

## SURVEY OF ASSESSMENT IN MAKERSPACES

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MakerEd

Open   
Portfolio  
Project

RESEARCH  
BRIEF

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## Surveying Maker Education Demographics & Assessments

To understand the impact that the expanding maker movement has on the demographics of maker-centered learning environments and their assessment techniques, we invited makerspaces across the globe to tell us about their demographics, assessment practices, human/material resources, and guiding philosophies.

Our 2017 makerspace assessment survey was distributed from spring to fall 2017 via an international maker education network, generating responses from 48 sites (20 in-school makerspaces and 28 out-of-school makerspaces).

In this research brief, we share findings from this survey (see the Appendix for a full copy of the survey), which will help researchers and practitioners gain a clearer picture of the assessment practices and interest in assessment among today's makerspaces, in and out of school. In this brief, we refer to "makerspaces" as both defined physical spaces as well as integrated programming within youth-serving, educational environments.

Our survey included two broad sections:

1. Demographics, including questions about youth served, staffing, and program information;
2. Assessment, with questions about the sites' overall and portfolio-specific assessment approaches.

Common questions from our prior surveys allowed us to compare demographic and programmatic details from Phase 1 of the Open Portfolio Project, as well as investigate various trends in the broader makerspace community over time. We substantiated and triangulated findings through ethnographic observations at three out-of-school and school-based field sites (see Research Briefs 12, 12A, 12B, and 12C), selected for their history of portfolio usage.

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### Who Were the Survey Respondents?

Forty-one of the youth-oriented makerspaces responding to our survey hailed from across the United States, in addition to six sites responding from European countries (Finland, Germany, Ireland, Italy, the Netherlands, and Romania), with one makerspace responding from Colombia, South America. The sites reported serving a mean of nearly 6750 participants annually, with a wide range—25 to 200,000—of annual participants. See Figure 1 for a visual map of the locations of the makerspaces participating in the survey and their relative sizes.

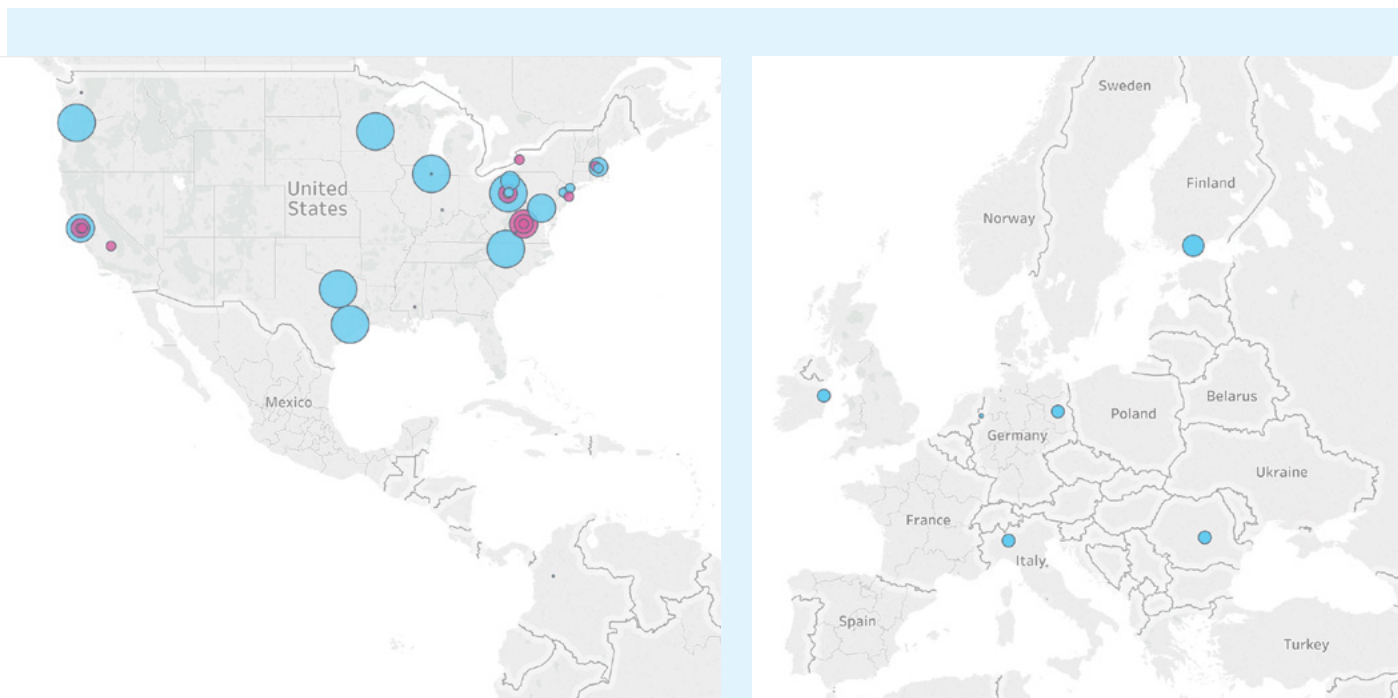
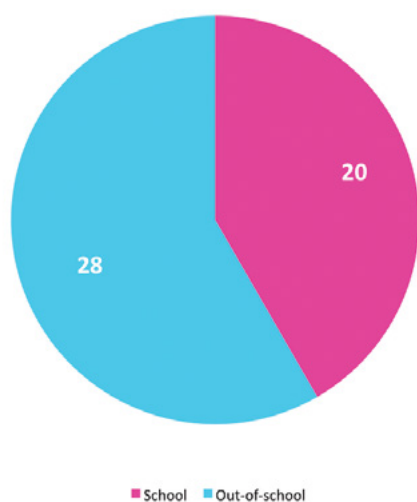


Figure 1: Survey respondents from North America and South America (left) as well as Europe (right). Both maps are not at the same scale.

The respondents identified as being located in one or more physical spaces, including 42% in schools, 10% in after-school programs, 23% in community-based organizations (e.g., libraries and museums), and the remaining 25% in a range of other settings (e.g., mobile makerspaces). Respondents represent a greater percentage of school-based makerspaces than our 2014 survey, reaching 42% of total respondents, compared with 35% from those surveyed in Research Brief 6 (see Figure 2). For the purposes of this brief, we examined some of the differences between in-school and out-of-school makerspaces and report on key differences whenever found.



Respondents have provided maker-oriented programming for an average of 5.1 years, an average of 6.5 years in out-of-school settings (1.4 years longer than the overall average), and 3.2 years in in-school settings, suggesting that in-school makerspaces are generally more emergent in the landscape.

Figure 2: Proportion of out-of-school and school-based makerspace respondents.



## WHOM DO MAKERSPACES SERVE?

Across all surveyed sites, we sought to identify the average diversity in relation to race and ethnicity, age, socioeconomic status, abilities, and gender of youth participants served. We also wanted to know more about makerspace staff diversity, in relation to their ethnicity, age, education, and gender. Unsurprisingly, there was a large variation across respondents; thus, we provide here a proportional (not weighted) average across sites.

### Racial and Ethnic Diversity

Across all makerspaces surveyed, 45.5% of program participants were White, 21.6% were Black/African-American, 8% were Asian, 0.3% were Native American, 1% were of Hawaiian or Pacific Islander descent, 6.7% were of more than two races, and 16.8% didn't fall in the given categories. Of all participants, 18.9% were Hispanic/Latino(a). While these represent the mean across all respondents, the sites vary widely in the populations they serve (see Table 1).

As a common measure of identifying market diversity, we utilized diversity indexes calculated with the Herfindahl-Hirschman Index (HHI), which takes the sum of each of the reported percentages into squares and divides it by 100. This index is a common measure of identifying market diversity (Rhoades, 1993) and has been applied to study policy and program diffusion (Napoli, 1999), effects of ethnic and racial leadership diversity on financial performance (Hunt, Layton & Prince, 2015), and the representation of the interests of ethnic minorities on television programs (Fowler, Hale & Olsen, 2009), among other uses.

HHI is a suitable measure for understanding diversity of various demographic aspects within complex educational settings, especially makerspaces, which often strive to broaden participation in disciplinary areas for traditionally underserved populations. In this case, a HHI score closer to 100% indicates a less diverse space. In our analysis for racial diversity of maker-oriented program participants, HHI includes all race-related variables, and we report on ethnicity separately.

