorts of questions about the locus, and types of mathematical concepts/ thinking embedded in the activities.

The idea of functions in the scribbling machines—that just blew my mind!

I was thinking that what we were doing was engineering primarily... I wasn't thinking about math, but now I can see the concepts that were definitely mathematical.

I need noticing tools!

Also on Day 1, participants had an opportunity to share and learn from each other's work in a showcase format. Many noted they would have liked longer, more in-depth experiences with making, and some said they would have liked more dialogue about equity and diversity issues, and more time to learn about each other's work. (Two days was clearly not enough time for all of this.)

Three themes were apparent in participants' reflections about math in making after Day 1 and in the continuing discussions on Day 2, across the math and making communities. (See Appendix B for questions.)

1) Defining math: How can we define math in ways that are meaningful to makers?

2) Context: For whom and under what conditions is it appropriate to incorporate math in a purposeful way in making?

3) Explicitness: How explicit should the math be in designing and facilitating making experiences?

In their comments about defining math, there were some differences in orientation between participants who identified as makers, and those who were part of the math education community.

Self-identified makers expanded their definitions of math:

I wasn't in love with the idea of calling out specific concepts of math in making, but after discussions, it became clear to me the need to find a model of thought and math process [either overlapping or similar to engineering or scientific method] and weave that through.

Today expanded my ideas of what math is. I was thinking that math could be measuring or thinking about proportion... thinking about Lego scribble bots as functions was mind-blowing.

Math educators commented:

After day 1 I am more convinced that we are better off thinking about practices than about content as a design goal.

Now I have a better sense of what some non-quantitative math could look like.

A new idea I had today is to think about mathematical thinking skills.

Comments about context and explicitness were more unified across the groups.

I now think that there is math/mathematical thinking in all making, but the full extent or range of the math practices will vary based on the maker, the specific making activity, the specific context of the making, and the degree to which the math is implicit vs explicit will vary.

Confirmed my belief that it is <u>tricky to connect open-ended making experiences</u> <u>with ideas/concepts/methods that the participant will recognize as 'math'</u>, but helped shift my thinking whether '<u>labeling'</u>, trumpeting' or putting signage up to help make that connections is the best/only/even a workable attempt at the solution.

Based on participants' comments about their Day 1 experiences, the conference leaders revised the Day 2 agenda to provide some concrete examples from museum exhibits. This was very useful, according to several participants. As one commented, "it's so much easier to talk about concepts grounded in a real example."

Equity also was a theme on Day 2, emerging both through explicit attention to this during the keynotes, and through experiences and discussions in which issues of gender equity arose, with some women pointing out ways in which men dominated conversation in a couple of their groups. The keynote presentations took the group into an examination of funds of knowledge and provided a view of equity from a maker's perspective. Many people also commented on the importance of attending to equity and diversity in the design of experiences and considering access to the environments in which spaces for making exist.

Kids don't make a distinction between in-school and out-of-school math in maker spaces... we need respond to the cultural knowledge they bring [and bridge informal and informal spaces].

One thing I bit into is the idea of using the experiences that they bring with them. Adults, kids, intergenerational experiences... that's the scaffold for new learning.

If you take an equity lens, you have to step outside the museum doors to begin with. And then Funds of Knowledge is about helping people understand that mathematics is embedded in their lives.

The small group conversations around varying topics were rich and offered participants a chance to go deeper into areas of particular interest to them, from Making in Math Education to Making Math Explicit. Initial conversations about next steps were productive to varying degrees and, overall, formed a solid foundation for moving forward.

As the day wrapped up, it seemed clear that the conference provided a forum for experiences and conversations that were bubbling up into new insights, as well as more questions and possibilities.

Post-conference

Online forum

In late July, the project leaders hosted a two-week post-conference forum. Perhaps due to the timing, participation was very light.

Dissemination

Project leaders have made presentations at ASTC, conducted a poster session at an AISL conference, written an article for ASTC <u>Dimensions on What We Learned</u>, and entered a video in the Video For All Showcase. In addition, they were interviewed for a <u>Q&A piece</u> on informalscience.org, and have posted their <u>project reflections</u> on the CAISE website.

The Math in the Making project <u>website</u> includes a video about the workshop, as well as key documents. The project leaders will continue to update the site as their work moves forward.

