

# Making: On Being and Becoming Expert

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**Abstract.** Making is considered to be democratizing technology design and production. Yet, in many cases, in order to be a successful maker or have a rewarding maker experience, participants/makers need to bring in some form of expertise, creating both implicit and explicit barriers for differentiated publics to take part. We explore the literature and existing scholarship regarding expertise and making, using it to briefly contextualize our own research into maker programs in U.S. Libraries and design-focused fab labs. Both cases illustrate how the acquisition of expertise is also affected by community and learning environment dynamics. Through discussion we critically engage how mundane aspects of infrastructure relate to maker notions of expertise, the Maker Movement's claims of broad participation toward democratization, and the contextual dimensions of expertise.

**Keywords:** making, expertise, non-experts, democratization, participation.

## 1 Introduction

In recent years, cultures of making, from craft, do-it-yourself (DIY), repair, digital fabrication and hacking, have been hailed as bringing about more open and accessible modes of design, material production, and use of technology through participation and the increasing of skills through hands-on practice. Making gained immense popularity among diverse groups; particularly with the idea that one does not have to be an expert in order to solder a circuit board, build a small interactive installation with Arduino, or write a few lines of code. Cultivated maker environments such as local makerspaces, fab labs, and maker programming in public libraries are supporting the maker's learning process. But much too often, the projects described in publicly available sources reveal themselves to be highly complex. They typically require skills that span a wide range of "knowledges" — from understanding the construction process, to knowing what tools and parts to use, where to acquire them, and then finally being able to reconstruct the project by oneself. Making, as design curator Daniel Charny argues, connects "two aspects of power" — technique, how something can be made, and personal skill, how good one is at it [1:8]. For anthropologist Tim Ingold, who follows the ecological approach, both skill and technique intertwine and

evolve not only out of bodily experiences, but as part of a relational system with the environment, where various forms for engagement act upon the process of skill-evolvement [2]. In their most specialized, disciplinary forms, these become key components of expertise. Thus expertise itself is situated within the environs and community out of which it grows. This is also the case with expertise developed in maker cultures.

Hands-on maker practice has garnered attention in academic scholarship (e.g. [3, 4, 5, 6, 7]), most predominantly in the fields of human-computer interaction (HCI), design research, digital humanities, and to a lesser degree in the social sciences. Prior research draws on a range of subject matter in their efforts to situate making and DIY practices, including the following: descriptions and the definition of making communities as 'expert amateurs' [8]; initial studies on the core motivations for making and self-definitions of the practices [9, 10, 11]; investigations on the central idea of user empowerment [12, 13, 14]; the connection between making and user innovation and technology production [15, 16], and a timely shift of focus on critical issues related to making [17, 18]. Much of this research has located some critical issues of how making is being framed and positioned in our society. For example, some examine the conflated nature of an identity as both an expert and an amateur or the disputable assumption that the access to maker practices and technologies is affordable for everyone and thus will genuinely increase the participation of 'non-experts' in technology design, production, and literacy.

Following this trajectory, we argue that the notion of expertise, as framed by institutional and professional validation and definitions, limits, if not contradicts, what expertise for and acquired by making means. Expertise by making is rather validated within a specific community. Nevertheless, the empowering narrative around it also denotes a challenge towards the established boundaries between professional and nonprofessional. In our research, we hope to further trouble the claims that maker cultures argue in regards to openly accessible knowledge and acquisitions of expertise. We have found that certain forms of expertise remain an essential requirement to enter maker culture, despite widespread views often promoting the opposite. Our analysis derives from participant observation, in-depth interviews, and a review of popular and academic discourse on accessibility, inclusion, and expertise. During this work we have queried how mundane aspects such as opening times, setup, skill-sharing practices, and location of makerspaces can constrain skill acquisition and the notion of expertise. Since we do not have room to fully describe our observations and ethnographic studies, we will focus on describing in what ways literatures and historical narratives unpack the development of different forms of expertise in relationship to current making. Based on initial analysis of nascent interviews and observations, we reflect on how these reconstruct the dissemination of expertise or its requirement for participation. A final discussion both contextualizes and draws on current scholarship regarding expertise and our own observations for an analytic outcome.

## 2 Research Background

In our research, we continue this line of aforementioned critical work both theoretically and empirically by looking at two differently positioned yet intersecting objectives for making. We will use this research anecdotally to think about boundaries of expertise. On the one hand, maker practices, programming, and culture have increased in popularity within various United States (US) educational institutions, seen by some as an avenue for diversifying and popularizing science, technology, engineering, and mathematics (STEM) skills [19]. One particular site of maker program development is in the US public library system. Allocation of funding through grants or budgetary surplus has allowed for interested library staff to explore possibilities of technical literacy via making. For adult maker programming in the library setting, the intention is often set around access to technology and skill development toward personal empowerment and possible footing in the professional world. This phenomenon was observed through visits to the Albany Made Creative Lab located in a library in downtown Albany, New York. Free of charge, the Creative Lab is open twice a week for the public to fabricate on tools such as 3D printers and a sewing machine. A similar, but more fully-resourced, space is the Fab Lab located in a library in downtown Washington, DC. With a more fully dedicated staff, the Fab Lab is able to have open hours and classes six days a week.