Race diversity across all makerspace respondents was 57% on average, and this is the same as the racial diversity of participants in out-of-school and in-school settings. We compared the results of this year's survey to the one administered in phase 1 of the Open Portfolio Project to determine if there were any noticeable shifts in the demographics of the survey respondents over time. We should note that this analysis is based on two independent samples (i.e., respondents weren't exactly the same at both time points). And, given the wider breath of international programs represented in this year's survey, we've isolated comparisons of race diversity to the US respondents in this comparison to closer match the sample demographics from our prior findings.

**Table 1. Racial and Ethnic Diversity of Makerspaces**

	MEAN	MEDIAN	STANDARD DEVIATION
HISPANIC/ LATINO	18.9%	10.0%	22.7%
AMERICAN INDIAN & ALASKA NATIVE	0.3%	0.0%	1.0%
ASIAN	8.0%	4.0%	10.6%
BLACK/ AFRICAN- AMERICAN	21.6%	15.0%	23.4%
HAWAIIAN AND PACIFIC ISLANDERS	1.0%	0.0%	2.5%
WHITE	45.5%	50.5%	31.1%
TWO OR MORE RACES	6.7%	3.0%	8.2%
OTHER	16.8%	0.0%	33.8%

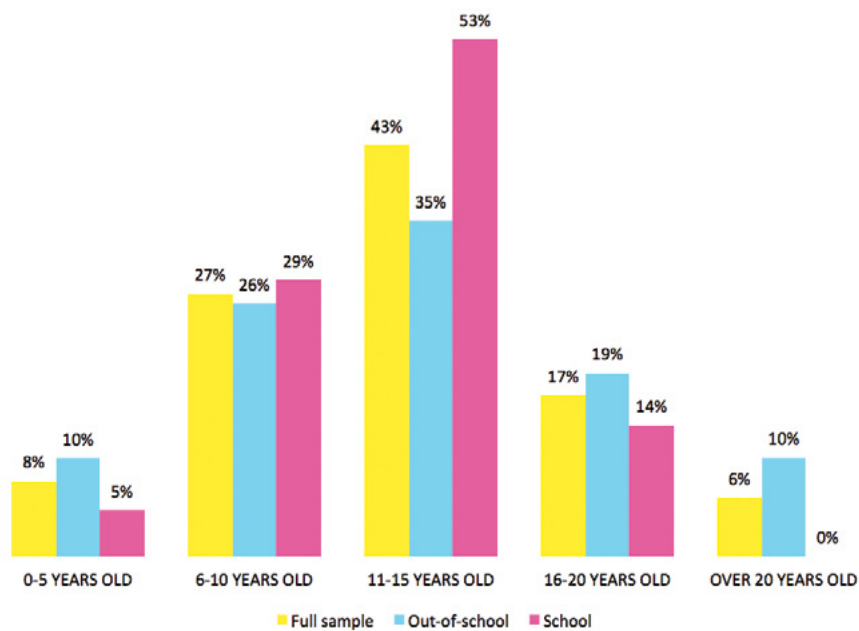
Using an independent t-test to determine whether a difference existed between the means of race diversity in the 2014 survey (M = 36.4%, SD = 26.7%) and in the 2017 survey (M = 54.2%, SD = 21.5%) in the US sites, we found that there were significant differences between the two time points:  $t(83) = -3.368$ ,  $P = .001$ . These results indicate that the mean of race diversity in the 2014 survey is statistically significantly lower than that in the most recent survey, indicating that there is significantly less diversity in the current sample in the US sites.

While this could be due to very different sites responding between the two time points or the small sample size of respondents, this may also be due to the influx of new school sites and makerspaces opening more easily in affluent, predominately White settings. The results could also be due to sites who identify themselves more as STEAM or innovation spaces and opted to not respond to this particular maker site survey. Further work should look at policies to preserve the overall commitment to minority or non-dominant groups in makerspaces.

## AGE DIVERSITY

*The most common age of youth served across both out-of-school as well as in-school makerspaces was between 11-15 years old (constituting above 42% of overall population). Over half of the youth in school makerspaces are within this age range, rendering the age diversity of these spaces as low. By contrast, the age diversity of youth within out-of-school makerspace participants is more stratified, serving over 26% of their overall youth population at 6-10 years old. Across all makerspaces, age diversity was at just over 56% on average. Figure 3 shows the age groups served across all surveyed sites.*

Figure 3: Average age diversity of makerspaces.



### Serving Individuals with a Range of Abilities and Economic Backgrounds

All surveyed makerspaces serviced an average of approximately 11% of youth with disabilities and 35% of youth who classified for free and reduced-price meal programs. On average, schools served more diverse populations in terms of ability (14% on average) and economic background (40%, on average, receiving free or reduced-price meals). The difference of population diversity in relation to ability and economic backgrounds may be in part due to the general role of schools, and by default, the populations represented, within society, though both in-school and out-of-school makerspaces play an important role in advancing larger equity initiatives within maker education. Future surveys may also wish to break out learning and physical disabilities to better understand a range of abilities in makerspaces and how makerspaces are working to serve those needs.

## GENDER DIVERSITY

Gender diversity among out-of-school and in-school makerspaces was nearly equal, with 1.6% of the makerspaces reporting to serve youth who don't conform to a binary gender definition (see Table 2). The gender diversity index calculation includes responses about non-binary and unidentified gender of youth participants. Overall, makerspaces serve a slightly larger amount of male youth (52% on average) than female youth (44% on average). This is similar across in-school and out-of-school spaces. Still, the less-than-10%-difference in gender participation among male and female youth in today's makerspaces is an important finding in comparison to the gender representation in STEM fields, which is traditionally much more lopsided (e.g., Beede et al., 2011; Riegle-Crumb, King, Grodsky, & Muller, 2012). It begs the question of how STEM initiatives do or do not closely align with makerspaces and their programming.

**Table 2. Average Gender Diversity Across Makerspaces**

	MEAN	MEDIAN	STANDARD DEVIATION
<b>HHI INDEX</b>	54.4% Full sample 55.5% Out-of-school 52.9% School	50.4% Full sample 50.5% Out-of-school 50.0% School	13.4% Full sample 14.8% Out-of-school 11.4% School
<b>MALE</b>	52.2% Full sample 51.4% Out-of-school 53.2% School	50.0% Full sample 51.5% Out-of-school 50.0% School	18.8% Full sample 21.6% Out-of-school 14.5% School
<b>FEMALE</b>	44.2% Full sample 43.2% Out-of-school 45.6% School	47.0% Full sample 45.0% Out-of-school 49.5% School	18.3% Full sample 21.2% Out-of-school 13.7% School
<b>NON-BINARY</b>	1.6% Full sample 2.0% Out-of-school 1.1% School	0.0% Full sample 0.0% Out-of-school 0.0% School	3.8% Full sample 4.6% Out-of-school 2.3% School
<b>OTHER</b>	2.0% Full sample 3.4% Out-of-school 0.1% School	0.0% Full sample 0.0% Out-of-school 0.0% School	8.7% Full sample 11.2% Out-of-school 0.4% School

Collectively, this continues to paint a picture that stands in stark contrast to the adult demographics (i.e., predominantly middle-aged, White males) attending U.S. Maker Faires or subscribing to Make: magazine (Maker Media, 2012, 2013a/b) that has been subject to a great deal of recent scrutiny (Buechley, 2013). The reported adult demographics may also not be representative of the youth who engage in making in their educational settings, outside of Maker Faires or branded opportunities. Continuing trends from our 2014 survey, this new generation of makers looks to be more diverse and holds a great deal of transformative potential, a point to consider as we think about supporting these young makers across their lifespan.

## DIVERSITY OF MAKERSPACE STAFF

Out-of-school makerspaces employ, on average, 10 staff members, whereas in-school makerspaces employ, on average, 12. School staff have a higher age diversity than out-of-school staff. In both types of spaces, staff members tend to be more frequently female (54%, on average, in out-of-school and 61%, on average, in in-school makerspace). Of the surveyed population, the largest number of out-of-school employees is between 36 to 45 years old (31% on average), while the highest age group of in-school makerspace employees is between 46 to 55 years old (38% on average). Within out-of-school and in-school makerspaces, the level of education is approximately equal, with educators having experienced, on average, 16.5 years of education, which is equal to the number of years required to earn a bachelor's degree.

Race diversity is low in both school-based and out-of-school makerspace employment, with White employees comprising 50% of staff in out-of-school makerspaces and over 80% in school makerspaces and Black/African American

employees comprising 12% in out-of-school and 5% in school-based spaces. For both out-of-school and in-school sites, on average 9% of the employees are Hispanic. This presents a wide margin when compared to the higher race and ethnic diversity of youth in both types of makerspaces. There's obviously a need to diversify staff, thereby providing youth with role models who look similar to them. Some out-of-school makerspaces are building pathway programs that provide opportunities for former youth participants to become employed at the makerspace, working toward decreasing this diversity margin between adult staff and youth participants (Keune & Peppler, under review).