Survey

A survey was distributed to workshop participants in early fall 2016. The 27 of 60 participants responding (21 completed surveys, 6 partially completed) provided some perspective on what participants were thinking about the conference themes, and described actions they had taken after some time had passed. Respondents included both those who identified as makers (14) and mathematics educators (14), with 6 identifying as both. They worked at universities, museums and science centers, as well as non-profits. Of the 20 who answered the demographic questions, 13 were female and 7 male; 17 Caucasian/White, 2 Asian and 1 Black/ African American. There were no identifiable patterns in responses based on career identity or workplace environment. When sorted by gender, several women mentioned making math accessible to those who don't think of themselves as math people, whereas the men did not mention this. Men and women voiced the need for more/earlier discussion of equity at equal rates.

When asked to reflect on the workshop goals, respondents said the most progress had been made on finding points of commonality in terms of values, burning questions, and wonderings. They reported that the least progress had been made on discussing and identifying what tools and resources the field could use for highlighting math in the making, though many noted that some progress had been made toward this goal. They were divided about how much progress had been made toward helping to foster participant collaborations for future efforts.

Since the workshop, 7 of 23 said they had contacted or met with someone from the workshop to collaborate on further work. In regard to future collaborations, 17 of 22 said they plan to contact or meet with someone from the workshop in the coming months, while 5 said they did not plan to do so.

Participants offered several suggestions about what would help support further collaboration. In particular, several mentioned that an opportunity to collaborate on a concrete project with a defined output--such as a paper, special issue of a journal, toolkit or roadmap of resources for math in the making-- would be helpful in fostering collaboration. Several others suggested that establishing asynchronous communication channels and providing information about possible funding would be helpful.

Sixteen people responded to an open-ended question about shared values, questions and wonderings, almost all of them identifying multiple shared values or questions that had come up. The most commonly cited shared values were promoting equity (4), the experience of making as a way to promote learning (4) and active and engaged learning (3). The most commonly shared questions were: 1) How can we promote math learning and reflection without distracting from the freedom in the authentic making experience? (3 mentions); 2) How explicit should the math instruction/ learning be in 'math in the making?' (4 mentions), and 3) How do we change people's mindsets about math and about 'math in the making?' (3 mentions). Another point that surfaced in 3 of the comments was amazement at the unexpected ways that math and making connect.

There are direct and obvious links between making and mathematics. We would like to find better ways to make those linkages more clear to museums, educators and visitors, but we need to be careful not to take them out of the making mindset generated by maker spaces. Mathematical reflection is important, but not to the detriment of the making experiences.

Two camps seemed to emerge, one of them finding math in existing maker activities, and another of designing (pseudo)-maker activities around mathematics.

The most valuable aspect of the workshop, according to12 of 21 respondents, was meeting other workshop participants. With some overlap, 7 mentioned discussions and getting to share approaches, challenges or questions as particularly valuable. Two more commented along similar lines: 1 said that it was most valuable to find out about people's projects, and another mentioned being part of the group energy. 3 said that thinking about math in the making or doing making activities and looking for the math in them was especially valuable.

The value in the workshop for me was working with others in the field and sharing tools and approaches as well as challenges and questions.

Networking, getting to see the projects other people are working on and being inspired/re-energized by them.

Comments on the workshop's influence on participants' thinking varied. While 1 said it had not influenced his thinking as he's already immersed in the work, the other 16 who responded described influences including placing a greater value on collaboration among different types of professionals and programs (4), raising questions for their own research and practice (4), and being more thoughtful or intentional about their activities since the workshop (4). 4 noted that they had increased their use of a "math lens" when they think

about their activities. Overall, 9 mentioned some increase in reflection, awareness and/or understanding.

I now believe there is meaningful math in the making, and I see the value of both highlighting that for learners (so they broaden their beliefs and attitudes towards math) and using making as a vehicle for practicing mathematical thinking.

I've found myself considering things differently, specifically calling into question how specific to be about both the math and the making.

When asked about the workshop's influence on their work, 8 described an influence on their research program, including 5 who have submitted or plan to submit grant or other funding proposals influenced by their experiences. 2 others said it had not *yet* had an influence on their work, and 6 reported that their experiences at the workshop have led them to initiate or look for more collaborations with professionals from a different field (e.g. a maker looking to collaborate with a math-focused professional).

We have submitted a grant proposal to do further work with informal math/math in the making.

