



# Communities for Maker Educators

A Study of the Communities and Resources that Connect  
Educators Engaged in Making

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### **Photo Credit**

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# Executive Summary

This report presents the results of a study focused on maker educators and the learning communities they participate in. It aims to inform ongoing efforts in the field to support and connect the growing number of educators who incorporate making into their practice. Toward this end, this study is based on a scan of relevant literature on professional learning communities and communities of practice and original data collected through interviews with maker educators and leaders of educator communities and a survey of maker educators. Original data collection focused on the work of maker educators, how they connect with one another, and what needs they hope to address through community.

Part I describes maker educators; including information on how they became maker educators, what motivates them, and the types of educational making they engage in. It includes a description of the landscape of existing communities that support maker educators, how people participate, and why.

Survey respondents who reported participating in maker educator communities were predominantly white and the majority were women. Many hold teaching jobs in K-12 institutions, and tend to be experienced, veteran educators and leaders.<sup>1</sup> They got involved in educational making for reasons that include the desire to foster real-world skill-building, creativity and problem-solving; engage students; and draw connections with subject matter content such as science, technology, engineering, and mathematics (STEM) and/or science, technology, engineering, art, and mathematics (STEAM).

When maker educators engage with communities or resources, they access a range of resource types including static web-based resources and interactive platforms, with the most popular resource type being projects or lessons. Many access maker communities within the major social network platforms they already use. Community participants feel connected to the wider field of maker educators; many reported that they appreciated the sense of openness and generosity that characterizes it. Several leaders voiced concern with and plans for ensuring wider access to their communities, and taking active steps to welcome educators of color and educators serving learners in under-resourced communities.

Part II is a needs assessment of maker educator communities. Findings point to interest in greater access to project ideas and targeted lessons; an organized and curated collection of

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<sup>1</sup> Because survey recruitment was carried out within Maker Ed's networks or program participants and social network connections, it is not possible to know how well the sample represents maker educators as a whole.

resources to meet educators' specific needs (e.g., mapping onto content standards for K-12 educators); a combination of face-to-face and online components; and tools supporting expert and colleague recommendations of resources. Respondents also reported interest in information on the broader research, policy, and funding contexts surrounding maker education. Most promisingly, survey respondents reported a strong sense of goodwill, with high interest not only in gaining access to information and expertise provided by others but also in contributing their own expertise and sharing with colleagues.

Overall, this study identified clear trends in how educators access resources, the kinds of resources they are interested in, and the ways they seek to connect with one another. These trends, alongside research findings on the importance of sustained interaction and pathways for newcomers and leaders within communities for learning, point to specific implications for the design and management of maker-centered communities for educators.

Successful communities are those that:

- Attend to equity;
- Provide both "on-ramps" for newcomers and opportunities for growth and increased involvement;
- Meet educators where they are, making resources available within the social networks that educators already participate in;
- Offer ways to connect with others who share similar roles and challenges.

Respondents consistently reported interest in the following types of resources. Providing them will likely help build and sustain community participation:

- User-friendly project plans and lessons, available on easily searchable sites;
- Organized collections of research on the benefits and impacts of making and on approaches that show greatest promise;
- Information about the broader policy and funding contexts;
- Resources tailored to the needs of school-based educators.

# Contents

<b>Executive Summary .....</b>	<b>i</b>
<b>Introduction .....</b>	<b>1</b>
Prior Research .....	1
Study Design and Methods.....	3
Analysis and Synthesis.....	5
<b>Part I. Study of the Current Landscape of Communities for Maker Educators.....</b>	<b>6</b>
a. Who are maker educators? .....	6
b. What draws educators to become maker educators? .....	9
c. How can we characterize the practice of maker educators?.....	11
d. Which communities and networks do maker educators belong to and participate in? .....	12
e. What is the nature and level of engagement with professional communities?.....	13
f. Do PLC participants identify and have a sense of connection with the community? .....	15
g. What drives educators to join and stay in communities? .....	15
h. What are the strategies community leaders employ to support their community members?16	
<b>Part II. Needs Assessment of Maker Educators and their Communities .....</b>	<b>18</b>
a. What are the needs of maker educators related to resources and connections with peers? .18	
b. How do maker educators participating in communities prefer to engage?.....	24
<b>Conclusions and Recommendations.....</b>	<b>27</b>
Recommendations for community content .....	27
Recommendations for community design .....	28
<b>References.....</b>	<b>30</b>
<b>Appendix A. Overview of Survey Respondents</b>	
<b>Appendix B. Educator Survey Instrument</b>	

## Figure

Figure 1. Map of the locations of North American survey respondents. ....7

## Tables

Table 1. Learners/students served by survey respondents. Source: Educator Survey data.....	9
Table 2. Percent of educators reporting that more than half of their students belong to groups underrepresented in STEM fields. ....	9
Table 3. Consolidated list of communities or resources used by multiple interview and survey respondents.....	12
Table 4. Responses to survey item 25, “What are the main ways you engage when you visit [name of community, group, or organization they visit most regularly]? (Check all that apply)” .....	13
Table 5. Responses to survey item 26, “How do you access the content that interests you when you visit [name of community, group, or organization they visit most regularly]? (Check all that apply)”.....	14
Table 6. Responses to survey item 27, “What kinds of resources do you typically access when you visit [name of community, group, or organization they visit most regularly]? (Check all that apply)” .....	14
Table 7. Responses to survey item 30, “How important is it for you to do each of the following in your ideal community?” (Choices: not important, somewhat important, very important).....	19
Table 8. Responses to survey item 31, “Which of the following resources are important to support your needs as a maker educator?” (Choices: not important, somewhat important, very important).. .....	19
Table 9. Responses to survey item 29, “What kinds of community engagement (online or face-to-face) would best support your needs as a maker educator? (Please choose up to three)” .....	20
Table 10. Responses to survey item 32, “Are there ways you would like to be able to access content (Please choose up to three)”.....	26

# Introduction

In response to the need to connect maker educators with one another and with the experiences of colleagues in their field, the Maker Education Initiative (Maker Ed) contracted SRI International (SRI) in early 2016 to conduct research aimed at better understanding the existing communities that bring maker educators together and the interests and needs for shared resources and connections with peers that bring maker educators to these communities. Study goals were to: (1) describe the current landscape of communities serving maker educators, (2) identify needs of maker educators in terms of access to resources and connections with peers, and (3) highlight common ways educators participate in these communities and their drivers for participation. Toward this end, this research incorporates findings from interviews with leaders of communities of educators including some maker-oriented communities; interviews with educators who take part (either in person or online) in maker-centered communities for educators; and surveys collected from maker educators. This work aims to scaffold the development of robust supports for educators working in maker-centered learning environments in and out of school.

## Prior Research

Communities linking individual maker educators to one another and to organizations engaged in educational making (e.g., schools, Maker Ed, Fab Labs) provide infrastructures for building relationships, fostering personal interactions, and supporting leadership capacity across educator communities. Communities support different kinds of engagement that further and reinforce interactions, foster the potential for a shared maker educator identity and/or interest, and deepen an interest in discussing and sustaining maker education. Communities are supported by networks, including designed infrastructure for interaction (e.g. facilitated online interactive forums, face-to-face events), that purposely link community members together.

What educators can and do gain from belonging to educator communities and the networks that support them is a topic that has been studied extensively, particularly since the 1990s when learning scientists began to emphasize learning as a social process and to think about communities of practice as a place and way of learning (Lave & Wenger, 1991). Building from this idea, researchers began to look at how people become active members of communities, learning within community as part of everyday activity, and how interactions between people can be designed to integrate newcomers and foster ongoing learning. Communities are powerful catalysts for enabling educators to change or improve their practice and are essential to ongoing professional learning and innovation (Lieberman and Grolnick 1996; Rényi, 1996, Thomas et al., 1998, Darling-Hammond & Ball, 1997; Cochran-Smith & Lytle, 1999).

One type of community often described in research, the professional learning community (PLC), grew from Peter Senge's (1990) work in the 1990s on learning organizations in business. PLCs are popular within educational settings and with educators themselves. While there is no agreed-upon or universal definition for PLCs, the term suggests a group of people sharing and critically interrogating their practice in an ongoing, reflective, collaborative, inclusive, learning-oriented, growth-promoting way" (Stoll et al., 2006, pp.222).

