

Exploring Maker Practice: Common Attitudes, Habits and Skills from Vancouver's Maker Community

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ABSTRACT

A growing number of schools, libraries, museums and institutions are running “maker” programs where youth are using new technologies (such as digital fabrication tools) to build creative projects. We examine the practice of expert makers to help inform these efforts. Common attitudes, habits and skills from thirteen expert makers were identified through semi-structured interviews. These findings are discussed along with possible implications for practice.

Categories and Subject Descriptors

D.3.0 [Computers and Education]: General

General Terms

Human Factors

Keywords

Maker, DIY, Do-It-Yourself, Hacker, Digital Fabrication

1. INTRODUCTION

The “maker community” is a new network of Do-It-Yourself (DIY) practitioners that has grown in popularity over the past decade. Like other DIY practitioners, makers want to do things for themselves and learn the skills needed to build their creative projects. This particular community is interesting for designers and educators who work with technology because it combines the following three elements: first, the community has a distinct technological focus, and is pioneering new tools for digital fabrication (3D printers), physical computing (microcontroller boards), and online knowledge sharing (how-to pages); second, it is interdisciplinary, attracting a wide range of DIY communities to maker events (including hackers, crafters and artists) and showcasing interdisciplinary projects (such as e-textiles); third, it is accessible. Maker events are informal and emphasize participation and collaboration (especially in contrast to events like science fairs or robotics competitions).

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The community has grown rapidly since its inception in 2005: in 2013 *Maker Faire* events were hosted in one hundred cities around the world and drew over half a million attendees [16]. The broad appeal of these events and their emphasis on hands-on technology make them a promising vehicle to promote interest in science and technology. As the maker community grows, institutions (such as school, libraries and museums) are starting their own maker programs or incorporating elements of maker practice into their existing programs [2,9,11].

“Makerspaces” (also called hackerspaces or digital fabrication labs) are an example of this interest from institutions. These interdisciplinary workshops are built to support creative projects by combining tools from the computer lab, art studio and fabrication shop. They also tend to use new technologies, such as digital fabrication devices [3].

The first author spent two years working at a makerspace housed in a science museum in Vancouver, Canada, where high school students came in after school to work on creative projects. He noticed that the students in the program often struggled to find inspiration, navigate online learning resources and stay motivated through projects. Which lead us to wonder how expert makers accomplish these tasks.

1.1 Research Goals and Approach

Some educators have long argued for teaching approaches similar to the practice of “making.” The value of applied projects driven by students interest is a central theme in constructivist education theory [15], and some researchers, such as Seymour Papert, have emphasized the potential of technology to enhance constructionist projects [17]. Contemporary education researchers are mapping the ideas from the education literature onto the new technologies, social movements and learning resources being pioneered by the maker community [3].

While we recognize the value of this approach, and the relevance of past education literature to modern “maker practice”, we chose to build a description of practice directly from expert makers. We felt that a “ground-up” approach would give voice to makers who are successfully utilizing the technologies available to novices makers today. Our approach compliments research from previous literature and hands-on teaching methods developed in the classroom. Using an ethnographic approach allowed us to capture specific habits, attitudes and skills that are common amongst expert makers. This description expands our understanding of contemporary DIY practice and may inform the thinking of teachers running maker programs.

The specific research question that we explore is: what attitudes, habits and skills are common amongst expert makers? This question alludes to the framework that we developed to describe

practice, which categorizes elements of practice as attitudes, habits or skills. To sample “expert makers” we interviewed a purposive sample of thirteen adults from the maker community in Vancouver, Canada.

2. BACKGROUND

2.1 Defining the maker community

Despite (or perhaps as a result of) its increasing popularity, “maker” is a poorly defined term. We believe that much of the confusion stems from the fact that the same term is used to describe a specific community and a very general practice.

The term “maker” was coined by Dale Dougherty in 2005. Dougherty wanted to start a magazine about DIY technology projects call “Hack,” but the term had negative connotations. On the advice of his daughter, he chose the term “Make” as a more approachable alternative [6].