## Makerspace Programming

We asked survey respondents to tell us about the programming they offer by selecting all that apply from a list. The most frequently mentioned programming includes courses and classes for youth (79% out-of-school, 85% school-based), community events (71% out-of-school), educator training and professional development (70% school-based), open studio time for youth (65% school-based), youth workshops (61% out-of-school), and summer camps (61% out-of-school, 25% school-based).

Comparing the programs offered across out-of-school and school-based sites reveals an interesting pattern that professional development is more frequently provided in school-based makerspaces and that out-of-school makerspaces adopt the kinds of formats that are often associated with school learning (e.g., workshops and classes). Table 3 highlights the most- and least-frequently mentioned programming offered.

**Table 3. Programming Offered Across Makerspaces**

	FULL SAMPLE (N=48)	OUT-OF-SCHOOL (N=28)	SCHOOL (N=20)
<b>COURSES OR CLASSES</b>	81.0% ↑	79.0% ↑	85.0% ↑
<b>COMMUNITY EVENTS</b>	63.0% ↑	71.0% ↑	50.0%
<b>OPEN STUDIO TIME</b>	60.0% ↑	57.0%	65.0% ↑
<b>PROFESSIONAL DEVELOPMENT</b>	56.0%	46.0%	70.0% ↑
<b>WORKSHOPS</b>	52.0%	61.0% ↑	40.0%
<b>DROP-IN PROGRAMS</b>	48.0%	46.0%	50.0%
<b>SUMMER CAMPS</b>	46.0%	61.0% ↑	25.0% ↓
<b>EDUCATOR MEETUPS</b>	35.0%	32.0% ↓	40.0%
<b>PROGRAMS FOCUSED ON GIRLS</b>	33.0%	32.0% ↓	35.0%
<b>OTHER</b>	<b>25.0% ↓</b>	<b>21.0% ↓</b>	30.0%
<b>WINTER/SPRING CAMPS</b>	17.0% ↓	21.0% ↓	10.0% ↓
<b>MEMBER PROGRAMS</b>	8.0.0% ↓	14.0% ↓	0.0% ↓

Note: Bolded percentages indicate most ↑ and least ↓ common responses.



## MOST FREQUENT ACTIVITIES OFFERED ACROSS MAKERSPACES

We asked sites to report the activities that presented their flagship offerings, meaning those activities and materials that characterized their makerspaces and were frequently facilitated. Respondents could select up to three choices from a provided list of topics and report other topics that weren't mentioned in the list. Overall, in out-of-school and in-school makerspaces, the most frequently reported activity was "Other" (42% on average), followed by robotics and 3D printing. Out-of-school makerspaces added other activities, including tinkering, exploratory play, paper art, engineering, recycled materials, CNC milling, language, and literacy. In-school makerspaces mentioned rockets and exploring recyclable materials. For both types of spaces, the least frequently reported activities included metalworking and sound design. Table 4 shows the average frequency of the activities offered across sites.

**Table 4. Most Frequent Activities Offered Across Makerspaces**

	FULL SAMPLE (N=48)	OUT-OF-SCHOOL (N=28)	SCHOOL (N=20)
OTHER	42.0% ↑	61.0% ↑	15.0%
3D PRINTING	29.0% ↑	21.0% ↑	<b>40.0% ↑</b>
ROBOTICS	27.0% ↑	25.0% ↑	<b>30.0% ↑</b>
2D DESIGN	21.0% ↑	18.0% ↑	<b>25.0% ↑</b>
FIBER ARTS	15.0%	14.0%	15.0%
INTERACTIVE ART	15.0%	11.0%	20.0%
LASER CUTTING	15.0%	7.0%	25.0% ↑
PHYSICAL COMPUTING	15.0%	18.0% ↑	10.0%
WOODWORKING	15.0%	11.0%	20.0%
MUSIC	13.0%	14.0%	10.0%
PROGRAMMING	13.0%	11.0%	15.0%
FASHION DESIGN	10.0%	14.0%	5.0%
SCRATCH (PROGRAMMING)	10.0%	11.0%	10.0%
GARDENING	8.0%	4.0%	15.0%
FILMMAKING	6.0%	11.0%	0.0% ↓
THEATRE ARTS	6.0%	7.0%	5.0%
WEB DESIGN	6.0%	4.0%	10.0%
E-TEXTILES	4.0%	7.0%	0.0% ↓
VIDEO GAME DESIGN	4.0%	4.0%	5.0%
COOKING	2.0%	0.0% ↓	5.0%
GAME DESIGN	1.0% ↓	4.0%	5.0%
METAL WORKING	0.0% ↓	0.0% ↓	0.0% ↓
SOUND DESIGN	0.0% ↓	0.0% ↓	0.0% ↓

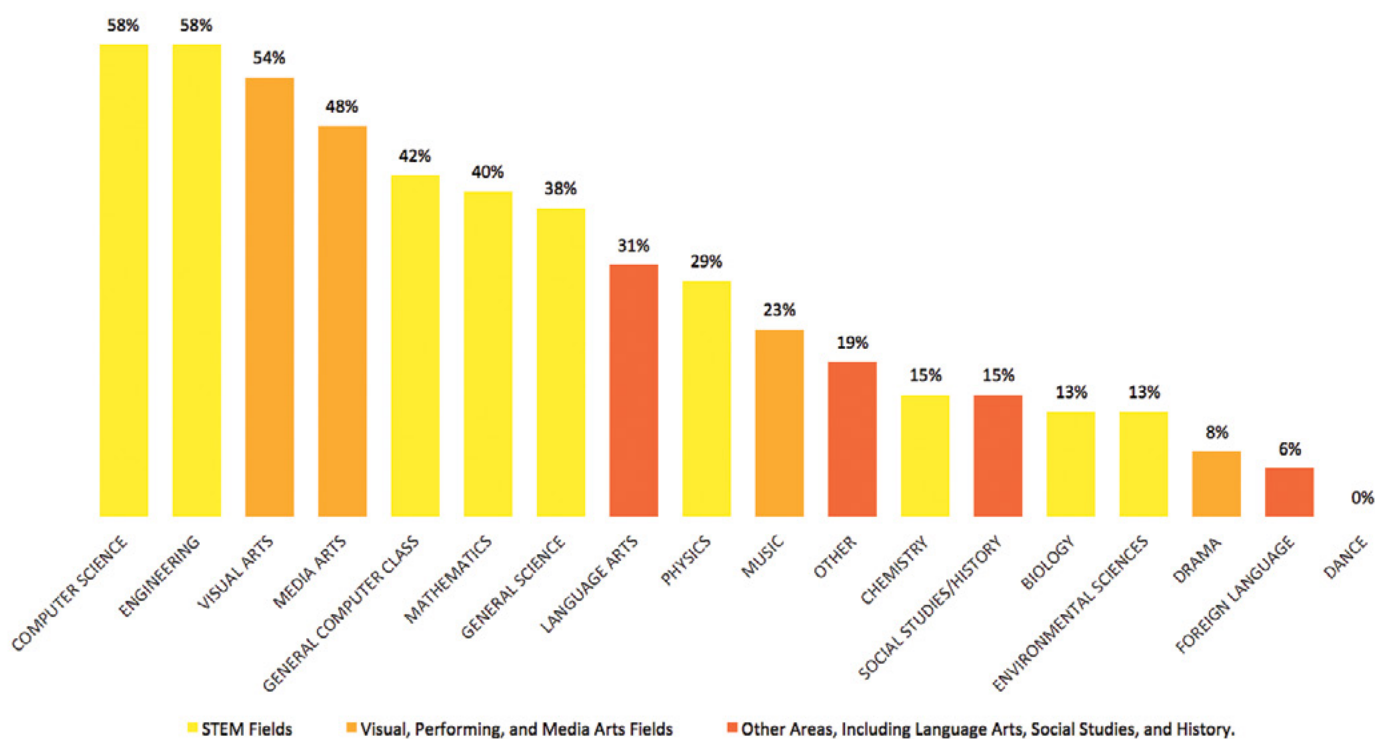
Note: Bolded percentages indicate most ↑ and least ↓ common responses.