Richard Dufour (2004), a public school educator, defines PLCs as involving educators in a continuous and iterative process of inquiry to achieve better outcomes for the students in their schools. Shirley Hord (2008) adds that PLCs offer educational professionals' self-directed opportunities to further their own learning and practice within a community. She argues for five important PLC dimensions: shared beliefs and values, shared responsibility and supportive leaders, shared learning and application of it, supportive staff and conditions, and shared practice. In the course of regular work, many educators lack time to engage in dialogue, collaborate, or work in context with their peers.

Another lens for understanding social learning is through the model of Communities of Practice (CoPs) introduced by Jean Lave and Étienne Wenger in 1991. Although PLCs and CoPs both examine community and learning within the research literature, these traditions represent distinct perspectives on how people learn through interaction. Through an investigation of learning in non-school communities (e.g., midwives, butchers, quartermasters, and members of Alcoholics Anonymous), Lave and Wenger argue that participation in distinct practices similar to apprenticeships help learners become members of groups and build relationships. Participants move from the periphery to more central roles in communities of practice as they develop from novices to experts.

In CoPs, members are working to improve themselves and their practice and the practice could be anything. Members do not always choose to join community, CoPs are often incidental to the work of their members as in the case of co-workers who learn from one another through ongoing interaction. CoPs are emergent, self-reproducing, and continually evolving; they center around a practice and work towards a goal; they have their own norms of behavior; members share over an extended period of time, and they have a shared history, with common cultural and historical heritage and shared beliefs. CoPs can be online or face-to-face but require extended interaction for members to develop their identity and learn with others.

This study has relied on the literature on both PLCs and CoPs to give context to the role of community in the lives of educators, inform data collection and analysis, and to frame the results of the data.

## Study Design and Methods

The two parts and research questions guiding this study are as follows:

### Part I. Analysis of Professional Learning Communities for Maker Educators

- a) Who are maker educators? How can we describe them according to experience level, role, demographics, background, location, and institutions?
- b) What draws educators to become maker educators?
- c) How can we characterize their practice as maker educators?
- d) Which maker educator communities and networks do they belong to and participate in?
- e) What is the nature and level of their engagement with communities?
- f) Do community participants identify and have a sense of connection with the community?
- g) What drives maker educators to join and stay in communities?
- h) What strategies do community leaders employ to support make educators

### Part II. Needs Assessment of Maker Educators and their Communities

- a) What are the needs of maker educators related to resources and connections with peers?
- b) How do maker educators participating in a PLC prefer to engage?

The data set for this study includes:

- *Community leader interviews (N=16)*. Interviews with leaders of communities serving educators. These included interviews with leaders of nationally recognized, established communities for educators and leaders of communities serving maker educators.
- *Community participant interviews (N=17)*. Interviews with educators who participate in maker-centered communities, both online and blended
- *Maker educator surveys (N=492<sup>2</sup>)*. A survey of educators self-identifying as having incorporated or planning to incorporate making into their practice.

All recruitment for data collection was carried out within Maker Ed's significant network including through contacts with organizational leads and professional connections (for interviews) and through announcements across Maker Ed's extensive social media presence.

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<sup>2</sup> Note that not every survey respondent completed all items. Numbers of responses on individual items will vary.

### *Interviews with community leaders*

SRI conducted hour-long phone interviews with educators who served as leaders in communities serving educators. Communities of interest were identified by Maker Ed and included established, nationally recognized communities and several communities specifically serving maker educators. Maker Ed curated a list of potential professional communities to interview based on specific criteria: the number of educators the PLC supported, the number of years in existence, and the foci of the PLCs, such as maker-centered or inspired networks or maker-centered communities. SRI then contacted leaders of these communities to schedule interviews.

Through April and May 2016, SRI conducted 16 phone interviews with community leaders. Leaders held a range of roles within the learning communities. Leader interviews were carried out using semi-structured interview protocols focused on aspects of educator community leadership, such as design, success measurements, resources, supports and barriers, and sustainability. Examples of interview questions include: *What is the community's value to participants? What is your staffing model for the community? What roles can participants play? How do members get to know each other? How do you know if the community is successful?*

### *Interviews with community participants*

SRI conducted hour-long phone interviews with educators who were participants in maker-centered communities. Interviewees were recruited by Maker Ed through their network of maker educators and introduced to SRI researchers. SRI followed up with potential participants by sending a follow-up email to schedule an interview. The interviewee list represented a broad range of individuals with varying levels of expertise and roles. To compile the list, Maker Ed reviewed past and present program partners from [Maker VISTA](#) and [Maker Corps](#), as well as those who attended past face-to-face events. Maker Ed also invited members of their educator advisory committee as well as researchers engaged in the field to participate. Of the 19 maker educators emailed, SRI interviewed a total of 17 community participants, who agreed to participate in phone interviews, in May 2016.

The interviews were carried out using a semi-structured protocol, and the main topics for the interviews included participants' background, their maker-focused activities and needed resources, and overall experience in professional learning communities. Some of the interview questions included: *How did you get involved with making? What kinds of projects and/or activities have you done with learners/students? Do you have enough support for making? Do you participate in any in-person or online communities that connect you with other maker educators? Explain what you do in a typical visit. Has the PLC met your needs?*

### *Surveys with maker educators*

SRI administered an online survey in April and May 2016 to learn about educators' participation in educator communities, both online and in person, and to better understand who comprised the larger population of self-identified maker educators.

Recruitment of survey participants was through Maker Ed's networks of educators. Maker Ed shared the online survey link via Twitter, Facebook, their online community on Google+, and included the link in their email newsletter reaching 1,500 people. Because survey recruitment was carried out within Maker Ed's existing network, there is likely some bias in the sample, which may not be representative of maker educators as a whole. For example, those who are not connected with existing communities, are not likely to have received invitations to participate in the survey.

Survey topics included the backgrounds of educators, the kinds of making activities they engaged in with their students, their roles, experience levels, workplaces, and their experience within maker-centered professional learning communities. Survey questions also asked how participants made use of community resources and what needs educators have from communities on their existing needs. The survey was anonymous. The complete text of the survey questionnaire is found in Appendix B.

## **Analysis and Synthesis**

Data were analyzed separately with coding of interview data and open-ended survey items according to each of the guiding questions that they informed. Findings were then grouped across data sources according to the research questions. Open-ended survey items were analyzed using thematic coding (Boyatzis, R. E., 1998) with researchers reviewing responses, identifying common themes. Groups of themes included reasons for becoming maker educators, types of participation, and types of resources accessed in communities. Responses were tagged or grouped according to themes. Quantitative survey items were grouped according to the research questions they addressed. Items within each group were analyzed together with data from similar topics from qualitative survey items and interviews.

# Part I. Study of the Current Landscape of Communities for Maker Educators

Interviews with leaders and participants of maker-centered communities informed the question of if and how communities provide pathways for educators to build connections, create a sense of purpose and identity, and distribute knowledge. Educator surveys provided information about who comprised the larger population of self-identified maker educators, and how participants made use of community resources.

## *Guiding questions for Part I:*

- a. Who are maker educators? How can maker educators be described according to experience level, role, demographics, background, location, and institutions?
- b. What draws educators to become maker educators?
- c. How can their practice as maker educators be characterized?
- d. Which maker educator communities and networks do they belong to and participate in?
- e. What is the nature and level of their engagement with communities for maker educators?
- f. Do PLC participants identify and have a sense of connection with the community?
- g. What drives educators to join and stay in PLCs?
- h. What are the strategies community leaders employ to support their community members?

## **a. Who are maker educators?**

Based on the 492 survey respondents, we have information on the demographics, roles, and backgrounds of the maker educators who are linked with Maker Ed in some way. Here we briefly summarize responses to these survey items. Further detail is provided in Appendix A. Survey eligibility was limited to educators who are either currently incorporating making into their practice (83%) or who are planning on incorporating making in the future (17%).

### *Educator demographics*

A large majority of respondents (84%) identify as white, while 35% percent of respondents selected at least one race option other than white.<sup>3</sup> Most respondents (66%) were also women.

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<sup>3</sup> The race survey item requested that respondents check all that apply.

A large majority of respondents (84%) identify as white, while 35% percent of respondents selected at least one race option other than white. Most (66%) respondents were also women. In interviews, community leaders remarked that they were interested in reaching out to educators of diverse backgrounds to bring them into the larger community of maker educators.

The largest age group selected was ages 35-44 with the second (25%) and third (22%) largest age groups were ages 25-34 and ages 45-54, respectively. Male respondents tended to be older than female respondents but men and women reported similar race demographics.