I've begun to rethink research designs to better leverage collaborations of this sort.

Regarding dilemmas raised, two interconnected themes were each mentioned in the comments of 6 (of 19) respondents: the difficulty of balancing between guiding or facilitating math learning and allowing for the authentic process of free exploration in making, and the question of how transparent and explicit the math instruction or discussion should be in 'math in the making.' These themes came up throughout the survey in other open-ended question responses as well. 3 mentioned questions that had been raised about removing barriers to entry and making math in the making accessible to members of different communities. 3 also mentioned that challenges in communication—both across and within groups—have been more on their minds, and 3 mentioned the challenges of defining 'math' for themselves and others.

Again, it's the question of how much math content to point out and when/in what contexts. When math emerges from the activity itself it's terrific, but are we doing learners a disservice by counting on this to happen?

Of course, the issue of calling it math is always a dilemma. If you don't know it's math, you don't know you can do math. If you **do** know it's math, you may never enter in the first place!

Respondents suggested several next steps to advance math in the making work. 6 (of 18) mentioned following up and staying connected with other participants, especially to hear about what changes others have made since the workshop and how effective those changes were. 4 suggested that developing case studies or examples of math in the making is an

important next step, and 4 said research into implementation of math in the making ideas and dissemination of findings from that research is important.

It would be nice to have a check-in to see changes that one site has taken up, and how that worked out.

Getting well-defined tools to help each institution train our facilitators translate the math learning to the community.

I'd love to see some deliberate theorizing about what kinds of learning is best supported in making and what kinds of mathematics (not just the mathematics of professional/academic mathematicians).

Follow-up interviews

Interviews with four workshop participants were conducted in early spring 2017, nearly a year after the workshop. Two of the interviewees were from the maker community, and two were mathematics researchers focusing on the process of making with traditional materials. Two had presented or facilitated a session during the workshop.

All were asked to reflect on if and how their thinking had changed since the workshop and what conversations or experiences might have influenced that; what actions they've taken over the past many months, what's important to keep in mind regarding equity, and what next steps they'd suggest for moving the field of making/tinkering and informal math education forward. (See Appendix D for interview guide.)

Three described ways in which the gathering had influenced their thinking, or their assumptions about math and making. All spoke of the rich interplay between members of the math and making communities.

I had a lot of epiphanies... the conference brought together a bunch of people that I had some ideas about, have been in the STEM field forever, but rarely talk about these ideas. [Referring to the scribbling machines activity]... We're trying to figure this computational thinking stuff out. I love the notion of the variable being implicit in the activity... to build something and make adjustments, speed and direction... subtle changes... so I came back with this lens in my head, and have been thinking about this [and trying things out].

It was my favorite, favorite meeting I've ever been to! I loved that there were people who were thinking about this but weren't necessarily coming from the same place...It was predominantly women, so there were more conversations than in the usual settings that are more male dominated... [it hasn't changed my thinking] but there are things that I still talk about. I was hoping that I'd come away with some great understanding or ideas about how people design for math and making experiences... I got to meet so many designers in museums, [that's been] a huge personal influence. ...conversations with math enthusiasts challenged assumptions I had about math in a lot of ways...Conversations in which I didn't totally agree with people stuck in my head. Those had to do with when to introduce the math, when it is inherent in the activity, when to call it out. People who love math the way I love making were in favor of doing it in a way that I didn't agree with... there were some conversations in which math was innate- in particular, the seamstress [using] innate knowledge—the fluency that comes from using and manipulating math versus when you have an introductory activity where you want to highlight the math. My awareness is heightened. We don't highlight math in exhibits and activities as much as we should but I'm seeing it all the time.

Each interview subject has taken ideas that came out of experiences and conversations at the workshop, incorporating them into their own work. One, a museum educator, has been integrating and exploring the connections between the expressive and mathematical elements of an activity, and "*ways to help people take advantage of the muscles they already have*," engaging museum visitors with mathematical concepts through activities such as making cookie cutters with metal strips, sewing mythical creatures and using simply-programmed Lego machines.

