

Learning How: The Search for Craft Knowledge on the Internet

Cristen Torrey

Human Computer Interaction Institute
Carnegie Mellon University
Pittsburgh, PA 15213
ctorrey@cs.cmu.edu

Elizabeth Churchill

Yahoo! Research
2821 Mission College Blvd.
Santa Clara, CA 95054
churchill@acm.org

David W. McDonald

School of Information
University of Washington
Seattle, WA 98195
dwmc@u.washington.edu

ABSTRACT

Communicating the subtleties of a craft technique, like putting a zipper into a garment or throwing a clay pot, can be challenging even when working side by side. Yet How-To content—including text, images, animations, and videos—is available online for a wide variety of crafts. We interviewed people engaged in various crafts to investigate how online resources contributed to their craft practice. We found that participants sought creative inspiration as well as technical clarification online. In this domain, keyword search can be difficult, so supplemental strategies are used. Participants sought information iteratively, because they often needed to enact their knowledge in order to evaluate it. Our description of people *learning how* allows us to elaborate on existing understandings of information-seeking behavior by considering how search originates and is evaluated in knowledge domains involving physical objects and physical processes.

Author Keywords

How-To, information seeking, search, social search, image search, video search, search usability, informal learning, craft, hobbies.

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

The knowledge required to practice crafts like sewing, silversmithing, or woodworking can be difficult to articulate to novices. Experts' skills are deeply embedded in their physical movements and in their history of interaction with materials, making this knowledge difficult to express [24, 25]. *Craft knowledge* has become

synonymous with any kind of knowledge rooted in deep practice, such as the wisdom of a highly experienced teacher. In this paper, we focus on craft knowledge in its narrower sense, as experience with the manipulation of physical objects, such as that employed in soldering circuit boards, joining two pieces of wood, or knitting a sweater.

Traditional Craft Education

The most traditional way of learning a craft is through apprenticeship, watching a master craftsperson and receiving feedback as the skills are practiced over and over [13]. The presence of an expert offers skilled demonstration and tailored feedback, yet there is no substitute for hands-on experience with the materials [20].

Crafts require bodily knowledge, and a skilled demonstration showcases good technique. There is, however, a large gap between watching and doing. It is not hard to imagine how challenging it is for a novice to successfully knit a row having only observed a skilled knitter for a short period of time. However, with the attention of a practiced teacher, tailored feedback can be offered, and objects can be mutually referenced. When being introduced to a craft, there is often new vocabulary that is easier to learn when both the teacher and student can point to features of an artifact or pick up the right tool.

Knowledge acquired in these interactions is social in nature. Dormer argues that teaching craft means giving people the ability to value nuance; in woodworking, for example, this may mean valuing the subtle details of a surface finish [10]. The key instructional objective is the socialization of a craft culture's standards for beauty and quality, aspects of what Greenhalgh calls a craft's genre [14].

Finally, understanding a craft takes time. Physical materials have particular boundaries and characteristics. In an ethnography about learning to blow glass, O'Connor talks about developing a sense of "rightness" about the state of the material [21]. With continued experience, people can acquire a sense for how a particular material, under specialized conditions, will behave. McCullough emphasizes physical engagement as well, "Acute knowledge of a medium's structure comes not by theory but through involvement," [18], p. 196.

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

CHI 2009, April 3–9, 2009, Boston, MA, USA.

Copyright 2009 ACM 978-1-60558-246-7/08/04...\$5.00

Online Representations of Craft Knowledge

The internet has become a vibrant place to find pictures of craft projects, watch videos illustrating techniques, and communicate with craft enthusiasts of all kinds. (For a timeline detailing the resurgent interest in craft, see [17].) Someone interested in learning to knit, for example, will find numerous diagrams and illustrations online. Flash animations of various knitting stitches illustrate the sequence of motions without the need for hands to manipulate the needles (<http://www.saveknitting.com>). Mrs Moskowitz's video, hosted on YouTube (Figure 1), demonstrates a knitting stitch called *purling* slowly and carefully while verbally describing the motions.