Respondents who selected a race other than white (including those who also selected white) were younger than the respondents as a whole, with 39% of these respondents aged 25-34.

Survey respondents came from almost all U.S states<sup>4</sup>. A large number of respondents (22%) hailed from California, while the remaining U.S. respondents were distributed roughly in alignment with regional population density (i.e., with respondents clustered around larger metropolitan areas). Forty-two percent (42%) of respondents worked in suburban areas, while 34% worked in urban areas. Only 13% worked in a rural setting. Although survey recruitment was not explicitly international, 7% of respondents were from outside of the U.S. Figure 1 (below) maps the locations of North American respondents<sup>5</sup>.

**Figure 1. Map of the locations of North American survey respondents.**



<sup>4</sup> All U.S. states excluding Alaska, Delaware, Kansas, Louisiana, Montana, North Dakota and Nevada were included.

<sup>5</sup> An interactive version of the map shown in figure 1 can be found at <http://makered.org/community/research/>.

### *Educator roles and work experience*

While educational making traces its roots to out-of-school settings, such as drop-in maker spaces and afterschool programs, a large number of teacher survey respondents work in K-16 settings, which may be indicative of a trend toward increasingly incorporating making into the school day. Consistent with this finding, only 20% of survey respondents work either a structured out-of-school setting (10%), museum, science center, or similar (6%), or a library (4%) while 62% worked in a K-12 public school, public charter, or independent/private school.

Nearly half of respondents (48%) identified as teachers. Almost all teachers were situated in a K-12, or held multiple positions (e.g. school and library). After teacher, the most common roles of the survey respondents were librarian (14%) and then activity leader (e.g., afterschool or summer) and administrator (8% each).

Maker educators shared their titles and roles within their organizations and institutions. The variety of roles suggests that some institutions are committed to integrating making into their programs. Some of the titles and roles included: makerspace manager, makerspace program director, museum educator, teacher librarian, STEM coordinator, STEM program manager, teacher-on-special-assignment (TOSA), scientist-in-residence, instructional coach, instructional technology specialist, educational technology coordinator, media specialist, consultant, mentoring facilitator, and volunteer.

In survey write-in fields for role and workplace, a common comment was that respondents work in more than one role and/or more than one setting. Another common write-in response to the question on workplace was makerspace or hackerspace. This was consistent with data from the educator interviews, in that the workplaces included three library makerspaces, a school-based makerspace, and a non-profit makerspace (a former workplace).

In survey items on experience level, more than half (56%) of respondents reported that they have been educators for 11 years or more. About 58% of the most experienced educators (with 11 or more years of experience) work in K-12 schools with higher numbers of experienced educators working in administrative roles or other leadership positions. Consistent with the survey result that many survey respondents work in school settings, several respondents were in roles that suggest a high level of administrative support for making. Roles of K-12 educators provided in survey write-in fields included several special positions in support of making such as “maker integrator” and “working with the whole school to incorporate making into curriculum.”

Over half the educators surveyed (55%) reported that they work with the same students or learners on a consistent ongoing basis, seeing each learner more than 10 times per year. The remaining responses were split nearly evenly between those who work with students on a drop-in basis (15%) and those who work with the same students several times but not more

than 10 times per year (14%). A relatively large percentage of educators selected “other” (16%) and, of these, many reported that they served learners on both a drop-in and ongoing basis.

#### *Demographics of the students or learners educators serve*

In surveys, we asked educators for background information on whom they serve. We also asked for approximate percentages of students or learners in various subgroups. Survey respondents reported working with a wide range of age groups and many worked with students in multiple age groups. Table 1 (below) summarizes the student/learner age group data<sup>6</sup>.

**Table 1. Learners/students served by survey respondents.** Source: Educator Survey data.

Age band of learners/students served	Percent of survey respondents selecting
Toddlers and preschoolers (age 3-5)	19%
Students in grades K-5 (elementary)	57%
Students in grades 6-8 (middle school)	52%
Students in grades 9-12 (high school)	41%

The educator surveys solicited demographic and background information, such as gender, and low-income status about the student or learner populations that maker educators serve. Surveys asked what percentage of the learners or students the educators work with are members of demographic groups underrepresented in STEM fields. Some respondents reported that more than half their students belong to specific underrepresented groups. Table 2 summarizes these data:

**Table 2. Percent of educators reporting that more than half of their students belong to groups underrepresented in STEM fields.** Source: Educator Survey data.

Underrepresented group	Percent of survey respondents reporting more than 50% of learners belong to group
Girls	29%
Low income <sup>7</sup>	31%
English language learners	14%
Minorities underrepresented in STEM fields <sup>8</sup>	21%

## **b. What draws educators to become maker educators?**

Surveys and interviews both provide insights on educators’ motivations to bring making to their work. Interviewees described how they became maker educators and survey respondents shared why they were interested in educational making.

<sup>6</sup> Survey respondents were asked to check all that apply in response to the item on student/learner age groups.

<sup>7</sup> Note that for low-income status, a large proportion (21%) of survey respondents selected “don’t know”.

<sup>8</sup> Survey item on minorities from groups underrepresented in STEM fields listed the following groups: Alaskan Natives, Native Americans, Blacks or African Americans, Hispanics, Native Hawaiians and other Pacific Islanders.

### *Introductions to making*

Interviewees, who had 2-3 years of making experience on average, generally became involved through an initial experience with a making-related program or event. Several respondents (5) participated in Sonoma State University's Maker Certificate Program for Educators. In addition, one interviewee participated in Sonoma State University's Making for Administrators course. Other respondents cited Maker Ed programs, including Maker VISTA, Maker Corps, and a Maker Portfolio Workshop, as gateways to making. Some reported attendance at Maker Faire as an instrumental introduction to making.

Other survey respondents were introduced to making through partnership opportunities with other organizations. One educator was introduced to making when her school became a maker host site for a local organization's summer programming, while another educator was introduced to making when a local maker-based organization sought a school-district partner.

Colleagues or institutional needs influenced some educators to get involved in making. One educator was introduced to making by word-of-mouth; she heard that another local educator was infusing disciplinary content with making. Another interviewee reported not being aware of the Maker Movement until researching what to do with vacant library space.

### *Reasons for interest in making*

Respondents reported a variety of reasons for their interest in making. Many indicated that making can help students develop real-world skills and dispositions associated with positive work and life outcomes. Common write-in responses included that making promotes creativity, problem-solving skills, critical thinking, perseverance, and the ability to innovate. Other respondents remarked that making complements traditional instructional approaches and can provide balance in formal educational environments characterized by too much testing.

Some respondents detailed why they thought making promotes the skills and dispositions outlined above, with responses that indicate that making helps to motivate and engage learners, the importance of low-stakes learning experiences in which failure is permitted and expected, and the connections between making and STEM or STEAM content. A small group of respondents tied their response directly to student learning, noting that making offers an exciting new type of learning experience and has great potential to engage students and help them see the value of their own ideas.

Several respondents observed that making is inherently social, involving communication and connection with others. Still others remarked that making is a self-directed, learner-driven process that builds empowerment and participants' sense of agency. Some also mentioned that making promotes equity, appeals to diverse learners, and can level the playing field. Some museum educators and respondents from organizations serving learners in out-of-school

settings noted that making supports their organizational missions, e.g. by fostering “hands-on/minds-on thinking”, design thinking, and problem-solving skills. Both in- and out-of-school maker educators also tied their making practice to equity objectives. One survey respondent commented as follows: “We incorporated making as a way to connect with all students - we have several after school and summer programs.”

### **c. How can we characterize the practice of maker educators?**

When asked to describe their practice as maker educators, survey respondents detailed the materials, resources, and approaches they commonly use, and also provided information regarding contextual factors such as dedicated spaces and time.

Respondents commonly described activities that involved producing objects and emphasized design thinking or engineering processes. These activities often include electronics and robotics (e.g., paper circuits, Arduino, LED textiles), programming and coding (e.g., Makey Makey), and 3D printing. A small portion of respondents also named woodworking, metallurgy, textiles, needle working (e.g., sewing, knitting, crocheting), paper-based products, Legos, and K'NEX as the basis of activities and programs.

Some survey respondents, who work in schools, described the spaces where they practice and the times of day when they practice. Some described working in pre-existing library spaces or shop classrooms that have been repurposed and converted into dedicated making spaces. Others mentioned mobile maker carts that can be used throughout school grounds.