Originally intended to describe people who make technology projects in their spare time (often called “hackers”), the maker community has broadened since 2005. This is largely due to the popularity of *Maker Faire* events, a series of DIY festivals started in 2006 by Dougherty and his team. These events, billed as “part science fair, part county fair” have attracted a range of DIY communities, including: hackers, crafters, burners (who make art for the Burning Man festival), artisans, bike co-ops, community artists, traditional craftspeople and education groups.

As the term is adopted by a growing number of researchers, administrators and teachers, it is being reinterpreted. To some educators who we spoke with, “making” is about creative technology projects; to others it is about hands-on work; to others it is about creative empowerment more broadly. For our purposes we will use a more restricted definition, based on the idea that “makers” are a specific network of DIY practitioners, who are connected through events like Maker Faire. Within this definition, Do-It-Yourself practitioners are considered to be people who create their own products as an alternative to buying something mass manufactured. Practitioners might engage in these projects out of necessity, for political purposes, or for pleasure. Just as the “maker community” is a subset of a larger world of DIY practitioners, “maker practice” is a subset of a larger world of DIY practice.

2.2 Previous Research

As mentioned in the Research Goals and Approach section, a large body of literature discusses education concepts relevant to making (see Martinez and Stager (2013) for examples). In this review we will focus on ethnographic literature from design fields that focuses on practice in the maker community.

The maker community has drawn the interest of a growing number of researchers from design fields such as Human Computer Interaction and Computer Supported Collaborative Work. Many of the studies that these researchers have conducted focus on use of a particular technology (e.g. how-to tutorials) or a particular sub-community (e.g. crafters), but together they sketch out a picture of DIY practice that can inform our understanding of making.

The maker community has a robust online presence, populated by blogs, personal websites, learning resources (such as Instructables.com), and online communities related to a specific practice (knitting) or products (Arduino microcontrollers). Detailed studies of DIY practitioner’s online behaviour find that people participate in these online communities to find ideas,

find likeminded practitioners, and share their projects [12,21,22]. Frequent, open sharing is also identified by several other researchers as an important part of DIY practice [19,21,23].

Studies of DIY practitioners that do hands-on work, especially crafts, have highlighted the importance of aesthetics and pleasurable practice [4,7,10]. Buechley compares this to the more analytical and problem oriented motivations of electronics enthusiasts [4].

Finally, the political elements of DIY practice are discussed in several studies. These elements include a resistance to authority as a motivation for work [23] and the inherently political environment in which making takes place [14,20].

Together these studies suggest several elements of practice that are important to making: online resources, sharing with a community, aesthetics, and politics. Our goal is to extend this work by building a description of maker practice that is both concrete (describes specific behaviours) and broad (is not focused on one aspect of practice or one specific sub-group).

3. METHODS

We interviewed thirteen makers in Vancouver, Canada. These participants were chosen as a purposive sample of practitioners who frequently worked on DIY projects. The first author has been involved in several local hackerspaces and DIY events (including the Vancouver Hack Space, Vancouver Community Laboratory and Vancouver Mini Maker Faire) so he approached participants directly or was referred by members of the community. To help counteract potential bias created by recruiting through a personal network, participants were chosen for diversity, representing a wide range of ages, genders and interests. Table 1 summarizes the demographics of the thirteen interview participants.

Table 1. Demographics of Interview Participants

Gender	Age	Areas of Interest
F	26-30	Crafting, Fiber Arts
M	31-35	Coding, Electronics
M	41-45	Electronics
F	26-30	Community Art, Crafting
M	26-30	Film, Machining
M	18-25	3D printers
M	26-30	Coding, Electronics
F	46-50	Machining, Crochet
M	31-35	Robotics
F	36-40	Sculpture, Architecture
M	41-45	3D Printing, Furniture, Art
M	36-40	Electronics
M	51-55	Electronics, Music

We used a thematic analysis to identify commonalities across out interviews. This technique, as described by Richards [18], involves iterative passes through the data to develop interview ‘themes’ (concepts that are mentioned across multiple

interviews). These themes were categorized as habits, attitudes, or skills according to our conceptual framework. Themes that were mentioned by less than 25% of the participants (4 out of 13 respondents) were discarded.