## SCHOOL SUBJECTS TO WHICH MAKERSPACES ALIGN THEIR PROGRAMS

Overall, makerspaces reported that their programming aligns with an average of five school subjects. The school subjects that out-of-school makerspace respondents aligned most frequently with were engineering (61%), computer science (57%), media arts (57%), and visual arts (57%; Figure 4). The subjects least aligned with their maker programs were foreign languages (0%), dance (0%), and biology (4%). School makerspaces aligned their programs most frequently with computer science (60%), engineering (55%), mathematics (55%), and visual arts (50%). The subjects they reported as least frequently aligning with their program were dance (0%), drama (10%), environmental sciences (15%), and foreign languages (15%).

Comparing the alignment among out-of-school and in-school spaces shows that there's a larger divergence among media arts (57% out-of-school, 35% in-school) and general computer science (46% out-of-school, 35% in-school) that is, on average, more frequently aligned with out-of-school makerspace programs. In contrast, language arts (21% out-of-school, 45% in-school), music (18% out-of-school, 30% in-school), chemistry (11% out-of-school, 20% in-school), social studies/history (11% out-of-school, 20% in-school), biology (4% out-of-school, 25% in-school), and foreign language (0% out-of-school, 15% in-school) are, on average, more frequently aligned with school maker education programs. Across the board, it appears that there are many subjects to be explored within the context of maker-centered learning and room for improvement across disciplinary domains, in order to support a broader spectrum of interests and possibilities for engagement.

Figure 4: Alignment of maker programs with school subjects.



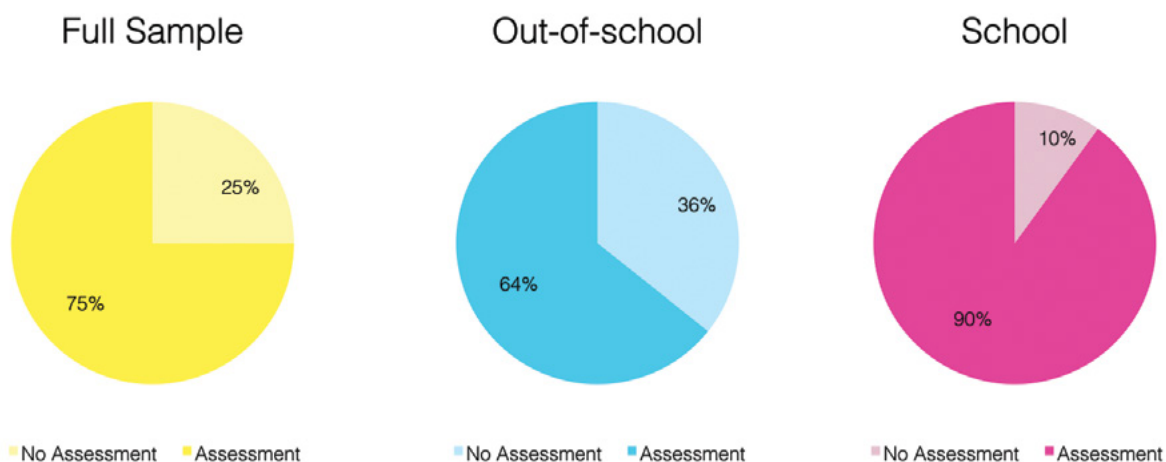
Comparing these findings to the prior survey administered in 2014, we can see shifts in alignment. Today, makerspaces most closely align their program offering with STEM fields, whereas they previously aligned their programming most closely with visual, performing, and media arts fields (i.e., digital media arts and visual arts). For example, while survey respondents aligned their programs, on average, 72% with digital and media arts and, on average, 70% with visual arts in 2014, this alignment changed to 48% for media arts and 54% for visual arts in 2017. Alignment with computer science remained similar (58% in 2017 and 57% in 2015), while alignment with engineering increased by over 50% and with mathematics and social studies/history decreased by over 10%.

Overall, this seems to suggest that makerspaces are aligning themselves with the STEM policy movements, including an increased emphasis on computer science for all, as well as engineering. However, the data analysis may also indicate that, in 2014, the sites early to embrace making were already engaged in media making in the realm of digital and visual arts, matching the attention and funding toward digital media at that time. In the years since, STEM-focused funding and widespread growth has opened up the subjects to which maker education connects.

## Assessment in Makerspaces

Across all makerspaces, three-quarters of survey respondents reported having assessment measures in place. However, there was a notable difference between in-school and out-of-school makerspaces, with 90% of school-based spaces integrating assessment, which might be due to curricular integration into other subject areas and/or pressures to grade youth work for demonstrable learning outcomes. By contrast, only 64% of out-of-school makerspaces reported the use of assessment in their programs (see Figure 5). Across both types of sites, the use of assessment seemed much larger than anticipated, revealing the size of the demand for high-quality maker assessment. At the same time, it also demonstrates that practice is ahead of research; despite researchers not providing a firm answer on how makerspace learning can be measured, educators in and out of school are moving forward to meet the practical realities.

Figure 5: Assessment in out-of-school and school makerspaces.



## ASSESSMENT TYPES

Of those out-of-school makerspaces that incorporated assessment into their programs (N=36), the most frequent approaches are youth self-assessment (i.e., a one-time reflection activity at the start or end of a program or accompanying each project; 36%), exit survey (i.e., a form presented to youth at the end of a program or activity that asks questions about their learning experiences; 32%), and peer assessment (i.e., critique or guided comments by a fellow youth participant; 29%).

In schools, the most frequently reported assessment types were self-assessment (65%), rubrics (60%), and portfolio assessment (55%). It's not surprising that schools report portfolio assessment more frequently considering this approach historically emerged as a school-based assessment alternative to numeric representations of student achievement (see Research Brief 11, "Introducing Phase 2 of the Open Portfolio Project: Assessment in Makerspaces"). Furthermore, rubrics are far more likely to be used in school-based settings than out-of-school settings presumably because they require a priori planning and likely stress common outcomes among makers, while out-of-school settings typically allow for more divergent and emergent outcomes.

It's important to note, too, that the least prevalent assessment types used across in-school and out-of-school contexts are those most heavily stressed in standard assessment measures—such as multiple choice, matching item, and essay questions—likely because they're a poor match to the types of learning occurring in makerspaces. See Table 5 for more detailed information on assessment types used and their usage among makerspaces. Examples of self-assessments, peer assessments, rubrics, and adult modeling are included in the Appendix of Research Brief 14.

**Table 5. Assessment Types Utilized Among Makerspaces**

	FULL SAMPLE (N=48)	OUT-OF-SCHOOL (N=28)	SCHOOL (N=20)
SELF-ASSESSMENT	48.0% ↑	36.0% ↑	65.0% ↑
PORTFOLIO ASSESSMENT	35.0% ↑	21.0%	55.0% ↑
EXIT SURVEY	33.0% ↑	32.0% ↑	<b>35.0%</b>
PEER ASSESSMENT	33.0% ↑	29.0% ↑	40.0%
RUBRICS	29.0%	7.0%	60.0% ↑
SHORT ANSWER QUESTIONS	21.0%	18.0%	25.0%
ADULT MODELING	17.0%	4.0% ↓	35.0%
PRE/POST-TESTS	10.0%	11.0%	10.0% ↓
ESSAY ITEMS	6.0% ↓	4.0% ↓	10.0% ↓
MATCHING ITEMS	2.0% ↓	0.0% ↓	5.0% ↓
MULTIPLE CHOICE	2.0% ↓	4.0% ↓	0.0% ↓

Note: Bolded percentages indicate most ↑ and least ↓ common responses.



Given the emphasis in both settings on self-assessment by youth, 33% of all responding makerspaces (7 out-of-school, 9 school-based) reported employing sentence starters to assist in youth's reflections. The prompts and sentence starters covered 18 aspects of making, among which learning, tools and materials used, project descriptions, challenges/failure, and proposed changes were the most frequent. Prompts included, "I had difficulty when...", "I solved my challenge by...", and "Did you use a new tool? Which one? How was it used to make your project?"

## PORTFOLIOS AND ASSESSMENT

Nearly a quarter of out-of-school makerspaces (21%) engaged in portfolio assessment, whether it be of publicly available or internally stored work, as compared to the 53% of school-based makerspaces that did (see Figure 6). Of the spaces that engaged in portfolio assessment, 75% of school-based makerspace respondents considered portfolio assessment at least "very important," compared with 42.8% of out-of-school makerspaces (see Figure 7). None of the schools thought that portfolios were "not at all" important, though five out of 28 out-of-school makerspaces did.