Respondents describe the different times of day they engage students in making both during scheduled school time and during out-of-school hours. Some respondents offer whole electives, some offer maker education opportunities in prescheduled "enrichment" or library hours, and others offer opportunities during lunch or recess and after school.

“All PreK-3rd grade students have monthly extra library time. I lead these students through group Maker projects to introduce them to a quick design process and orientation to some of the tools in our Makerspace.” (Survey response)

Several respondents who described dedicated in-school time or space for making also mentioned championing making within their schools, including working with teachers to blend making into course content and curricula:

“I started an elective class called [class name] in which we have transformed an old shop class into a modern makerspace. I am also working with other content area teachers to integrate the tools and philosophies of making into their curriculum.” (Educator survey response)

## d. Which communities and networks do maker educators belong to and participate in?

Interviews yielded a broad range of online resources and face-to-face community contacts that are important to both maker-focused and general education community leaders. These include general resources such as YouTube channels and Khan Academy as well as communities geared specifically towards maker education such as Maker Ed's own website, and the Exploratorium Tinkering Studio's website and blog.

Leaders also referred to communities where makers can connect face to face such as the Bay Area Maker Educator meet-ups, the Crucible in Oakland, CA, Digital Harbor in Baltimore, MD; and the Artisan Asylum in Somerville, MA. The majority of the communities with which leaders connect are those that combine face-to-face and online components such as the Fab Lab annual conference, the Exploratorium-led California Tinkering Afterschool Network, and the Mozilla Foundation's Maker Party.

Survey respondents as well as interviewees named many of the same communities as leaders with the addition of several references to online repositories where they could find project ideas such as Instructables, Project Ignite, and Pinterest. Table 2 summarizes the communities and resources referenced by multiple interview or survey respondents.

**Table 3. Consolidated list of communities or resources used by multiple interview and survey respondents.**  
Source: Educator Survey data.

Primarily online	Major face-to-face and in-person components	Primarily face-to-face
<ul style="list-style-type: none"><li>• Maker Ed Website</li><li>• Maker Ed Twitter feed</li><li>• YouTube channels</li><li>• Khan Academy</li><li>• The Exploratorium Tinkering Studio's website and blog</li><li>• Agency by Design website (Project Zero)</li><li>• National Science Teacher's Association website</li><li>• Instructables</li><li>• Project Ignite (from Autodesk)</li><li>• Thingiverse</li><li>• Tinkercad</li><li>• Edutopia</li><li>• Sparkfun</li></ul>	<ul style="list-style-type: none"><li>• ASTC making and tinkering community of practice for museum educators</li><li>• Bay Area Maker Educators Meet-up</li><li>• Fab Lab community and a Fablearn conference</li><li>• California Tinkering Afterschool Network</li><li>• Mozilla Foundation's Maker Party</li><li>• Maker Vista Meetings (Maker Ed)</li><li>• Remake Learning (Pittsburgh)</li><li>• Various websites serving educators in a particular district (e.g. Ravenswood Maker Space Collaborative)</li><li>• Children's Museum of Pittsburgh</li></ul>	<ul style="list-style-type: none"><li>• The Crucible (Oakland, CA)</li><li>• Digital Harbor (Baltimore, MD)</li><li>• The Artisan Asylum (Somerville, MA)</li><li>• Designing Making Experiences Workshop (Lighthouse Charter, Oakland, CA)</li><li>• North Bay maker educator meet-ups</li><li>• Regular meet-ups of Austin area maker educators (no formal name)</li><li>• Hacker Lab (Sacramento and Rocklin, CA)</li></ul>

Some survey respondents referred to platforms for connecting online without always specifying which groups they connect with. In these cases, Google +, Twitter, and Facebook were mentioned as ways to connect with others engaged in maker education.

### e. What is the nature and level of engagement with professional communities?

Based on educator interviews, the nature and level of engagement with educator communities varied. Although educators were familiar with existing communities, several reported not being actively involved in either an online or in-person community. The kinds of participant engagement with community ranged from actively connecting with other educators and contributing to posts or discussions to passively viewing followers' posts or Twitter chats related to maker movement and making in education. Several interviewees reported that in-person communities present an opportunity for participants to meet one another, engage in a hands-on activity, and generate an open discussion.

#### *What participants do in communities*

We asked survey respondents to characterize their participation in the communities they engage with in several different ways. One question asked respondents what they do when visiting the community, group, or website they use most frequently. Respondents could check all boxes that apply. Table 4 summarizes their responses.

**Table 4. Responses to survey item 25, “What are the main ways you engage when you visit [name of community, group, or organization they visit most regularly]? (Check all that apply)”. Source: Educator Surveys.**

Response	% of response (N=236)
Get ideas about projects / lessons	89%
Read/view static resources (e.g. tutorials, articles)	76%
Read/view visitor-posted content (e.g. forum posts, comments)	66%
Connect with other educators online	52%
Share examples of projects / lessons	47%
Ask questions	41%
Share student projects / work	37%
Connect with experts online	33%
Connect with other educators face to face	20%
Connect with experts face to face	14%
Work 1-on-1 with mentors	8%
Earn credentials, credits, or certification	6%
Other (please explain)	3%

Though many of the most commonly selected categories related to use of static resources, many respondents also indicated that they interact with other educators. Combined, 70% of respondents chose at least one of the response options related to connecting or sharing with

others. This happened most often by accessing visitor-contributed content (66%), connecting with other educators (52%), and sharing projects or lessons (47%).

### *Navigating resources*

Survey respondents described how they access content within communities. Table 5 summarizes their responses.

**Table 5. Responses to survey item 26, “How do you access the content that interests you when you visit [name of community, group, or organization they visit most regularly]? (Check all that apply)”. Source: Educator surveys.**

Response	% of response (N=233)
I search for resources using keywords	73%
I access things recommended by other educators I know	56%
I access curated content (selected by staff or experts)	48%
I access content based on recommendations of other users (e.g. upvotes, likes)	39%
Are there other approaches do you use to find content and resources? If so, please explain.	12%

While keyword search was the most common way to access resources (chosen by 73% of respondents), combined, the three responses related to recommendations of others including other educators, staff or experts, or other users were reported by 79% of respondents. Twelve percent (12%) of respondents reported that they used other approaches to find content and resources. Other approaches included email, hashtags, Twitter, and notifications and subscriptions.

### *Resources accessed*

Respondents detailed the resources they typically access when in their most frequently visited community, group, or organization. Table 6 summarizes their responses.

**Table 6. Responses to survey item 27, “What kinds of resources do you typically access when you visit [name of community, group, or organization they visit most regularly]? (Check all that apply)”. Source: Educator surveys.**

Response	% of response (N=235)
Text-based resource collections (e.g. articles / tutorials / latest research)	73%
Resource collections with photos / video	65%
News and announcements	60%
Calendar events (e.g. webinars, Maker Faires, face-to-face events)	46%
Personal blogs	41%
Discussion boards	34%
Profiles of individual makers or educators	34%
Live online events (e.g. Hangouts)	22%
Live face-to-face events	17%
Information about grant applications (e.g. application wizards)	17%
Other (please explain).	3%

Though a first glance at responses suggests that educators are engaged mainly in asynchronous online access to static resources, 46% of respondents chose at least one of the live event categories or the calendar events indicating that synchronous interaction with colleagues, either online or in person, is an important part of how people interact with the community. Also, when taken together, respondents seem to be accessing time-sensitive information; 58% of respondents regularly access at least one of the following resource types that require regular updating: calendar events, news and announcements, and information about grant applications.

**f. Do PLC participants identify and have a sense of connection with the community?**

Survey respondents described whether or not they felt a sense of connection to a broader community of educators, in general, and to a broader community of maker educators, specifically. Although 83% affirmed feeling connected to a broader community of educators, 68% of respondents affirmed feeling connected to a community of maker educators.

Overall, respondents were strongly positive about the community of colleagues engaged in maker education. When survey respondents were asked an open-ended question, "What do you like most about the maker educator community?", over 80% of answers had to do with the sense of community. Over 50% cited the community's openness and willingness to share; another 30% percent addressed the ability to make connections and feel connected and/or the support the community provides. Some also noted appreciating that the community enables them to offer a different kind of learning experience for their students—both hands-on and open-ended. A minority of respondents reported appreciating the inspiration, excitement, and passion of others in the community, and also the spirit of innovation and creativity that pervades exchanges.