On the other hand, we investigate spaces catering facilities and services for creative professionals in the field of product and interaction design. This included visits to Happylab, Austria's first fab lab, which was developed as the outcome of an EU-funded engineering project for which several computer-aided design (CAD) machines were acquired. As part of the large international community of fab labs, Happylab adheres closely to the principles of the global Fab charter by providing access to digital fabrication technologies to everyone [20]. Full access is granted by paid membership, whereas newcomers and occasional users benefit from the free access during the weekly open lab time. Another such group, InterAccess in Toronto, is a not-for-profit, artist-run gallery and electronic media production space that offers its members and the wider public access to different tools and machines as well as workspace. Similar to Happylab, regular access to the studio, except during the weekly drop-in open studio, is guaranteed by membership.

Digital fabrication technologies and practices reintroduced and connected making back to a rather conceptual form of design. In this context, making means the process of creation of an artifact. At the same time, most of these makerspaces are proclaiming openness to everyone. Moreover, similar to the public libraries they suggest that amateurs and users can turn into designers, innovators, and technology producers by virtue of maker practice. However, despite the subversive nature of DIY and of making, we initially came to encounter the users of these practices and technologies as what in computer science and HCI is understood as an 'expert user' — someone who brings in enough skills either by degree or practice to understand a new technology or process.

### 3 Contextualizing Expertise

Defining expertise, who can claim to be an expert, and what role the remainder play have been questions of scrutiny in science and technology studies (STS) from its inception, when the field was still focused exclusively on elite scientists and their work. Since these early days, STS has opened its perspectives and has embraced multiple concepts such as lay expertise [21], citizen science [22], non-expert user interactions with technology [23, 24], or non-users and misusers [25, 26].

One account of lay expertise that is well-known in STS is Brian Wynne's study of Cumbrian sheep farmers [27] and their ignored knowledge of local environment by scientists — leading to wrong scientific predictions affecting the farmers' existence. Because the issue of examination was the highly delicate topic of radioactive fallout via rain in this region and its effects on the local environment, scientists would not consider that the local population might have some valuable experiential knowledge to contribute. As a result, "the farmers felt their social identity as specialists within their own sphere [...] to be denigrated and threatened" [27: 287]. Conversely, in Steven Epstein's [21] description of lay expert AIDS activists, the vulnerable population was able to leverage their higher social status as college-educated white males to effectively change medical testing protocol to their benefit. While not easy, and a hugely laudable feat, Epstein relates that the ability for the lay experts to speak and meet with the medical community came out of other forms of cultural capital. This was particularly based upon how to speak and act — expertise garnered from college-level school experiences and cultural capital caches, and something that the farmers may have not had at their disposal when trying to negotiate with environmental scientists. The scientists may have also been conducting what Gieryn calls 'boundary work' [28], working to demarcate boundaries between their scientific and authoritative expertise from what they saw as the non-science and colloquial knowledge of the farmers. Scientists often conduct such boundary work to ensure professional success, and to keep the function of their expertise clear to the public and other knowledge producing communities.

In writing about how to widen participation in such cases of technical decision-making, sociologists of science Harry Collins and Robert Evans argue that we need to "develop a discourse on expertise which will help to put citizens' expertise in proper perspective alongside scientists' expertise" [29: 251]. They assert that 'lay expertise' is an oxymoron based on the dictionary definition of 'layman' as 'someone who is not an expert'. Thus, they suggest "that those referred to by some other analysts as 'lay experts' are just 'experts' — albeit their expertise has not been recognized by certification; crucially, they are not spread throughout the population, but found in small specialist groups" [29: 238]. Their special technical expertise is based on experience, not recognized by degrees or certificates, and so Collins and Evans describe them as 'experience-based experts'. Collins and Evans have come under scrutiny for their categorizations of expertise by several STS scholars [30, 31, 32], demonstrating that 'expertise' and how it is defined or bounded continues to be contentious. In the context of making, what becomes important is not only expertise but legitimacy, which plays into debates within STS of how to bound or unbound, to categorize, and to 'make real' differentiated forms of expertise — especially in terms

of who has the power to legitimate and bring different forms of expertise into important decision-making apparatuses.