4. FINDINGS

The following section provides a brief description of each interview theme we identified, along with illustrative quotes. Interview themes are presented in **bold font** throughout, so that they can more easily be connected to the summary of results in Table 2.

4.1 Inspiration

4.1.1 Continually searching for inspiration

Our interviewees indicated that an important part of DIY practice is maintaining a steady supply of inspiration for new projects. Interviewees mentioned several habits related to this need. One common method was to **use projects to solve problems from daily life** or, as some participants put it, to “scratch an itch”. Interviewees also **use projects to help others** by solving their problems or creating gifts. Many participants also mentioned the habits of continuous **online reading for inspiration** and **talking to friends for inspiration**. Interviewee 10 summarized their sources of inspiration saying:

Most of my work now is more about being inspired or getting a gem of an idea from the Hack Space people or from the web or from Arduino or YouTube, seeing what somebody's done and saying "oh, I wonder how they did that" and often trying to reproduce it and extend it.

Interviewees also mentioned their process for capturing and fostering ideas, the most common of which was **keeping an idea journal**. Several participants described highly intentional processes of recording and working on ideas using a notebook.

4.1.2 Desire for control over environment

When probed about the attitudes that motivate their work, interviewees showed a wide range of opinions: from utopian ideas about the promise of technology to negative opinions about screen time and a desire to return to more hands-on crafts. One common thread that ran through these comments was participants' desire for control over their environment. This was expressed as two related attitudes. The first was a **belief that people should understand the things they own**, a reaction to “black box” technology and passive consumerism. Participant 10 expresses this attitude:

I'm not just going to accept the fact that everything I need I have to buy...I have to take it as it is, and if it's broken I have to throw it away or take it to somebody else to fix. This idea that I'm as capable as other people to create, discover, modify, build, command, envision, dream. This is something that I got in my early times.

The second was a more personal **desire to customize the world to fit their needs exactly**. As interviewee 4 put it, “the status quo works if it fulfills 100% of what we need, but if there's 5% that isn't there, we're willing to say, ‘let's make it better.’”

4.1.3 Curiosity leads to understanding

Interviewees often expressed an intense **desire to understand the world around them**, which lead to the habit of **taking things apart**. As described by participant 6, “Ripping apart stuff that my parents brought back was a big one for me.

Understanding how things worked. So... we lived close enough to a junk yard that I could go bring junk back, rip them apart.”

Interviewees also described a more specific consequence of intense curiosity: a **desire for deep knowledge**. Many interviewees talked about the need to fully understand tools and ideas. As participant 4 explains, “I like to understand why something works. I never accepted things that were just ‘oh it works this way.’”

4.2 Problem Solving

4.2.1 Confidence in problem solving ability

Another attitude commonly referenced in the interviews was confidence in one's problem solving abilities. Many of the interviewees expressed confidence that they **could overcome any problems they encountered and could figure out how the objects around them work**. Several interviewees joking referred to this as maker “ego” or “hubris,” but cited it as a constructive force that prevented them from being intimidated. Participant 10 elaborates:

I think it's the maker's credo... it's "wow, everything that's made by humans on this planet is made by people like me." Maybe smarter, maybe with more education, but the makers credo is: if somebody made it, I can understand how it works and given enough time or energy I can probably make it or enhance it.

This confidence is also reflected in the common theme of **wanting to solve problems yourself**. As participant 1 put it, “I suffer from a fair amount of “not invented here” syndrome, so I'll look at all [these products], and then I'll do it myself. I want to own it by the time I'm done it.” Whether arrogant or optimistic, a deep sense of empowerment was a clear theme amongst interviewees.

4.2.2 Embrace failure

Perhaps related to a sense of empowerment, interviewees expressed an attitude that **failure is an important way to learn**. Interviewee 2 put it succinctly by saying, “someone once said just keep making new mistakes, and that's exactly what I aim for.” This attitude was also evident in the common habit of **learning through trial and error**. Interviewee 9 describes her process, “I also tend to be somebody who isn't super intimidated by a lot of that stuff with my hands so I'll just dive in and figure it out as I go.”