In interviews with maker educators, we learned that many did not self-identify as community participants or members at all. For example, in interviews, respondents often said that they were not part of a community of maker educators; however, when probed to talk about participation in online and face-to-face events or groups, they revealed that they were participants in some form of community for educators. Some described their involvement as more passive (e.g., following Twitter feeds, part of Google+ groups) without actively posting or contributing.

**g. What drives educators to join and stay in communities?**

A significant number of maker educator and community leader interviewees reported valuing the openness and willingness to share ideas that they view as characteristic of the maker

educator community. Many discussed the value of sharing ideas and being willing to see them adopted, modified, and hacked—a spirit that aligns well with the spirit of making more generally. Another common theme that emerged in both interview and survey data was satisfaction with having found a community of like-minded people. This connection helps communities avoid isolation among educators many of who do not work with other maker educators in their schools and organizations.

In addition, survey respondents noted valuing the inspiration, excitement, and passion they feel in the maker educator community. People expressed that they are energized and inspired when they hear from others who are so passionate about making. They valued the innovation, creativity, and willingness to experiment in other educators.

*Connecting with others who share common experiences and views*

In interview and survey data, both leaders and educator participants emphasized the importance of connecting with others who share experiences and views. Some communities have special interest groups to help participants connect with others who are in similar roles (e.g., school administrators, high school teachers, museum makerspace managers, museum educators, and volunteers). Others talked about the importance of connecting with those who share similar approaches to educational making (e.g., emphasis on art, emphasis on embedded STEM content, use of technology). Both leaders and participants agreed that having these focused communities was important. These groups are likely better able to support one another due to shared experience and challenges.

**h. What are the strategies community leaders employ to support their community members?**

Interviews with community leaders provided insights into two key means for helping participants build connections, creating shared purpose and identity, and distributing knowledge among members: 1) support the development of personal connections, and 2) provide high-quality, context-appropriate facilitation, to help connect people to needed resources and keep the group focused on objectives.

Educator communities are particularly timely and necessarily for the growing field of maker education, in which individuals with diverse roles and experiences show a great willingness to share and learn from one another. A diverse mix of intentional and incidental communities, many of which include both online and face-to-face components, currently serve maker educators.

### *Flexibility*

In community leader interviews (with those from well-established communities, not necessarily maker communities), leaders emphasized the importance of being flexible. For example, they discussed how “in the early days of online community” (generally before 2010) communities used to try to put borders on the community, require log ins, and own the space, but now, with Twitter, Google Hangouts, and in-person events, leaders try to be in as many places as they can and meet members where it is easiest without barriers. The community leaders noted that some people participate without necessarily realizing whether they are actually members of the organization. The free-flowing nature of Internet-enabled interactions can make counting members more difficult, but despite this trend towards less structured interactions, the multiplicity of channels and modes enables organizations to increase their impact and is similar to what Thomas and Brown (2011) described as “a collective.” The leaders noted that Twitter users sometimes feel part of an organization even when the organization doesn’t view them as part of it. Leaders also underscored the importance of looking to their members for input, since members often know what kind of online community they want and need.

### *Sustainability*

Some of these leaders of maker communities see their role as getting a community started that will be able to sustain itself through participant leadership over time. When asked to characterize how distributed the network of connections between members is, several maker community leaders indicated that their work is now very centralized but that they imagine their community moving toward more of a distributed model. They seek to establish systems of facilitation and management that distribute responsibility over the many people involved. Most established communities have funded staff or volunteers supplemented with stipends for leadership roles (e.g., developing content, teaching or leadership roles, or as facilitators).

In interviews with community leaders a difference between the communities serving maker educators and those not specifically targeting maker educators was noted. Maker educator organizations often have newer communities that are driven by passionate leaders, but the communities they run are not always staffed in a stable way. Many of these new communities lack funding for dedicated staff and are run by leaders who work on personal time or have communities competing for time with other projects. This means that design, facilitation, and management is often carried out by people who squeeze this role in as a side project in addition to a set of main job responsibilities.

## Part II. Needs Assessment of Maker Educators and their Communities

Interviews with leaders and educators and educator surveys provided information on the needs of maker educators related to resources and connections with peers. Survey topics included the kinds of community engagement that would best support the needs of maker educators and the ways that educators would like to access content and resources.

*Guiding questions for Part II:*

- a. What are needs of maker educators (e.g., time, money/materials, space, support, etc.) in terms of access to resources and connections with peers?
- b. How do educators prefer to participate in maker-oriented communities (online, face-to-face, and/or blended)?

### **a. What are the needs of maker educators related to resources and connections with peers?**

In interviews and surveys, maker educators were asked questions related to the support they needed, and potential constraints such as time, material, money, and space. Survey and interview respondents highlighted several categories of needs such as more time and materials, more support from leaders and administrators, access to timely information, and opportunities to connect. A minority mentioned that more funding would be helpful, and these responses have been categorized within the materials or time categories depending on how the educators would spend the money. With the survey questions, educators were asked about their needs related to community engagement, the kinds of resources that are important to them, and how they would like to access online content. Responses from surveys highlighted the importance of information, ideas, and connections and included only a few references interest in earning credentials or certifications.

One educator survey item asked about the importance of different community features. Table 7 below outlines the community features rated most valuable to respondents.

**Table 7. Responses to survey item 30, “How important is it for you to do each of the following in your ideal community?” (Choices: not important, somewhat important, very important)”.** Source: Educator survey data.

Response	% selecting “very important” (N=330)
Get ideas about projects / lessons	90%
Share examples of projects / lessons	64%
Read/review static resources (e.g. tutorials, articles)	59%
Connect with other educators online	56%
Share student projects / work	55%
Connect with experts online	51%
Connect with other educators face to face	41%
Connect with experts face to face	40%
Read/view visitor-posted content (e.g. forum posts, comments)	35%
Ask questions	33%
Work 1-on-1 with mentors	26%
Earn credentials, credits, or certification	16%

#### *Project and lesson ideas*

Respondents overwhelmingly indicated “get ideas about projects / lessons” as very important (90% of responses). The second option most frequently rated as “very important” was “sharing examples of project / lessons,” suggesting that the larger community is interested and prepared to contribute project ideas and lessons as well as learn from others. Overall, 75% of respondents indicated connecting with other educators or experts, both in person or online, was “very important”.

In a similar survey item concerning the importance of access to different kinds of resources, 97% of respondents rated resource collections as “very important” and 78% ranked multimedia resources such as photos or video as “very important.” Responses to this question, presented in Table 8, and additional survey data suggest a strong interests among educators in access to a resource collection.

**Table 8. Responses to survey item 31, “Which of the following resources are important to support your needs as a maker educator?” (Choices: not important, somewhat important, and very important).** Source: Educator surveys.

Responses	% Selecting “very important” (N=330)
Resource collections with articles / lesson ideas / tutorials / latest research	87%
Resource collections with photos or video	78%
Information about grant applications (e.g. application wizards)	57%
Calendar events (e.g. webinars, Maker Fairs, face-to-face events)	50%
News and Announcements	40%
Profiles of individual makers or educators	24%
Personal blogs	25%

Interestingly, despite logistical challenges, 25% of survey respondents said they would like more opportunities for in-person meetings with other makers in their local area or region.

Respondents cited specific types of in-person engagements they would like to see more of, such as meet-ups, professional development sessions, and chances for newcomers to interact with experienced makers or experts.

Turning from the format of face-to-face engagement to the people involved, some educators reported that they want to improve local connections in order to share resources and tools as well as expertise. (It is worth noting that people expressing interest in improved access to other local makers and maker educators were from across the main demographic areas, including urban, rural, suburban, and even outside the United States. The types of local connections sought included not only connections with other makers and maker educators but also with representatives of other types of local entities, so that resources for making could be better integrated across a locality's schools, libraries, and other community-serving organizations, as well as with local businesses. Thus, an important need is the development of a regional network or community.

#### *Combination of static and changing resources*

Survey respondents were asked what kinds of community engagement would support their needs as educators. Table 9 summarizes responses to this question.