Overall, portfolio assessment was considered less important by out-of-school makerspaces than by in-school makerspaces, which also explains why a lower number of out-of-school makerspaces perform portfolio assessment in comparison to in-school makerspaces. This data suggests that portfolio assessment may not be a one-size-fits-all solution to assessment in makerspaces and may have greater perceived value to school-based than out-of-school settings.

Figure 6: Portfolio assessment in out-of-school and school makerspaces.

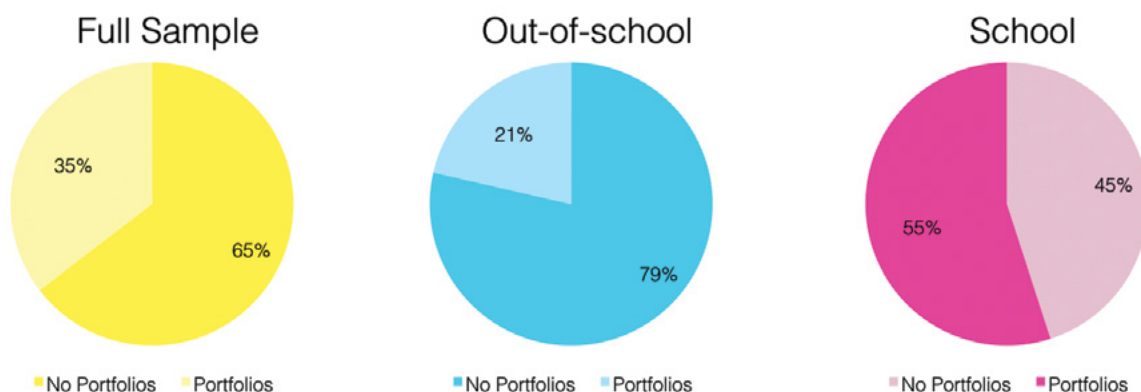
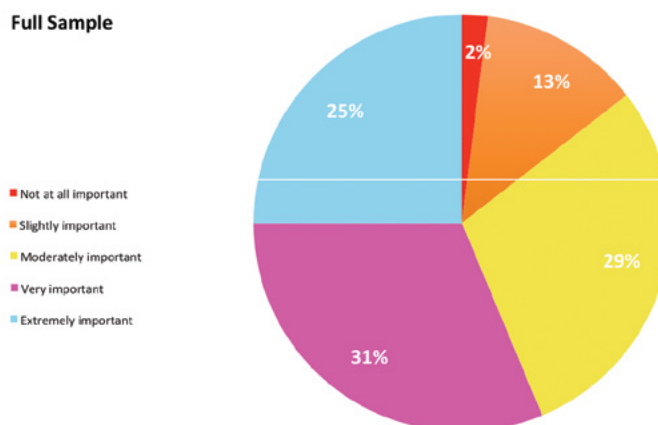


Figure 7: Importance of portfolio assessment for out-of-school and school makerspaces.



On the whole, about 40% of sites reported that they publicly post portfolios online for broader audiences. However, this was an area of stark difference between in- and out-of-school makerspaces. For example, 46% of the out-of-school makerspaces reported that they published portfolios and documentation of youth projects online, while only 20% of the in-school makerspaces shared youth projects openly beyond the makerspace or school community (see Figure 8). Of those, 66% of the responding sites (12 in-school spaces, 20 out-of-school spaces) reported sharing youth projects on a collective total of 27 platforms. The most popular platforms for this purpose included YouTube (27% on average), Facebook (25% on average), Instagram (23% on average), and Google Drive (16% on average). (See also Research Brief 13, “Youth Motivations for Open Portfolios.”)

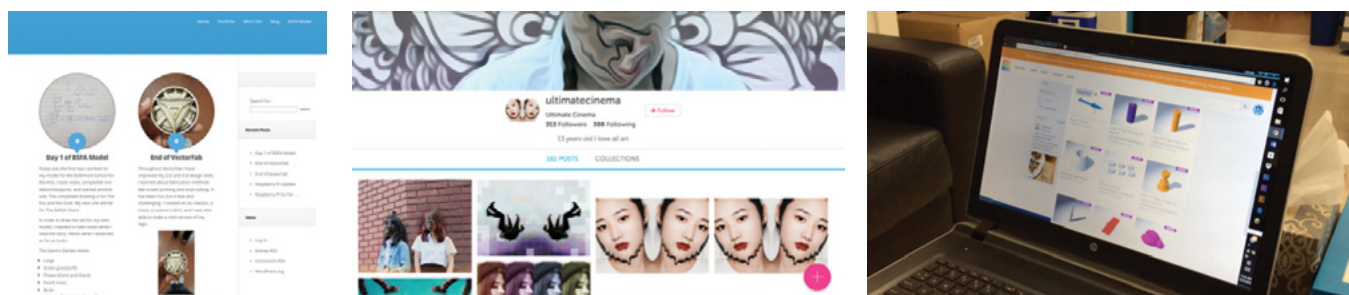


Figure 8: An open portfolio by a teen from the Digital Harbor Foundation in Baltimore, MD, including posts across three pages that are all openly available to the public.

A total of 91% of the respondents reported that they exhibit projects in their space. Sites mentioned a total of 15 ways of displaying projects in physical locations. Among these, the most frequently mentioned were display cases and special shelves; on top of cabinets and shelves; wall installations; during exhibitions, showcases, and gallery walks; in public and community locations; as well as everywhere throughout the makerspace where space was available. One space reported that youth projects become part of the furniture used in the makerspace, and three spaces reported displaying youth projects on screens in the space as well as published in local newspapers. See Figure 9 for more information.

Portfolio implementation seems to be fueled more by youth documentation practices than by staff practices around documentation and display. This suggests that when a venue adopts a portfolio system, a large component of its success involves engaging youth in self-driven documentation to help ensure that it becomes a more sustainable practice of the community. The implications are that the intentional development and dissemination of documentation practices need to be cultivated in makerspaces over time, which can lay the foundation for higher quality assessment practices. This is represented through the correlation matrix (see Figure 9), which shows that portfolio assessment and youth documentation practices correlate more so than portfolio assessment and staff practices.

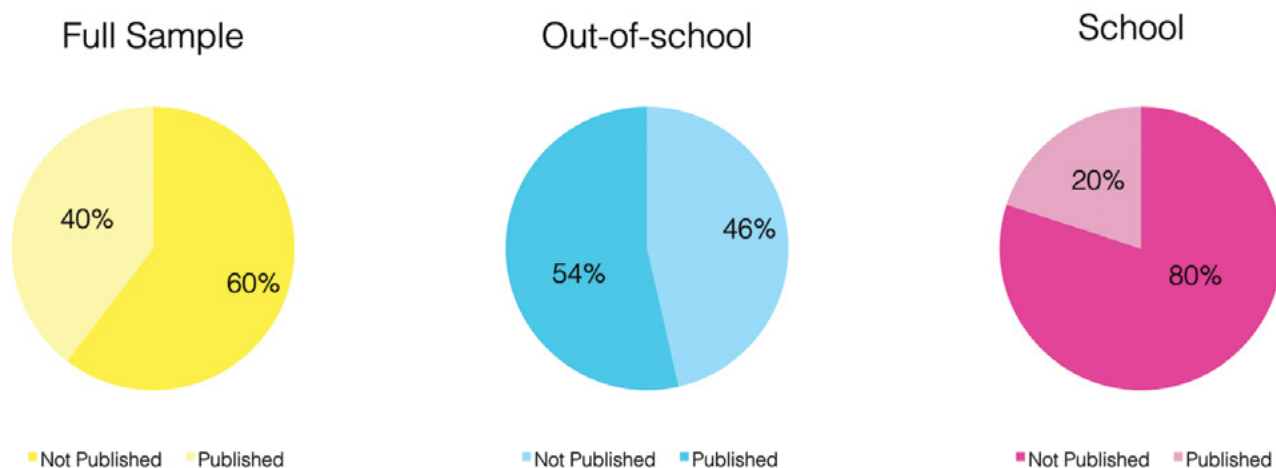


Figure 9: Portfolios published beyond the makerspace and portfolio assessment correlation matrix

	Portfolio Assessment	Youth Capturing	Staff Capturing	Project Display
Portfolio Assessment	1			
Youth Capturing	0.4947	1		
Staff Capturing	0.2893	0.2652	1	
Project Display	0.2405	0.4862	0.3223	1

## BARRIERS TO PORTFOLIOS

On average, neither the out-of-school nor the school makerspaces reported that portfolios were difficult to adapt into maker education, disagreeing with the notion that documentation takes time away from making, that it's challenging to integrate documentation with making, that making is mobile and documentation is stationary, and that documentation interrupts the flow of making. However, a number of spaces reported other barriers to documenting making, such as access to dedicated technology for documentation (23%), privacy concerns (e.g., sharing youth work, collecting consent and release forms, data security; 14.5%), and lack of youth motivations to capture making (14.5%).