Another has taken the concept of 'make and take' activities from exhibit designers to modify her math and traditional textiles program for youth to focus more on projects that can be completed in a single session. And a third said she's *been taking action in small ways, doing a lot more Lego tinkering, having a lot more conversations about math than I would have...*

While one person said she hasn't yet followed up on conversations about possible collaborations, others have. Two of those interviewed have been engaged in a project together (one as convener, the other as one of several participants) to test out some activities with Lego kits and give feedback. A third had a conversation with another participant and the NSF program officer at the workshop and wrote a supplemental grant to support one of her graduate students in working on a science museum project with that other person.

All of those interviewed had been thinking about equity challenges in their work prior to the workshop, but the gathering highlighted these issues and provided a forum for dialogue. One noted that he was deeply moved by the Funds of Knowledge presentation, which has informed his work on two projects in which his museum has been working with historically marginalized community members to explore ways to engage them with the museum, including designing activities that use materials and cultural traditions that honor local heritage.

Two others noted that it's important to ask *Who is doing the making?...Is it the white tech guys* or are we considering the ways in which activities and materials are inherently gendered and class-biased? Even within traditional communities, knitting a sock, for example, is seen as a grandmotherly activity, while building something with pipes is more easily seen as using mathematical concepts. Another question is *where are making activities situated*? Museum admission and transportation present barriers for some, while libraries offer free access and are generally more accessible in terms of location. Schools reach young people across the community, but their *curriculum is so locked up...* it's difficult to create time and space to engage students with inquiry-focused making activities.

Suggestions for next steps were consistent with survey results and conversations at the workshop. One person spoke about the value of concrete opportunities to explore the process of math in making. He described a project he had just participated in with colleagues as a simple model of what's possible. Two people (including one of the other interviewees) had sent out Lego kits to a few people and asked them to explore and provide feedback. Another person suggested it would be helpful to have disciplinary-based conversations *with five people who are really designing with math in mind*, as well as cross-disciplinary conversations and a mechanism for sharing what people are doing, what's working and what's not. Another said *it's important to think life-long and life-wide*, and it would be helpful to explore the balance [between the math and interests and compelling materials]—*teasing out what, through a set of case studies or exemplars where people in the math realm see it as a wonderful experience and people in the making do too… how do we get to the balance place?* Further exploration of equity is also important...One person noted, *paying attention to who isn't coming, who's drawn to what kinds of activities and how we design to be more inclusive*.

The Discussion section that follows sums up what we learned.

DISCUSSION

As described by internationally renowned musician YoYo Ma, the *richest environments for transformation exist at the edges where two ecosystems come together*¹. The Math in the Making workshop provided such a fertile environment for makers and informal mathematics educators/researchers to explore the intersection of these two fields, and generate new perspectives, ideas and possibilities. Solid progress was made on all of the workshop's goals: 1) collaboratively generating approaches to integrating mathematics in making and design environments and programs; 2) producing a research agenda to guide studies of mathematical reasoning in making and tinkering; and 3) developing new partnerships between researchers and practitioners in the fields of out-of-school mathematics education and making/engineering.

This was the beginning of what could become an extended conversation, and opened up several lines of inquiry about defining mathematics and its relationship to making, starting places (designing for specific mathematical learning outcomes versus starting with interests and compelling materials and activities in which math is integral), and where/ how to find a balance between math and making. In addition, equity was both explicitly addressed and a real-time sub-text that ran through the workshop conversations and experiences.

The expertise and assumptions of members of both communities were illuminated as participants were immersed in conversations and activities that raised their awareness of the possibilities and the questions across disciplines. Is it math? (or engineering, science, etc.) How explicit should the math be? Which math? What materials? What space? Whose voices, ideas and practices? Are there differing approaches that make sense depending on the context and purpose of making activities? What is the role of design vs. facilitation? How can guidance be provided for educators who don't have strong mathematical backgrounds?

Some of the tensions and challenges identified, such as defining mathematics, addressing equity, and the role of learning outcomes and choice in designing informal learning experiences are not new from a larger perspective. What is evident is that this workshop brought together two communities who engaged with each other in ways that could produce new interdisciplinary insights, approaches and products to advance the field. Several participants have pursued next steps, including one team that invited other participants to engage with a concrete exploration of materials to inform designing for computational thinking. This is a simple and useful example of what's possible, and addresses all three of the workshop's goals.

The Math in the Making workshop created a fertile ground for continuing exploration through conversation and collaborative projects, but any next steps – whether creating an asynchronous forum for exchanging ideas and information or pursuing collaborative research projects – require funding.