4.2.3 Good at troubleshooting

In addition to habits and attitudes, two skills were commonly mentioned as essential parts of DIY practice. The first of these was **being good at troubleshooting**. Interviewees also emphasized two attributes that support the problem solving process, **being adaptive** and **being tenacious**. As interviewee 7 describes it:

I think [makers are] the people that don't give up... you couldn't last very long if you got really depressed from sucking. If you're making things... you're going to have a lot of times when you're like "oh crap that didn't really work out the way I thought", and you have to have the guts to do it again, and do it again, and do it again, and not feel embarrassed about doing it wrong the first couple times, or doing parts of it imperfectly.

Table 2. Summary of Findings

Interview Themes Organized by Finding	Number of Interviewees Who Mentioned Theme	Interview Themes Organized by Finding	Number of Interviewees Who Mentioned Theme
INSPIRATION		Good at troubleshooting	
Continually searching for inspiration		good at troubleshooting	9
use projects to solve daily problems	7	adaptive	4
use projects to help others	7	tenacious	5
frequently read online for inspiration	8	Effective researcher	
talk to friends to get ideas	9	good at internet search	8
keep an idea journal	4	use online tutorials	4
Desire for control over environment		ask friends when trying to learn	7
believe people should understand the things they own	7		
desire to customize the world to fit your needs exactly	5	MOTIVATION	
Curiosity leads to understanding		Keep project work enjoyable	
desire to understand the word around you	8	often work on creative projects	5
always taking things apart	5	work on projects in irregular bursts	5
desire for deep knowledge	7	work on multiple projects at one time	9
		incorporate play into their process	6
PROBLEM SOLVING		Productive work environment	
Confidence in problem solving ability		have a workspace at home	8
feel you can overcome problem you encounter	10	get the most work done when alone	4
can understand how anything works	10	Have a peer group	
want to solve problems yourself	6	had adult DIY mentors when young	11
Embrace failure		had a peer group with shared interests when young	6
failure is an important way to learn	5	currently have a peer group that shares interests	7
learn through trial and error	5		
		DEMOGRAPHICS	
		have formal training	13
		work in technical or design field	10

4.2.4 Effective researcher

Another skill that was identified as important for DIY was research. In particular, online research skills were emphasized as both **effective internet search** and **use of online learning resources**, such as videos. Participant 8 explains:

I find the internet to be good for referencing things, like, if I forget how to cast on and if I want to learn a new way, I can just search. And I can see pictures of a video where they show me with their hands, because you need to see the hands.

Interviewees also pointed out the value of their social network for finding information describing how they **ask friends for help when trying to learn new skills**. Participant 2 expressed this clearly:

When I can, I talk to local makers. If there's anyone I know who's actually done anything related to what I'm doing I turn to them first, because that's even faster than [online forums]... because I've built up a personal relationship with that person. That's immensely helpful, social networking all the way.

4.3 Motivation

4.3.1 Keep project work enjoyable

Unsurprisingly, many interviewees mentioned that they **often worked on creative projects** and found them enjoyable. Interviewees also mentioned three other habits that support this goal. The first habit was to **work on projects in irregular bursts**, capturing inspiration and motivation when they occurred. The second was to **work on multiple projects at one time**. Participant 1 described their process:

I work on one for a while, then get tired of it, then work on something else. Then I'll have an idea in the shower about how to improve, two projects back, so... if I don't have more than one at a time I'm going to get quite bored with whatever I'm doing.

The third habit was **incorporating play into your creative practice**. This unstructured time was often used to experiment with new tools or generate ideas.

4.3.2 Productive work environment

Several common habits related to work environment also arose. Contrary to our expectations, one of these was working alone. There were some exceptions to this rule (one interviewee talked about going to a local art collective on the weekends to do “fun projects”) but a greater number of participants emphasized the fact that they **get the most work done when alone**. Participant 5 complained that:

If I'm at the Hack Space and I try to work on something, I either get distracted talking to someone or I get distracted trying to find something that doesn't exist there and I'm like, 'well I should have worked on this at home in the first place.'"