Other barriers mentioned were youth insecurity to share unfinished work (4%), youth forgetting to capture work (4%), and youth—particularly young makers—having the requisite skills for capturing (4%). This echoes the barriers makerspaces mentioned in our 2014 survey. Resources, including software, hardware, and staff support, continue to be a challenge for integrating portfolios into maker education settings. Furthermore, these barriers speak to the need for larger policy issues, as well as the need to resource makerspaces to capture their making well and cultivate practices that are well aligned with youth motivations (see Research Brief 13, “Youth Motivations for Open Portfolios”).

## REASONS FOR PORTFOLIO ASSESSMENT

In order to better understand the rationale for investing in portfolios and assessment systems, we thought it helpful to gain a grounded perspective of the adult motivations. For out-of-school makerspaces, the most predominant reasons for portfolio assessment were self-reflection (86%), development of community inside of the makerspace (57%), and using portfolios for youth to develop community outside of the makerspace (54%; see Figure 10). Surprisingly, reasons that related to college preparation, college applications, and career development were the least mentioned among out-of-school makerspaces.

For in-school makerspaces, the most predominantly mentioned reasons for portfolio assessment were self-reflection (95%), program development (70%), and community development inside of the makerspace (55%). The first two responses mentioned by schools aren't surprising, as these are the main reasons for portfolio assessment mentioned in the literature.

In terms of portfolio assessment rationale, there were two key differences between school-based and out-of-school spaces: out-of-school makerspaces were far more likely to desire connections to communities through youth portfolios (54% vs. 35% for in-school spaces), potentially to support the youth themselves and/or to fundraise or promote the space. In comparison, school-based makerspaces were more likely to use portfolios to further their program development (70% vs. 36% for out-of-school spaces). In out-of-school spaces, the predominant adult motivations, in supporting community development, resonate with what we uncovered in regard to youth motivations (see Research Brief 13, "Youth Motivations for Open Portfolios"). Youth found it motivating to create portfolios when it led to increased engagement with and growth of the community in- and outside of the makerspace.

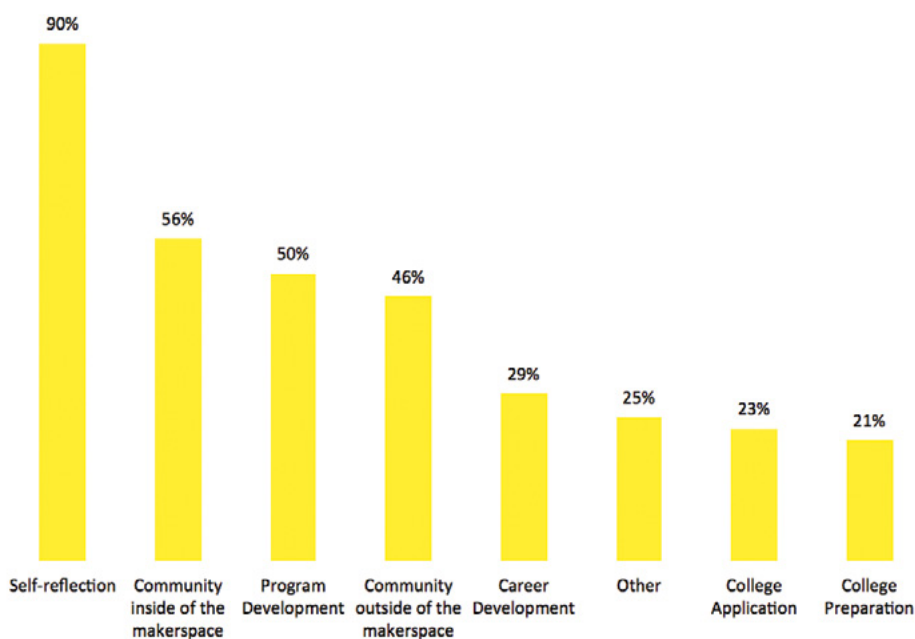


Figure 10: Reasons for portfolio assessment in out-of-school and school makerspaces. (Makerspaces could select multiple responses.)



The degree to which youth assessment data shaped administrative decision-making for the makerspace also varied across spaces. Across all respondents, 33% of the makerspaces reported that their assessment informed decisions on instructional design, 16% reported that their assessment informed decisions on future programming, 8% stated that it informed funding and administrative decisions, and 8% reported professional development improvements based on assessment. Other decisions informed by assessment included educational research, outreach, featured online programs, modes of communication with students, strategies for broadening gender equity, and the purchasing of materials. This echoed the need in prior survey as well; in addition to technology resourcing, there's a need for ongoing professional development to support work on portfolio assessment in makerspaces.

### **FUTURE PLANS FOR IMPROVING DOCUMENTATION**

A total of 36 makerspaces reported that they have plans to increase portfolio assessment. The most frequently mentioned aspects for improvement included increasing the number of projects that were being captured, improving the technical setup of documentation, increasing youth capturing, and making portfolio assessment more interest-driven by, for example, supporting a range of possibilities for capturing opposed to only one portfolio practice and increasing the number of educators who were facilitating portfolios within courses and programs of the same makerspace. Several makerspaces also asked for professional development, including in-person workshops, online courses, and publications. This is part of the rationale for the creation of the Maker Ed Practical Guide for Open Portfolios, as well as the continuing professional development offered through Maker Ed.

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## **Conclusions**

Our survey continued to track the emerging demographics of the maker education network. While overall makerspaces seem to be continuing to serve diverse populations in terms of ability, age, and gender, the race of youth participants in the US sites in 2017 is significantly less diverse compared with that of participants in the 2014 survey. As the network shifts over the years, this finding serves as a reminder to renew our commitments to underrepresented groups within the larger maker movement. In addition, this research increases our understanding of the extent to which portfolios and assessment practices are taking place amongst the network and the reasons and rationales for doing so. Furthermore, this work helps to inform future research and practice to respond to the demonstrable need amongst the network for high-quality portfolio and assessment practices.

## References

- Beede, D. N., Julian, T. A., Langdon, D., McKittrick, G., Khan, B., & Doms, M. E. (2011). Women in STEM: A gender gap to innovation. U.S. Department of Commerce Economics and Statistics Administration, 04 (11), 1-11.
- Buechley, L. (2013, October). Thinking About Making. Keynote speech presented at FabLearn Conference, Stanford University.
- Fowler, E. F., Hale, M., & Olsen, T. D. (2009). Spanish-and English-language local television coverage of politics and the tendency to cater to Latino audiences. *The International Journal of Press/Politics*, 14(2), 232-256.
- Hunt, V., Layton, D., & Prince, S. (2015). Diversity matters. McKinsey & Company, 1.
- Keune, A. & Peppler, K. (under review). Materials-to-develop-with: the Making of a Makerspace.
- Maker Media (2012). Maker Faire Bay Area Attendee Study. Online. Available at <http://cdn.makezine.com/make/sales/maker-faire-bay-area-survey-09-2012.pdf>
- Maker Media (2013a). Maker Faire Bay Area Attendee Study. Online. Available at <http://cdn.makezine.com/make/sales/MFBA%202013%20Survey%20.pdf>
- Maker Media (2013b). World Maker Faire New York Attendee Study. Online. Available at [http://makermedia.com/wp-content/uploads/2013/01/WMFNY-2014-deck\\_FOR-PRINT.pdf](http://makermedia.com/wp-content/uploads/2013/01/WMFNY-2014-deck_FOR-PRINT.pdf)
- Napoli, P. M. (1999). Deconstructing the diversity principle. *Journal of Communication*, 49(4), 7-34.
- Rhoades, S. A. (1993). The herfindahl-hirschman index. *Fed. Res. Bull.*, 79, 188.
- Riegle-Crumb, C., King, B., Grodsky, E., & Muller, C. (2012). The more things change, the more they stay the same? Prior achievement fails to explain gender inequality in entry into STEM college majors over time. *American Educational Research Journal*, 49(6), 1048-1073.

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## Appendix

### Open Portfolio Project Maker Site Survey 2017

Thank you for agreeing to participate in the Open Portfolio Project Maker Site Survey 2017. The data collected through this survey will inform research and general understanding of the demographics and assessment practices within maker education programs and sites.