¹ Remarks at the Passion Driven Learning Institute, Harvard Graduate School of Education, Cambridge, MA., August 8, 2014

RECOMMENDATIONS

• Culminating conversation

Project leaders plan a culminating on-line conversation to get more detail about participants' reflections and actions over the past year. This will provide an opportunity both to look back at what people have learned and what they are thinking and doing, and to look forward toward next steps.

• Ongoing community of practice

Questions posed starting in the pre-conference on-line forum and explored in the workshop and beyond are complex, salient, and important. Consider setting up an ongoing on-line community for the exchange of ideas and information, and possibly reconvening this group face to face at a future date (for Math in the Making 2.0). Consider setting up both cross-disciplinary and disciplinary communities of practice to explore some of the most salient questions identified by participants:

- 1) How can we promote math learning and reflection without distracting from the freedom in the authentic making experience?
- 2) How explicit should the math instruction/ learning be in 'math in the making?'
- 3) How do we change people's mindsets about math and about 'math in the making?'
- 4) How do we authentically respond to and cultivate equity in access to, design, and facilitation of math in making experiences?

• Interdisciplinary research and development

Pursue interdisciplinary research and development projects in math in the making. Such projects would allow for in-depth exploration into promising approaches for embedding rich mathematical learning with making activities in various settings – from designed informal learning environments that offer visitor experiences to making/tinkering environments that provide more extended engagement – focused on finding, articulating and engaging with the mathematical thinking embedded in the making. These projects might invite participation from other mathematics educators and makers to try them out and provide feedback, and develop guides for others to use in their own settings (such as the one described in follow-up interviews).

•Cultural responsiveness

Work with the community and experts on culturally-responsive education to identify culturally-situated math in the making activities, and find ways to build connections with informal education programs/settings.

APPENDICES

A. Evaluation design matrix

CIMBLE EVALUATION DESIGN MATRIX									
DATA SOURCES	Observations- planning	Observations- conference	Interviews/ focus group- planning team	Interviews/ focus groups- participants	Interviews-other key people	Survey- participants	Monitor web site use/communication	Review products	Review planning documents
QUESTIONS									
Pre-conference	1			[
How effective were pre-conference activities in setting the stage for a highly productive conference?	v		٧				v	v	٧
How well was the team able to present information and perspectives from the two fields in order to inform the conference?	v		٧		٧		٧	v	
During the conference									
In what ways and to what degree does the conference facilitate dialogue and knowledge-sharing and building among participants?		V		V	٧	٧	V		
To what extent was the participant group diverse and broadly representative?		v		v		v			v
What areas of convergence and divergence of approach surfaced during the conference?		v		v	٧	V	٧		V

What was participants' experience of the conference?									
Did participants see mathematics through a different lens? Maker spaces?		v		v		v	v		
Were new ideas and partnerships for promoting mathematical learning in maker spaces generated? Are concrete steps being taken/envisioned for furthering these ideas?	v	V	V	V	V	V	V	V	
Did participants feel a research agenda was articulated and developed as part of the conference? Did they feel their views/perspectives were represented?		v		v		V	V		
Post-conference									
What products were produced as a result of the conference?							v	٧	٧
What products were produced as a result of the conference?How well did products of the conference contribute to the field (e.g., development of future goals and agendas, new insights, reports and presentations, etc.)?	v		V	v	v	v	√ √	V	V
 What products were produced as a result of the conference? How well did products of the conference contribute to the field (e.g., development of future goals and agendas, new insights, reports and presentations, etc.)? To what extent did partnerships and plans that began at the conference continue afterwards? 	V		V	V V	V	 √	√ √ √	V	_√
 What products were produced as a result of the conference? How well did products of the conference contribute to the field (e.g., development of future goals and agendas, new insights, reports and presentations, etc.)? To what extent did partnerships and plans that began at the conference continue afterwards? To what extent, through the conference, were clear and actionable goals and next steps for the field articulated? 	V		V	√ √	V	√	√ √ √	√	
 What products were produced as a result of the conference? How well did products of the conference contribute to the field (e.g., development of future goals and agendas, new insights, reports and presentations, etc.)? To what extent did partnerships and plans that began at the conference continue afterwards? To what extent, through the conference, were clear and actionable goals and next steps for the field articulated? To what degree did participants buy into and support the process and outcomes of the conference? 	√ 		V	√ √ √		√ √ √	v √ √ √ √	 √ √ 	

B. Day 1 survey questions

1. Did today's experience confirm your prior thinking or beliefs about Math in the Making; or did the experience influence a shift in your thinking? Please explain. [I used to think/believe and now I think/believe...]