As Collins and Evans interpret Wynne's example of Cumbrian farmers: "The scientists' expertise was not at risk of being displaced by that of the farmers; it was, or should have been, added to by that of the farmers" [29: 256]. Even here, though, the scientists hold the power in deciding whether or not the farmers' knowledge should be compounded with their own knowledge — rebounded into the realm of science. Making works to move beyond concerns of risk from non-experts encroaching on the hallowed knowledge held by experts, hoping to dissolve established boundaries between professional and nonprofessional. This is especially the case with boundaries of expertise demarcated by professional certification, since expertise can be garnered by those who want to and can participate in maker cultures through experience with low-cost tools and open source software made freely available. In this way, maker culture seems to be producing experience-based experts, fitting into Collins and Evans' claim that "professionalism is not a barrier to the inclusion of experience-based experts into the heart of scientific decision-making" [29: 264].

A similar view has been expressed in the design scholarship on amateur design and its relationship to professional practice, which has been challenged particularly by the recent developments of DIY and maker practices [33, 34, 35, 36, 37]. Looking from different perspectives at the place of non-experts in design, these design scholars argue that a recognition of the practice and skills of nonprofessional designers by the professionals is not about equating but putting this alongside and in dialogue. In outlining a history of nonprofessional design activities, Philip Pacey identifies this as an issue of attitude of the professionals: "have they regarded, do they regard, the lay person for whom they design as non-designer incompetents, or as themselves actual or at least potential designers?" [33: 217] The recent possibilities of participation in design activities, denoted by maker cultures, put a stronger emphasis on this issue. For Paul Atkinson and Gary Beegan DIY practices and 'digital tinkering' demonstrate that clear-cut boundaries around professional and nonprofessional design cannot be retained. Conversely, they are connected even if through rejection — both amateurs and professional designers alike appropriate DIY and maker practices and do this in dismissal of professional specialization [34]. Atkinson goes a step further and claims that the recent technological developments are moving design towards a "post-professional era" [35: 138]. And yet, in his view, DIY and digital manufacturing cannot and should not replace professional design in its entirety. Instead, these practices are making design more inclusive by giving agency to non-professionals through participation.

This mindset from design scholars is also recognized by those studying the practices of hackers. Alison Powell writes extensively on legitimacy and authority within hacker cultures and delineates the boundary work entailed in setting themselves apart from institutions, while as yet working to dismantle the authority and knowledge hierarchies as set by the institute.

*In contrast to the authority associated with institutions accrued through symbolic reinforcement of the functional necessity for an institution (Castoriadis, 1987 [1975]), the authority associated with hacker culture is rooted in the imagination of participation and in*

*expertise consolidated through participation. Other scholars of hacking in the DIY vein have focused on how participation in building and rebuilding technology operate as strategies for eroding boundaries between experts and laypeople and redistributing authority (Dunbar-Hester, 2014). [38: 603]*

While there is a redistribution of authority or possibly new forms of expertise, this does not fully undermine the institution, as it were. Hackers (and makers) create communities and their own qualifiers of acceptance, working in parallel to certified institutions, sometimes even in conversation with said institutions. Even as the maker and hacker communities may in part be a continuation of what Donald Schön saw as a decline in public trust of professionals [39], they define themselves in relation to established institutions and professional knowledge. Maker cultures may also hold part of the answer in Schön's call for reflection in action toward more accountable professional practices and productive conversations between professional experts, lay experts, and different user-bases.

Following this line of arguments on expertise, our commitment, in our own work, is to examine how participation and experience-based learning work to solidify the expertise of makers. In following Ingold, we want to ask: How are these forms of expertise contextual and entangled with the environment in which they are developed? Further, who really feels they have the capacity or base-line knowledge to take part in these environments and communities of practice? In our research of library makerspaces and fab labs for creative professionals we hope to further explore and contribute to these discussions of expertise, boundary-work, and changing attitudes toward the professional and nonprofessional.

## **4 Discussion**

In jointly considering expertise within our own research and the state of the field, it becomes clear that a certain level of comfort as well as technical expertise is still needed to take part in maker culture that claims "everyone a maker." Comfort relates not only to the architecture of physical space, but also to social dynamics, a welcoming atmosphere and a sense of belonging — comfort with experimentation and the possibility of failing at a new endeavor. This in turn affects the ability to acquire different levels of expertise or even to claim current forms of expertise already held. The focus on particular tools of production and upon the end-product, often makes invisible important knowledge development and different forms of expertise in which some participants may be more well-versed or which are networked forms of expertise. This includes skill-sharing skills, organizational skills, skills of maintenance, fundraising, active listening, and archiving, but also the ability to recognize any of these forms in the participants. By saying that everyone should, can, and will be engaging in technical production, it discounts the importance of those who want to develop other expertise to help further projects within the space. It often shuts out different forms of knowledge or expertise that may yet be very important for technological use, design, and development. Instead of just critiquing these issues,

however, we want to think productively with this assessment. In a paper written for the 2016 meeting of the Conference on Human Factors in Computing Systems (CHI), Silvia Lindtner, Shaowen Bardzell and Jeffrey Bardzell re-examine the utopian vision of making in regards to HCI research [40]. They point out that there's a dilemma:

*We can pursue making as an avenue to increase participation and democracy in technology use and design, if we take what has been criticized as a naïve technosolutionist stance. Or we can take a critical stance and thereby risk abdicating our agency in contributing towards making's sociopolitical potentials. [40: 1391]*

Our personal stance about making at this moment is along these lines. If we criticize too much, scholarship might fail to identify what the real potentials might be or at least the ways in which we can try to maneuver maker practices in particular directions. In pointing out and recognizing that certain levels of skill are still needed to take part, we hope to unpack the all-encompassing claim of maker cultures toward technological democratization and broad public participation. The base-level need to have a welcoming environment and particular skills/"knowledges" is something that librarians and designers and organizers of these spaces deal with directly. Through reflexivity, or reflection in action, they may be able to instantiate practices and an environment that can either push to lower or push to solidify these high barriers.

By keeping in conversation with and accountable to their center for accessibility, the DCPL fab lab amended their work table setup — providing lowered tables and wider walkways between tables for wheelchair accessibility. They may have not gotten it the first time, but they were willing to hear feedback and change their physical setup for better comfort, something they know they will continually need to iterate as new suggestions and needs arise within the patron community. They have also run several patron surveys, something that the Albany Made Creative Lab has also done — to ensure accountability and keep a continuing conversation open to the public. Providing a mechanism for feedback and a welcoming environment that is open to failure is hopeful. However, there are still aspects of these spaces and their programming that continue to be intimidating to the local publics which they serve. This includes physical infrastructures that the librarians and staff have little to no control over in a bureaucratic and top-down system. A great deal of teaching and outreach labor may be needed, which is a great burden to put on librarians who are quickly becoming not just archivists and information technologists — but social workers, community organizers, and educators as well.

Both Happylab and InterAccess provide an open and welcoming environment — if you know exactly what to do. Like libraries, they also have problems of labor, and most of those running the spaces are volunteers or part-time. Happylab cannot be successful if they limit their open hours to those of their regular staff. Many of their members are full-time professionals or university students who simply cannot arrange with a regular nine to five schedule. As a result, a lot of the action happens outside regular open hours which puts additional restrictions on novices, especially those who need support but might also have other social obligations. While it is troublesome that the burden of knowledge acquisition potentially falls completely upon the new visitor, the infrastructure of these spaces does not allow for a more welcoming atmosphere, as

the primary focus is not educating the public, but more on providing tools and resources. Thus, an essential change to the perception of such spaces can begin with eliminating a strong position as spaces for everyone. Instead of portraying themselves as democratic and very accessible, these spaces that are placed on the boundary between professional and nonprofessional design and production can be at the forefront of a critical reflection about how maker cultures have unfolded and are still unfolding.

## 5 Conclusion

This article began with the articulation of one of making's central commitments — the moderation of expertise by institutional authorities. Making challenges traditional and long-held views about the design and production of technologies and the knowledge that goes into that by opening the avenues for participation for everyone. And yet, there are still many barriers to participate in makerspaces and fab labs without comparable skills. Throughout this paper, particularly the discussion, we have articulated alternative forms of expertise which seemingly contest what appears to be the status quo for maker culture expertise. This ties into the situatedness of expertise within maker communities and how it is established in context. Something to explore even further is how these local forms of expertise can align with or be in conversation with broader communities or established cultures of expertise as the interconnected field of citizen science illustrates in a more effective way. Moreover, we described several scholarly accounts on making and DIY that parallel our view that the recent developments should not be bringing experts and non-experts in conflict but instead aligning them and putting them in dialogue.

Democratic ideas like this one are not new to design approaches like participatory design where designer and users are partners working together in mutual respect for their skills and knowledge. As Langdon Winner argues, “the freedom experienced in communities where making things and taking action are one and the same” [41: 359]. Yet, such claims of broad participation and democratization need to be engaged critically and productively, as has become the case in participatory design projects, and must become the case for maker communities. When considering power relations, one might question who has the power to initiate engagement for a participatory design project. Along a similar line of inquiry, the politics of who can claim “making” and which communities are engaged to take part in its development should be considered.

By taking seriously the idea that maker cultures sit on the boundary between professional and nonprofessional, instead of just proclaiming it, we might be able to empower individuals previously divided by that. In doing a fuller examination of these communities, we may be able to even further delineate the ways in which maker expertise is scaffolded and solidified, and in turn bounded. This also highlights the great effort it takes on the part of DIY culture, public service workers, and otherwise to dissolve established boundaries around professions and education, work toward a meaningful democratization of maker culture, and to lower the barriers of technological production.

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