It should take between 20 to 30 minutes to complete this survey. Once started, you may leave your survey and then re-enter where you left off when you click the survey link again. This works by placing a cookie on your browser that keeps track of the survey progress. The survey will close on June 16th, 2017.

By starting this survey, you consent to participate. Your responses will remain strictly confidential. This research is conducted by Dr. Kylie Peppler at Indiana University in collaboration with Maker Ed. Please direct any questions or report a research-related problem to Dr. Kylie Peppler at [kpeppler@indiana.edu](mailto:kpeppler@indiana.edu) or (812) 856-8381.

**RESEARCH PROCEDURES** – This survey is conducted to inform research and general understanding of the demographics and assessment practices within maker education programs and sites. If you agree to participate, you will be asked to complete an online survey that will take between 20 to 30 minutes.

**RISKS AND BENEFITS** – There are no foreseeable risks for participating in this research. There are no benefits to you as a participant other than to advance research on demographics and assessment practices within maker education programs and sites.

**CONFIDENTIALITY** – The data in this study will be confidential. Identifying information will not be disclosed in any publications that result from this study. Only the research team will have access to the data collected during this study. Survey data will be stored on a password-protected external hard drive, which will be maintained in a locked office at Indiana University. We will keep the data for five years following the study, at which point all data will be erased from the hard drive.

**PARTICIPATION** – Your participation is voluntary, and you may withdraw from the study at any time and for any reason. If you decide not to participate or if you withdraw from the study, there is no penalty or loss of benefits to which you are otherwise entitled. There are no costs to you or any other party.

CONTACT – If you have any questions regarding your rights as a research subject or your participation in this research, please contact the Indiana University Human Subjects Office at (800) 696-2949 or (812) 856-4242. This research has been reviewed according to Indiana University Human Subjects Office procedures governing your participation in this research.

By clicking the box below, you indicate that you have read and understood the above Informed Consent statement and you agree to participate in this survey.

## Thank you again for your participation!

Please provide consent to participate. \*

- ☐ I have read and understand the above Informed Consent Statement and agree to participate in this survey.

### **MAKER EDUCATION PROGRAM OR SITE: PLEASE PROVIDE INFORMATION ABOUT YOUR PROGRAM**

Program or site name \*

Program or site location (City, State, Country) \*

- City
- State
- Country

When did your maker education program first start? Please provide the month and year. (We realize that you may identify your programming more with STEM, STEAM, innovation, invention, or other.) \*

- Year (YYYY)
- Month (MM)

What type of setting is your maker education program part of? Please select the one that best fits your setting. (The responses to this question will help us in the response recruitment process.) \*

- School
- Museum
- Library
- Mobile (e.g., bus)
- After-school clubs and activities
- Pop-up shop
- Other

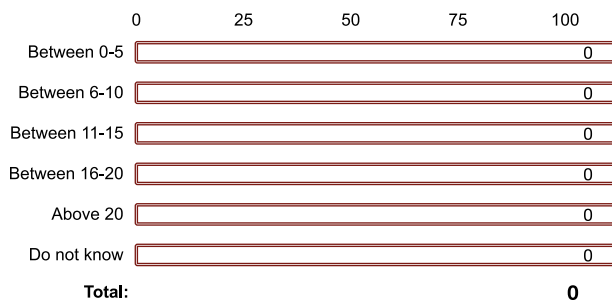


## MAKER EDUCATION PROGRAM DEMOGRAPHICS: YOUTH PARTICIPANTS - PLEASE PROVIDE DEMO

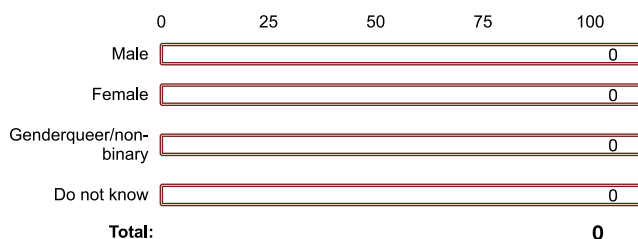
How many youth participate in your programs? Please estimate the unique number of participants in your programs during a typical day, week, and year. \*

- Youth participants per day
- Youth participants per week
- Youth participants per year

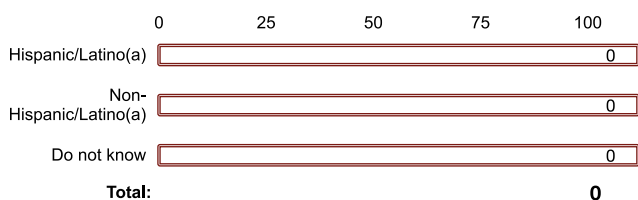
What is the age range of your youth participants? Please use the most recent full/regular week of your program as a reference to provide an estimated percentage breakdown. (Total sum must be 100.) \*



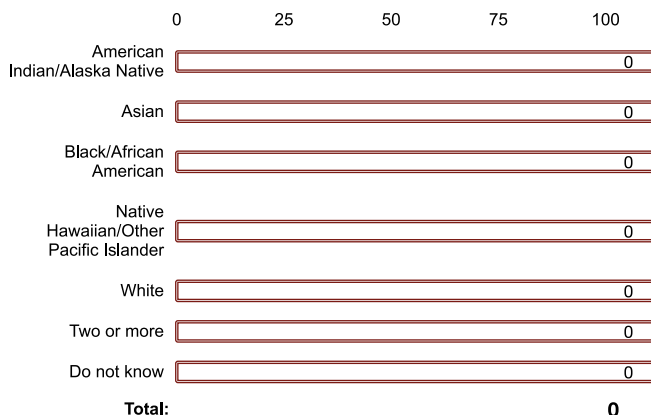
What is the gender distribution of your youth participants? Please use the most recent full/regular week of your program as a reference to provide an estimated percentage breakdown. (Total sum must be 100.) \*



What is the ethnicity of your youth participants? Please use the most recent full/regular week of your program as a reference to provide an estimated percentage breakdown. (Total sum must be 100.) \*



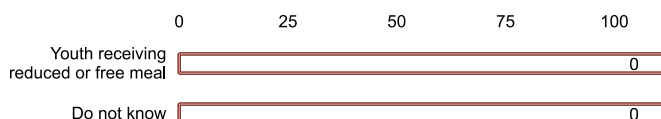
What is the race of your youth participants? Please use the most recent full/regular week of your program as a reference to provide an estimated percentage breakdown. (Total sum must be 100.)



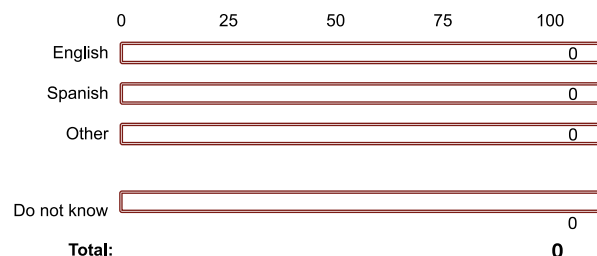
If applicable, what are the disability types of your youth participants? Please use the most recent full/regular week of your program as a reference to provide an estimated percentage breakdown.



What percentage of youth are eligible for a free or reduced meal? Please use the most recent full/regular week of your program as a reference to provide an estimated percentage breakdown.



What is the dominant household language of your youth participants? Please use the most recent full/regular week of your program as a reference to provide an estimated percentage breakdown. (Total sum must be 100.) \*

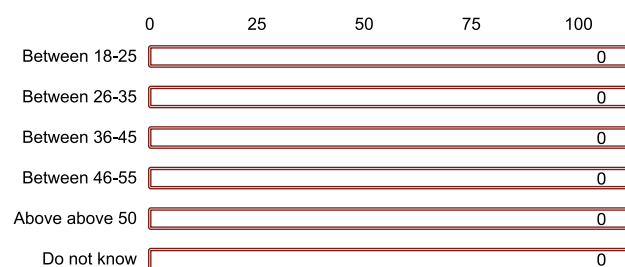


## MAKER EDUCATION PROGRAM DEMOGRAPHICS: STAFF MEMBERS - PLEASE PROVIDE DEMOGRAPHIC INFORMATION

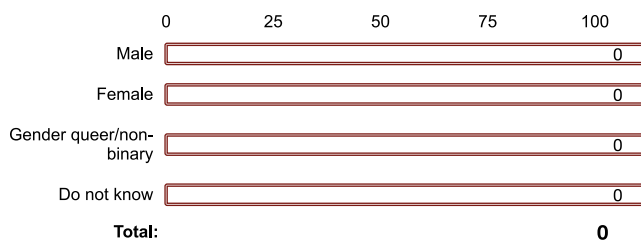
How many staff members does your maker education program employ? Please include both educators and administrators. Please estimate the number of staff in the program per day and year. \*