**Table 9. Responses to survey item 29, “What kinds of community engagement (online or face-to-face) would best support your needs as a maker educator? (Please choose up to three)”. Source: Educator surveys.**

Response	% Selecting “very important” (N=145)
More access static resources (e.g. tutorials, research articles)	64%
More chances to communicate with educators	59%
More chances to communicate with experts	55%
More access to contributions by other educators (e.g. comments, forum posts)	45%
More opportunities to pose questions to other educators	31%
More opportunities to pose questions to experts	31%
Other (please explain)	12%

Consistent with respondent comments about how survey respondents engage within their community now, respondents prioritized access to static resources while also valuing opportunities to interact with others. Seventy-six percent of respondents chose at least one of the options related to additional opportunities to communicate with others, including other educators, experts, or both, and 44% were interested in posing questions to other educators, experts, or both. Write-in survey responses included references to interest in in-person meet-

ups and contact with experts, and echoed the sentiment that what is needed is a combination of static and dynamic resources. Additionally, several write-in comments echoed this sentiment that what is needed is a combination of static and dynamic resources.

#### *Access to information about funding sources and applications*

Survey respondents noted an interest in accessing information related to funding, including funding sources, strategies for seeking funding, such as eligibility requirements, and guidance on preparing grant applications. 57% of educators ranked information about grant applications as “very important,” with another 35% of respondents ranking it as “somewhat important”. Many of the educators interviewed did not have long-term funding plans. Community leaders need more time to support growing communities, but cannot afford that time sustainably when it is not funded.

#### *Small grants for materials and tools for learners*

One interview respondent referred to access to materials as “a game changer.” Another mentioned that materials costs can be a burden on educators who oftentimes use their own personal money to supply materials. A third educator mentioned need for small, targeted grants that would allow educators to try new things and jump-start new approaches. One specific example of a potential grant-funded project, mentioned by a library makerspace director, was the building of a robotics lending library from which students could check-out robotics parts and materials.

#### *Time for professional development and connections*

Several educators and community leaders mentioned an interest in more time, not specifically time to carry out programming, but rather time for connecting with other educators and comparing ideas. For example, one survey respondent mentioned that she saw in-person meetings of maker-educators in her community as valuable, but she was not always able to attend because of her limited time.

Several interview and survey responses referred to a lack of time that can limit participant’s engagement with community. One educator praised the value of events and other opportunities to connect in her community but said that she was not able to attend most events because of limited time in the workday. Another educator, referring to online access to resources had similar time constraints:

If sites used language where I had to research technical information, I didn't go further because I don't have time for this. Looked for sites written for educators. Looked at pictures to see if kids were doing the activities; if not, moved on

### *Support from leaders*

Overall, almost all (90%) of the survey respondents state that they have the support of their administrators. Most are supported by other educators they know in person (89%) and those they know online (82%). More than 70% reported support from almost all other sources listed: makers (local and online), parents, and other stakeholders. Several interviewees reported that having support from administrators is important to their work. In one case, an interviewee who lacked access to adequate maker materials through her school, said that she was “happy to scrape about for those materials” because the administrator was so supportive of making.

It is worth noting that, because data was collected from self-identified maker educators who are or plan to carry out making in their work settings, these results may not be typical for educational institutions as a whole. Support from administrators may be a barrier to the educators who are not yet making or plan to in the near future.

### *Access to research evidence*

One common request among survey respondents describing needs and interests was for access to research evidence regarding the contribution of making to learning, and the value of making for education. Maker educators were interested in sharing this evidence with school administrators and other stakeholders, and in using the research to make a case to funders.

I would love more professional research on how the maker movement has/ is going to transform education. Where will the most impact be? (Survey response)

[...] finding compelling ways to tell the story of impacts of our work is key. (Survey response)

Moving beyond building engagement activities to ask how new tools can be used to make our lessons more efficient, effective or both. (Survey response)

### *Accommodating teachers' needs and scheduling constraints*

Many survey responses suggested a need for better integrating K-12 teachers and schools into programs for maker educators through the teacher-friendly scheduling of events, and the development of ties to curriculum and standards. Along these lines, teacher professional development was a noted need. The interest in how K-12 educators can be better served is consistent with the large number of survey respondents working in this setting.

Teachers not comfortable in this area need support in developing meaningful tasks for students and the slow onramp to the kind of work that is advertised. No one talks about how teachers and programs evolve but it's hard and messy and real. (Survey response)

Some respondents were interested not so much in the development of new professional development for teachers, but in taking into account teachers' scheduling conflicts:

Oftentimes webinars and Hangouts are in the middle of the school day, which makes it virtually impossible to participate live because we are teaching. I would appreciate if more of these learning opportunities were held in the evening. (Survey response)

Others wanted to learn from other educators' challenges and successes—that is, not just to connect with individual makers but to hear system-level perspectives on other programs, e.g., how school champions develop relationships and support, or how the nature of partnerships between making programs/groups develop.

Several survey respondents mentioned an interest in information about the links between making and school content standards, in particular NGSS standards. Educators who participated in interviews shared a similar interest; one wished for more vetted projects and explicit standards collections. The closest thing to what they sought they were aware of was the collection of project ideas offered by the Community Science Workshops Network. Another mentioned the importance of figuring out where hands-on science fits in terms of larger standards, since teachers are responsible for the standards and their maker activities need to be well integrated.

#### *Bridging large-scale and small scale community*

Though many survey respondents were interested in more opportunities for local or regional in-person meetings, and easier ways to identify other local makers. Educator interviewees were interested in both large-scale community (e.g., resources to serve all maker educators) and in more personalized resources. Many educators voiced their appreciation for the offerings in their local areas, or in those aimed at their specific audience type (e.g., The [Making & Tinkering Spaces in Museums Community of Practice](#) for museum educators). While some community managers and educators were committed to building and maintaining connections within groups of educators in similar roles, several school-based educators mentioned in interviews that they still feel unable to connect with others with similar job titles or who work with students in similar age groups. One interviewee who served as a school-based manager of maker programs noted that she had not yet found a community of people like herself to connect with. Others mentioned an interest in connecting with educators who worked with students in the same grade bands.

Overall, survey respondents seek both services designed for maker educators within small groups (e.g. geographic areas, or working within particular kinds of institutions) while also demonstrating interest in connecting with the larger community of maker educators as a whole.

### *Improving community inclusion*

Survey respondents indicated an interest in seeing increased diversity among educators who take part in communities, especially greater inclusion of communities of color and under-resourced communities.

In interviews with community leaders, two remarked that they were interested in reaching out to educators of diverse backgrounds to support their introduction to the larger community of maker educators. Respondents also noted needing better “on-ramps” for newcomers and novices to become participants.

### **b. How do maker educators participating in communities prefer to engage?**

Survey and interview respondents alike indicated an interest in both face-to-face and online modes of interaction. Consistent with prior research on learning communities (Grossman, Wineburg, & Woolworth, 2001; Best & Kruger, 2006; Zheng et al., 2001), community leaders we spoke with sought to leverage the benefits, and account for the limitations, of each mode of interaction. Interviewees and survey respondents generally indicated an appreciation for a blended approach, and contributed rich and varied insights regarding their preferences and needs for both face-to-face and online engagement.

#### *Balancing the need for face-to-face engagement with affordances of online resources*

In interviews, leaders underscored the importance of face-to-face interaction including visits to other educators’ workspaces and engaging in making and maker activities with others. Some reported using online, asynchronous connections within groups of colleagues in-between face-to-face events for coordination and immediate communication. Similarly, most educators we interviewed reported a preference for face-to-face interactions, highlighting the inherently hands-on learning that takes place in making, and the importance of connections made with other makers. Some also recognized the importance of a hybrid model that includes face-to-face interaction, as well as an online space for educators to access and share lesson plans or activities. Below are excerpts from educator interviews.

Without the face-to-face [component], it loses effectiveness in terms of building a community. (Educator interview)

The beauty of online is it’s easier to do, but I think you can’t underestimate the value of you sitting in a room with somebody and talking. (Educator interview)

Often the lines between online and face-to-face interaction can be blurred, with people customizing their experiences for their own context. For example, one of the leaders of the *Introduction to Tinkering* MOOC reported that some people sign up for the online course as individuals, experiencing all interaction online. Others enroll with colleagues from their

workplaces or peers from in-person courses. People who take it individually can do the activities in their own spaces, and share and ask questions online, while those who in effect enroll as a co-located group, add a face-to-face component to an experience designed to take place online.