2. What aspect/s of workshop supported or enhanced your experience?

3a. What do you wish workshop facilitators designed differently? Or what was missing?

4. Other comments?

C. Follow-up survey

Math in the Making Post-Workshop Survey June 2016

Your individual responses will be kept confidential. We will aggregate survey responses by the community(ies) you identify with and your institutional or community affiliation to understand your interests, ideas, and concerns. A summary of the findings will be shared with workshop conveners.

If you have any questions, please contact Debra R. Smith at the Program Evaluation and Research Group (<u>drsmith@endicott.edu</u>).

Background Information

- 1. I consider myself a: (Please check any/all that apply.)
 - Maker
 - Mathematician
 - □ Mathematics Educator
 - Other (please explain) ______
- 2. My institutional affiliation[s]: (Please check any/all that apply.)
 - □ Community Center
 - □ Museum
 - □ Science Center
 - **U**niversity, Institution of Higher Education
 - □ Other (please specify)_____

Workshop Goals

The goals of the Math in the making Workshop were:

- To help participants find points of commonality across communities and among individuals in terms of values, burning questions, and wonderings,
- To help foster participant collaborations for future efforts, and
- To discuss and identify what the field could use in terms of tools and resources for highlighting math in making.
- 3. Please indicate the progress made on each of the Worskhop goals using a scale of 0-3 where 0 = no progress towards goal and 3= significant progress. Then comment on the goal-related questions below.

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	u No progress	i Early steps	z Some progress	3 Significant progress
Finding points of commonality in terms of values, burning questions, wonderings				
Helping foster participant collaborations for future efforts				
Discussing and identifying what tools and resources the field could use for highlighting math in the making				

- 4. What were the shared values, questions, wonderings identified at the workshop?
- 5. Have you contacted or met with anyone from the workshop to collaborate on further work?
 - □ Yes
 - 🛛 No
- 6. Do you plan to contact or meet with anyone from the workshop in the coming months? Yes
 - 🛛 No
- 7. If you would like to collaborate further on *Math in the Making* what would help support that effort?
- 8. What do you think are the most needed and valuable tools/resources for highlighting *Math in the Making*?

9. Further comments on Workshop Goals:

Other reflections on Math in the Making Workshop Experiences

- 10. What was the most valuable aspect of the workshop?
- 11. While recognizing the limitation of having only two days, what was either missing or given too little time?
- 12. To address or better address this issue/s, what could have been done?
- 13. Have/how have the workshop experiences influenced your <u>thinking</u>?
- 14. Have/how have the workshop experiences influenced your <u>work</u>?
- 15. What <u>dilemmas</u> about 'math in the making' are you thinking more about?

Next Steps: Future Work

While we have already gathered your first thoughts on this question in the homework following Day 1 of the workshop, we want to check in with you again to hear your ideas now that you've had more time to reflect on your experiences.

- 16. What do you think are the most important next steps to advance *Math in the Making* work?
- 17. Please identify any specific steps related that you have initiated since the workshop. If not, what 'next steps' are you interested in working on or contributing to?
- 18. Other comments?

Demographic Information

- 19. What is your gender?
 - **G** Female
 - Male
 - □ Other
- 20. Which of the following best describes your race or ethnicity? (Please select all that apply.)
 - □ American Indian or Alaskan Native
 - Asian
 - □ Black or African American
 - □ Hispanic or Latino/a
 - □ Native Hawaiian or other Pacific Islander
 - □ White/Caucasian

- Prefer not to answer
 Other (please specify)______

D. Follow-up interviews

How has your thinking changed since the workshop – perhaps as a result of the workshop? Your view of mathematics?

Which conversations or experiences from the workshop do you find yourself remembering/going back to?

What conversations have you had that were informed by/influenced by your experience at the workshop?

What have you done since the workshop in May that is related to the workshop?

For "making" people: How comfortable are you thinking about integrating math into your maker space? What challenges do you see?

What do we have to keep in mind re: equity as we move forward?

What do you now think are important next steps for the field of making/tinkering? For the field of informal math education?



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