- Daily staff members
- Yearly staff members
- Overall staff members

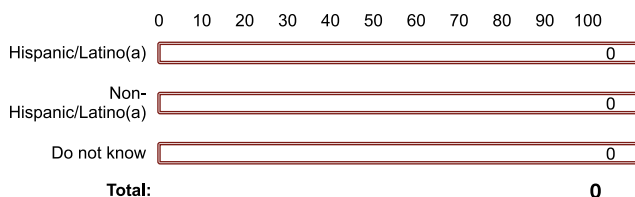
What is the age range of your staff members? Please use the most recent full/regular week of your program as a reference to provide an estimated percentage breakdown. (Total sum must be 100.) \*



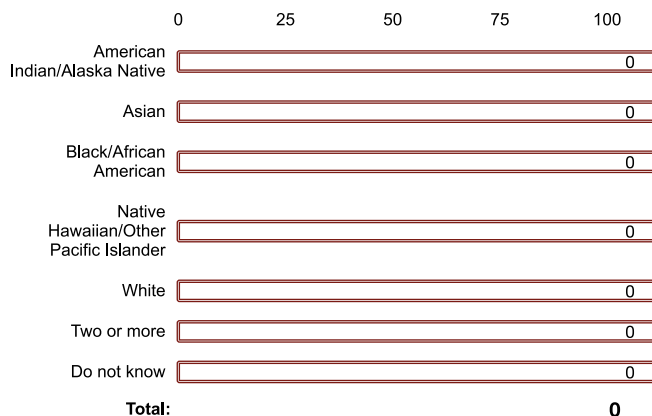
What is the gender distribution of your staff members in percent? Please use the most recent full/regular week of your program as a reference to provide an estimated percentage breakdown. (Total sum must be 100.) \*



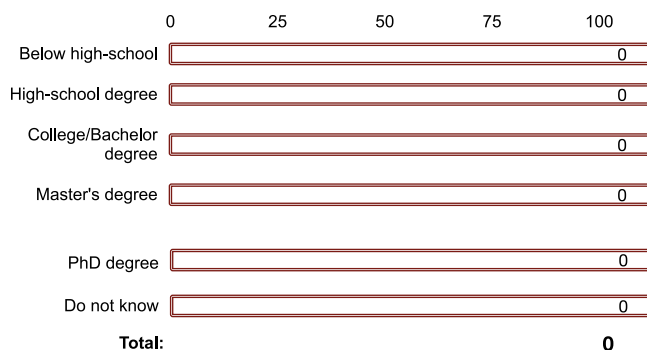
What is the ethnicity of your staff members? Please use the most recent full/regular week of your program as a reference to provide an estimated percentage breakdown. (Total sum must be 100.) \*



What is the race of your staff members? Please use the most recent full/regular week of your program as a reference to provide an estimated percentage breakdown. (Total sum must be 100.) \*



What is the highest level of education of your staff members? Please use the most recent full/regular week of your program as a reference to provide an estimated percentage breakdown. (Total sum must be 100). \*



## MAKER EDUCATION PROGRAMS

What are the formats of the programs you offer? Please select all that apply. \*

- Community events
- Courses or classes for youth workshops
- Drop-in programs for youth Educator meetups
- Educator training or professional development
- Member programs
- Open studio time for youth Youth programs focused on girls
- Youth summer camps
- Youth winter or spring camps Youth workshops
- Other



What topics or areas best describe your flagship offerings?

Please select 1-3 choices. \*

- 2D design (including graphic design)
- 3D printing
- Cooking
- E-textiles
- Fashion design
- Fiber arts (e.g., knitting, weaving, sewing)
- Filmmaking
- Game design
- Gardening
- Interactive art
- Laser cutting
- Metalworking
- Music
- Physical computing
- Programming Robotics
- Scratch programming
- Sound design
- Theatre arts
- Video game design
- Web design
- Woodworking
- Other
- Other
- Other

If your site or programs were to be offered during the school day, in which of the following subject areas or disciplines would they most likely be offered?

Please select all that apply. \*

- Biology
- Chemistry
- Computer science
- Dance
- Digital or media arts
- Drama
- Engineering Environmental science
- General computer class
- General science
- Language arts
- Mathematics
- Music
- Physics
- Foreign language
- Social studies/history
- Visual arts
- Other

## GENERAL ASSESSMENT

We are interested in the kinds of learning assessments used in makerspaces including forms of recording the process and products of making. Do you assess the maker work of your youth or evaluate maker activities at your maker education program or site in any way? \*

- Yes
- No

What kind of assessments do you use? Please select all that apply. \*

- Adult modeling
- Essay items
- Exit surveys
- Matching items
- Multiple choice items
- Peer assessment
- Portfolio assessment
- Pre and post-tests
- Rubrics
- Self-assessment
- Short answer questions

Specific to your program or site, what decisions do the above assessment inform? These can include, for example, instructional design decisions or administrative decisions. Please describe by providing examples.

## PORTFOLIOS

How important is it for you and your maker education program or site to have youth document the maker activities that they take part in? \*

- Extremely important
- Very important
- Moderately important
- Slightly important
- Not at all important
- Why do you consider it important to document and capture the process of making for youth, educators, and administrators? Please select all that apply. \*
- Career and job opportunities
- College admissions
- College preparation
- Community building inside the maker education program
- Community building outside the maker education program
- Development of instruction Learner self-reflection Other

## YOUTH PORTFOLIO PRACTICES

Do youth capture their making at your maker education program or site? \*

- Yes
- No

How often do youth document and capture making? Please select one option. \*

- Once a day
- Multiple times per day Once a week
- Multiple times per week Once a month
- Multiple times per month
- Other

We would like to learn more about the online content that your youth publish. Please share examples of youth documentation, if available (e.g., URLs to their portfolios or other documentation).

Do you provide youth with prompts or sentence starters for documenting maker education activities? \*

- Yes
- No

Please share any prompts or sentence starters you provide to youth for documenting maker education activities.

Do youth publish or display their work online, outside of the site/platform that your organization uses? \*

- Yes
- No

Which platforms do youth publish on apart from the tools provided by the makerspace? Please select all platforms that you have seen youth use. \*

Adobe Voice Behance

- Blogger
- DIY.org
- Dropbox
- Evernote
- Facebook
- Flickr
- Freshgrade
- Github
- Google Drive
- Google for Educators
- Hackpad
- Instagram
- Instructables
- Jellycam Jing
- Pathbrite
- Pinterest
- Portfoliobox
- Screencast-o-matic
- Seesaw

- Shadow Puppet Edu
- Snapchat
- Soundcloud
- TACKK
- Thingiverse
- Tumblr
- Twitter
- Ubersnap
- Vimeo
- Weebly
- Wix
- Wordpress
- YouTube
- Other

## STAFF MEMBER PORTFOLIO PRACTICES

Do staff members document youth projects, processes, or practices? \*

- Yes
- No

How do staff member document at your maker education program? Please briefly describe the process of documentation including the tools used (software and hardware), and any other special practice (e.g., videos of themselves or their friends making, process pictures, reflection text, music etc.). Please provide as many details as possible.

## CHALLENGES AND FUTURE PLANS

To what degree to you agree or disagree with following statements related to documentation? Please select responses for all options. \*

	Strongly Agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Documentation takes time away from making	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is challenging to integrate documenting with making	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Making is mobile and documentation is stationary	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Documentation interrupts the flow of making	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Are there any additional reasons that prevented or stopped youth, educators, and administrators from documenting their maker work? If so, please describe the reasons.

Are there plans for your maker education program to increase or improve documentation of making in the future? \*

- Yes
- No

What are potential plans to increase or improve documentation of maker education practices in the future?

## MAKER EDUCATION LEARNING ENVIRONMENT

Are youth projects displayed in your maker education environment? \*

- Yes
- No

How are the projects displayed? Please describe the projects and how they are presented.

We are working on an online platform to view 360° photographs of maker-educational learning environments: [www.360makerspaces.com](http://www.360makerspaces.com) We found that these pictures can be useful and inspiring for educators to identify material design aspects that they would like to include into their own makerspace setups. We warmly invite you to participate in this initiative. If you would like for your space to be featured on our website, please provide your contact information (e.g., email address) so we can follow up with you with instructions on how to participate.

Do you have anything else you would like to add, or do you have any questions you would like to direct to us?