*Preferred formats and connections for face-to-face opportunities*

The most notable challenges of face-to-face interaction, as described in educator interviews, were the time required and the costs associated with travel, for example, to attend regional meetings. Lack of time and resources were similarly challenging to educators specifically pursuing in-person making opportunities. One survey respondent noted that tapping into existing events could be an efficient use of time and money:

Maker educators are frequently at other education or maker conferences trying to get together on their own. Intentional planning of a gathering specifically for maker educators (like the Maker Ed Convening 2015) would be incredibly valuable. (Survey response)

Interestingly, despite the reported challenges of attending in person events, 25% of survey respondents said they would like more opportunities for face-to-face meetings with other makers in their local area or region. Respondents cited specific types of in-person engagements they would like to see more of, such as meet-ups, professional development sessions, and chances for newcomers to interact with experienced makers or experts.

Another important need of maker educators in this study is the development of a regional network or community. Some educators reported that they wanted to share resources and tools as well as expertise with other maker educators. These responses were common across the main demographic areas, including urban, rural, suburban, and even outside of the United States. The types of local connections sought included not only connections with other makers and maker educators but also with representatives of other types of local entities; resources for making could be better integrated across a locality's schools, libraries, and other community-serving organizations, as well as with local businesses.

*How educators would like to access content*

The survey also asked how maker educators would like to access community content online. Table 10 summarizes responses to this question.

**Table 10. Responses to survey item 32, “Are there ways you would like to be able to access content (Please choose up to three)”. Source: Educator survey data**

Response	% Selecting “very important” (N=330)
I would like to access things recommended by other educators	76%
I would like to search for resources using keywords	74%
I would like to access curated content (selected by staff or experts)	63%
I would like to access content based on recommendations of other users (e.g. upvotes, likes)	48%
I would like to search for content based on geographic location	42%
Are there other approaches you would like to use to find content and resources? If so, please explain.	6%

In contrast with how respondents described their current means for finding content, keyword search was not the most popular choice (though still selected by 74% of respondents). Instead, educators stated that they are most interested in content that is recommended by other educators. Write-in responses in the “other” field of this part of the survey included requests for the option to filtering by content or content standards, level (e.g., higher education), learner ages, amount of preparation time required by educator, topic, activity length, and educator experience level.

# Conclusions and Recommendations

The growing field of maker education includes both formal and informal educators with diverse roles and experiences. Findings from survey and interview data suggest common patterns in how educators access resources, the kinds of resources they are interested in or need, and the ways they seek to connect with one another. Most promisingly, findings point to a strong sense of good will among the educators who reported high levels of interest not only in gaining access to information and expertise provided by other maker educators but also in contributing and sharing with colleagues.

A significant number of maker educator and community leader interviewees reported appreciating the openness and willingness to share ideas and consider this a valuable characteristic of the maker educator community. Many discussed the value of sharing ideas and being willing to see them adopted, modified, and hacked. Maker educators expressed satisfaction with having found a community of like-minded people. Connections among community participants help communities avoid isolation among educators, many of whom do not work with other maker educators within their schools and organizations.

Many of the findings from the interviews and surveys have direct implications for the kinds resources educators seek and for the kinds of interactions that would meet the needs of many maker educators seeking to connect with others.

## Recommendations for community content

Based on the findings concerning the needs of educators and the kinds of resources they access, community designers should consider prioritizing the following:

*Provide consolidated, user-friendly, easily searchable project plans and lessons.*

While it is likely not necessary to build things from scratch and develop new project ideas, many of the resources that are currently out there were developed for audiences other than school-based educators. An index or system of organization that incorporates specific key information for project ideas (e.g., standards alignment, time required, setting of educator, or age of learners) is needed.

*Provide well-organized access to research.*

Maker educators seek clear and well-organized information about what research can tell them about the benefits and impacts of making. They need this information when communicating with stakeholders at their institutions and in order to develop and understand their own

practice. Educators seek research in accessible formats, such as 3-4 page summaries of important studies or white papers geared for practitioners.

*Provide access to information about the broader policy and funding context.*

Educators involved in maker-centered communities seek timely information about the broader research, policy, and funding context. There are opportunities as educators participate in face-to-face and online communities to broker connections between the practitioner perspective and policy. Because making does require investment of time and materials resources, educators need up-to-date information about grant opportunities and support for preparing grant proposals.

## **Recommendations for community design**

Based on findings across data sources, the following are design recommendations for the continued growth of maker-centered educator communities:

*Meet educators where they are.*

Continue to integrate opportunities to connect with the platforms that maker educators are already using such as the major social media platforms and the websites they already check regularly. This includes platforms such as Twitter, Facebook, Google+ and Google hangouts, and in-person events.

*Integrate face-to-face and online experience.*

Continue to combine face-to-face, online synchronous, and online asynchronous opportunities for educators. Create links between these experiences so that relationships and trust that are built in face-to-face settings can be combined with the anywhere, anytime advantages of online connections.

*Build targeted communities.*

In addition to resources that are freely available, educators appreciate opportunities to connect with others who share similar roles or challenges. Continue to develop targeted communities for special groups of educators (e.g., in-school educators) and provide resources that allow educators to meet with others with similar profiles (e.g., institution type, experience levels, roles, and/or locations).

*Provide streamlined ways for participants to make recommendations to one another*

Provide participants with many ways to engage that allow them to take on increasing roles in their community while helping others find valuable information. Systems for searching project ideas, such as online repositories and resource libraries, could include mechanisms that allow community participants to recommend, rate, or characterize resources. For some participants,

this could include reviews or profiles of project ideas but others might be interested in quickly upvoting a project idea or recommending a research article.

*Tailor resources for school-based maker educators*

Maker educators who work in schools have needs that are relatively new and emergent in the maker movement. School-based educators would benefit from efforts to map maker projects to school curriculum and content standards (especially NGSS) and from efforts to provide professional development (e.g., webinars and events) at times that align with the schedules of school-based educators.

*Attend to equity and design for trajectories of participation*

It is crucial to take active steps to provide access for and welcome maker educators of color and educators working in under-resourced communities into the wider maker educator community. One strand of this work might include increasing access to information regarding funding sources and support for seeking funding. Another strand might be initiatives to actively connect makers of color with the wider community, since educator experts in a community often broker relationships to help members identify others who can serve as good resources. Community participants will need different kinds of supports depending on their level of experience and time within the community. Explicitly designing onramps for engagement of newcomers and communities of color as well as approaches to helping established participants take on increasing leadership roles are two important components of community building.

*Emphasize community sustainability*

Many of the community resources for maker educators are supported by the generous efforts of busy educators who give their time for a cause they feel passionate about. These individuals believe in the capacity of maker education to improve equity and unlock the potential of young learners. Without adequate funding, however, these resources may be difficult to sustain over time. Providing support, particularly in financial and logistical planning, so existing community leaders can focus on the substance of community building and avoid burnout is essential.

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# Appendix A. Overview of Survey Respondents

The tables below summarize the demographic and work background data collected in surveys. The overall respondent column summarizes the data collected from all survey participants.

ROLE	Overall respondent %
Teacher	48%
Instructional support (e.g., teacher's aid)	2%
Instructional materials developer	5%
Activity leader (e.g. in afterschool, summer)	8%
Librarian	14%
Docent	1%
School administrator	8%
Other education manager	16%

RACE	Overall respondent %
White	84%
Hispanic or Latino	5%
Black or African American	4%
American Indian or Alaska Native	1%
Asian	6%
Native Hawaiian or Other Pacific Islander	1%
Other (please specify)	3%

AGE	Overall respondent %
18-24 years old	2%
25-34 years old	25%
35-44 years old	37%
45-54 years old	22%
55-64 years old	13%
65 years old or older	1%

GENDER	Overall respondent %
Male	34%
Female	66%

<b>EXPERIENCE</b>	
<b>Selection</b>	<b>Overall respondent %</b>
Not yet an educator, plan to become one soon	0%
In first year	3%
1-3 years	8%
4-6 years	11%
7-10 years	22%
11-15 years	22%
16 years or more	34%

<b>WORK SETTING</b>	
<b>Selection</b>	<b>Overall respondent %</b>
Public school (K-12) - not including charter	46%
Public charter school (K-12)	5%
Independent / private school (K-12)	11%
College or university	9%
Library	4%
Museum, science center, or similar	6%
Structured out-of-school learning (e.g. summer programs, after-school site, etc.)	10%
Other (included 10 makerspace and a lot of people with multiple jobs)	9%

# Appendix B. Educator Survey Instrument

## Professional Community Survey for Educators Engaged in Making

### 1. Welcome to the survey

Thank you for taking the time to complete this survey. SRI International is carrying out this survey on behalf of the Maker Education Initiative (Maker Ed). Survey results will be used to better understand the needs of educators who work with making.