When asked about their work environment, many interviewees elaborated on their **workspace at home**. Participant 10 explains that, “having a fixed space to work means that I don't have to do much teardown and setup and that means I have less of a barrier towards actually doing things.”

4.3.3 Have a peer group

The value of having a supportive peer group was emphasized by interviewees in three different ways. The first two were about getting started in DIY. **Having adult DIY mentors when young** was a common story of beginnings, as was **having a peer group with shared interests when young**. Participant 1 explains:

I'm pretty sure that peer influence is a huge thing. If you do have other friends around that do find some of this stuff interesting, it sort of reinforces whatever latent interest you may have. I know that worked for me, knowing that a few of my friend and acquaintances were into this stuff.

When describing their lives today, the value of **currently having a peer group that shares your interest** was also emphasized.

4.4 Formal Training

The final themes from our interviews relate to demographics. We found that interviewees often **had formal training**, and many of them **worked in technical or design fields** like programming or architecture. The advantage of this training was described by participant 12:

We actually had pretty good courses in high school physics, we got to play with some logic chips and debounce switches and various other things, like RS flip flops... in university we had more op amps and logic and whatnot, kind of low level stuff... good foundation.

5. DISCUSSION

The broad description of maker practice arising from our interviews is not ground breaking, but it presents a simple framework for thinking about the elements of practice that are common across making's many disciplines: finding inspiration, solving problems and maintaining motivation.

Our analysis also identified common habits, attitudes and skills shared by expert makers. The common practices of these adults do not necessarily map directly onto novice makers (the two groups have different needs and circumstances) but they provide an interesting starting point for practitioners working to design and implement maker programs. Below we discuss some of these specific elements of practice and their relation to other literature.

5.1 Failure and Confidence in Problem Solving

The idea of embracing failure arose as a theme in our interviews, and slogans such as “fail fast” are common in the maker community. However, the term ‘failure’ has been criticized for its negative connotations and ambiguity [8].

When interviewees talk about failure, we suspect that they mean failures *on the way to success* (these could also be called experiments, prototypes or iterations). This interpretation fits with interviewees high levels of confidence in their problem solving ability and a habit of learning through trial and error. Some comments during the interviews refer to a more profound sense of failure, where entire projects went poorly (sometimes in public). In these cases interviewees emphasized the need to be tenacious and not give up when a project goes badly (see section 4.2.2).

Beyond giving more nuance to the idea of “failure” these statements emphasize the interplay between problem solving skills (such as troubleshooting problems and finding information) and attitudes related to the troubleshooting process (such as embracing failure and having a high degree of confidence). In addition to specific skills, it seems that a high level of self-efficacy - confidence in one's abilities [1] - related to problem solving is an important attitude that makers share.

5.2 Importance of Community

Interviewees indicated that community was important to their practice in several ways. Many participants spoke of the positive influence of mentors and peers that supported their creative habits when they were young. As adults, interviewees indicated that they used online communities for: finding inspiration, finding information, and learning new skills. These results align with previous studies on the online behaviour of makers [12,22], but interviewees also indicated that face-to-face communities were important for the same purposes. This relates to the idea of “communities of practice”, where peers join together to share information and learn from each other [13].

Some of the interview statements that we found most interesting described how makers use online search, online communities, and face-to-face communities in parallel in their search for information. This suggests, not only that makers possess sophisticated search skills, but that social networks play an important role in makers' strategies for acquiring information.

6. CONCLUSION

In this exploratory, ethnographic study, we identify common elements of practice amongst “makers”, an interdisciplinary group of DIY practitioners that gather online and around physical events like Maker Faire. Our analysis of interviews identified common attitudes, habits and skills these practitioners share, relating to the broad categories of: finding inspiration, problem solving, and maintaining motivation. This information expands our understanding of modern DIY practice, which we hope will contribute to the implementation of “maker” programs in formal and informal education institutions.

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