Your participation in this study is voluntary and does not involve any risk to you beyond that of everyday life. Additional inquiries may be addressed to the Human Subjects Committee, SRI International, 333 Ravenswood Avenue, Menlo Park, CA 94025, or 650-659-2666. Refer to IRB #1626.

*How long will it take?* We estimate that it should take about 15 minutes to complete. Please be sure to click done at the bottom of the last page when you have finished the survey.

*Can I save my survey and add to it later?* Yes. If you don't finish the survey all at once, please submit. You will see a link for editing your responses. Please save that link for later.

*Who is the survey for?* The survey is intended for educators, including volunteers, who work with making. The questions on this page confirm eligibility.

*How should I ask questions?* If you have any questions about the survey, please contact Tiffany Leones at SRI International at [tiffany.leones@sri.com](mailto:tiffany.leones@sri.com).

1. Are you an educator?

- Yes
- Not yet, but I plan to become an educator
- No

2. If you are an educator, which of the following best describes your role?

- Teacher
- Activity leader (e.g. in afterschool, summer)
- School administrator
- Instructional support (e.g., teachers aid)
- Other
- Other education manager
- Instructional materials developer
- Docent

Other (please specify)

3. Have you incorporated making into your practice as an educator?

- Yes
- I plan to
- No

## Professional Community Survey for Educators Engaged in Making

### 2. Your background and work as an educator

#### QUESTIONS ABOUT YOU

4. How would you describe your race (Check all that apply)

<input type="checkbox"/> White	<input type="checkbox"/> Black or African American	<input type="checkbox"/> Asian
<input type="checkbox"/> Hispanic or Latino	<input type="checkbox"/> American Indian or Alaska Native	<input type="checkbox"/> Native Hawaiian or Other Pacific Islander
<input type="checkbox"/> Other (please specify) <input type="text"/>		

5. Which best describes your gender?

- Male
- Female
- Other

6. What is your age (in years)?

7. How long have you been working as an educator? (including as a volunteer)

#### QUESTIONS ABOUT YOUR WORK

8. Which of the following best describes your work setting?

- Public school (K-12) - not including charter
- Library
- Public charter school (K-12)
- Museum, science center, or similar
- Independent / private school (K-12)
- Structured out-of-school learning (e.g. summer programs, after-school site, etc.)
- College or university
- Other (please specify):

9. Which of the following best describes your work as an educator?

- Employee/staff
- Volunteer

10. Where is your workplace?

(If you work in multiple locations, choose the one where you spend the most time.)

City

State

Zip Code

11. Which of the following best describes the community where you work?

- Urban
- Suburban
- Rural
- Other (e.g. mixed)

12. What ages of learners do you work with? (Check all that apply.)

- Early childhood / Preschool aged (age 0-5)
- High school aged (grades 9-12)
- Mixed-age groups
- Elementary aged (grades K-5)
- Young adult (age 18-23)
- Middle school aged (grades 6-8)
- Adult (23 and over)

13. How do students become participants in your programs? (Check all that apply.)

Students or participants choose the program  Parents choose the program for their children  Someone else (e.g. school administrator) assigns students or participants to me

Other (please explain)

14. Do you work with the same learners regularly?

I work with learners on a drop-in basis and may only see them once.

I see most learners I work with several times but not more than 10 times in a year.

I see the same learners on a regular basis, more than 10 times in a year.

Other (please explain)

15. In your workplace, approximately what percentage of students or participants are:

White	<input type="text"/> %
Low-income	<input type="text"/> %
English language learners	<input type="text"/> %
Minorities from the following groups: Alaska Natives, Native Americans, Blacks or African Americans, Hispanics, Native Hawaiians and other Pacific Islanders	<input type="text"/> %

Professional Community Survey for Educators Engaged in Making

3. Your experience as a maker educator

16. When we asked if you had incorporated making into your practice as an educator, you answered "1" (Q3). Please briefly explain how.

17. What are the main reasons you are interested in making?

18. Overall, how supportive are others for integrating making into your work?

	Not supportive at all	A little supportive	Somewhat supportive	Very supportive	N/A
Administrators / managers in my organization	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other colleagues in my organization	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other local educators (not at my site)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Educators I know online	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Local makers	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Makers I know online	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Parents / Community members	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other stakeholders in my organization (e.g. Board of Directors)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other stakeholders outside of my organization (e.g. funders)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please list the other groups that are supportive or not supportive; or explain anything further about the support you get.

In the next few questions you will be asked about your connection to communities as an educator and then as a maker educator; the questions are the same, but please answer from the two different perspectives.

19. As an educator, is there a website, group, community, or organization that you visit most regularly?

Yes  
 No

If not, briefly explain why not.

20. If yes, what is the name of the website, group, community or organization that you visit most regularly as an educator?

21. Do you feel connected to a broader community of educators?

- Yes
- No

Why is this so?

22. As a maker educator, is there a website, group, community, or organization that you visit most regularly?

- Yes
- No

23. If yes, what is the name of the website, group, community or organization that you visit most regularly as a maker educator?

24. Do you feel connected to a broader community of maker educators?

- Yes
- No

Why is this so?

#### Professional Community Survey for Educators Engaged in Making

##### 4. Your participation in professional community

Educators have many reasons for joining groups where they can connect with organizations and colleagues engaged in similar work. The questions below are aimed at understanding your participation in these online and face-to-face communities and your goals and motivation for participating.

25. What are the main ways you engage when you visit [Q23]? (Check all that apply.)

<input type="checkbox"/> Read/view static resources (e.g. tutorials, articles)	<input type="checkbox"/> Earn credentials, credits, or certification	<input type="checkbox"/> Connect with other educators face to face
<input type="checkbox"/> Read/view visitor posted content (e.g. forum posts, comments)	<input type="checkbox"/> Ask questions	<input type="checkbox"/> Connect with other educators online
<input type="checkbox"/> Get ideas about projects / lessons	<input type="checkbox"/> Share examples of projects / lessons	<input type="checkbox"/> Connect with experts face to face
<input type="checkbox"/> Work 1-on-1 with mentors	<input type="checkbox"/> Share student projects / work	<input type="checkbox"/> Connect with experts online
<input type="checkbox"/> Other (please explain):		

26. What kinds of resources do you typically access when you visit [Q23]? (Check all that apply.)

- News and announcements
- Calendar events (e.g. webinars, Maker Faires, face-to-face events)
- Text-based resource collections (e.g. articles / tutorials / related research)
- Resource collections with photos / video
- Profiles of individual makers or educators
- Personal blogs
- Discussion boards
- Information about grant applications (e.g. application wizards)
- Live online events (e.g. Hangouts)
- Live face-to-face events
- Other (please explain):

27. How do you access the content that interests you when you visit [Q23]? (Check all that apply.)

- I search for resources using keywords
- I access curated content (selected by staff or experts)
- I access things recommended by other educators I know
- I access content based on recommendations of other users (e.g. upvotes, likes)
- Are there other approaches do you use to find content and resources? If so, please explain:

## Professional Community Survey for Educators Engaged in Making

### 5. Resources and Wish List

28. For each of the following Maker Education Initiative (Maker Ed) led resources or communities, please rate your familiarity.

	I am not familiar	I have some familiarity	I have visited	I visit regularly
Maker Ed's online community on G+	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maker Ed Twitter feed	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maker Ed Facebook page	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maker Ed's Makerspace community on G+	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maker Ed Maker Corps Community	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maker Ed on LinkedIn	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Maker Ed on Instagram	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

29. What kinds of community engagement (online or face to face) would best support your needs as a maker educator? (Please choose up to three)

- More access static resources (e.g. tutorials, research articles)
- More chances to communicate with educators
- More chances to communicate with experts
- More access to contributions by other educators (e.g. comments, forum posts)
- More opportunities to pose questions to other educators
- More opportunities to pose questions to experts
- Other (please explain)

32. Are there ways you would like to be able to access content? (Please choose up to three.)

- I would like to search for resources using keywords
- I would like to access curated content (selected by staff or experts)
- I would like to access things recommended by other educators
- I would like to access content based on recommendations of other users (e.g. upvotes, likes)
- I would like to search for content based on geographic location
- Are there other approaches you would like to use to find content and resources? If so, please explain.

33. What do you like most about the maker educator community?

34. What do you wish could be improved about the maker educator community?

35. As the last question in the survey, please let us know about any other needs or interests that you think could be met by an online or in-person professional community for maker educators.