Mrs. Moskowitz's Knits: How to Knit: Part II



Figure 1. Video Demonstration of Purling
(<http://www.youtube.com/watch?v=dKgmknSqCI>)

But people using the internet to learn to knit are able to do more online than simply watch others knit. Knitters can subscribe to a Flickr group called the “Odd Balls,” one of many feeds where people can see pictures and comment on projects done by members of the group (<http://flickr.com/groups/90592512@N00/pool/>). Members of the Ravelry online community can share knitting patterns and information about yarn, ask questions in forums, and post pictures of their own work (<http://www.ravelry.com>). There are many opportunities online for aspiring knitters to get feedback on their technique and on their completed projects. Knitters can also make their crafts available for sale online at Etsy and receive feedback from paying customers (<http://www.etsy.com>).

Numerous, interconnected blogs offer information and knitting patterns as well. The Craft Magazine blog offers information on a wide range of craft activities. It regularly links to personal blogs that focus on the individual's area of craft expertise. In Figure 2, the Craft blog editor links to hizKNITS, where one knitter has posted a detailed How-To for knitting a messenger bag (<http://hizknits.com>). Blogs like these link reciprocally to one another, creating a network of connections for information seekers to follow.

HOW TO - Felted Messenger Bag



Lime & Violet links to this [felted messenger bag pattern](#) designed by Stephen Houghton of [hizKnits](#). The project appeared on the “Real Men Knit” episode of [Knitly Grifty](#).
Posted by Jenny Ryan | Sep 8, 2008 12:00 PM
[Felted](#), [Knitting](#) | [Permalink](#) | [Comments \(0\)](#) | [Email Entry](#) | [TrackBack](#)

Figure 2. Knitting Inspiration (<http://craftzine.com/blog>)

Knitting is just one example of the many craft domains that are currently being represented online. Knowledge representations of craft skills are becoming increasingly rich, as video becomes easier to capture and share and computer-aided modeling becomes more available. Websites like Instructables offer templates for the creation of How-To instructions (<http://www.instructables.com>), but content creators still have a lot of choices to make. An experienced craftsman has many avenues for articulating his or her knowledge, including text, images, video, illustration, schematics, and animation. Correspondingly, the aspiring craftsman has a great deal of online content to navigate. People learning a new craft must reconcile competing pieces of information and decide whose information they will use.

Research Questions

We are interested in the consumption of these varied forms of online craft knowledge. Given that many crafts involve physical and procedural skills, seeking and consuming online resources presents certain challenges. Torrey, et al. interviewed authors of online How-To pages to discover how people approached the challenge of documenting their electronics projects [28]. These interview participants worked diligently to capture their efforts effectively, yet they still fielded many questions from readers. Creators of online content in craft domains are attempting to capture their knowledge about their activity in their documentation. It is not always clear, however, that readers can successfully turn these online instructions back into action. Our research explicitly addresses the issue of how readers of How-To pages and viewers of instructional YouTube videos integrate these knowledge forms into their learning process. More concretely, in this research, we focus on three related questions:

1. How do people navigate and locate information about a craft online?

2. How do people make sense of the online content they find and integrate it with their skilled practice?

And, finally, as we investigate how people approach the challenge of finding and using online information, we want to be attentive to the social aspects of learning in this domain. One concern of traditional craft educators about online education is that people learning from videos or online How-Tos are missing the socialization vital to becoming a craftsperson [19, 29]. This issue is addressed explicitly by our final research question:

3. How do people engage in the social learning that is traditionally part of acquiring craft knowledge?

BACKGROUND LITERATURE

There is much ongoing research in the area of internet information seeking and retrieval. Research interests range from the development of improved information retrieval algorithms, to cognitive models of search behaviors (e.g. [23]), collaborative information retrieval (e.g. [22]), and to analyses of what has been called “social search” sites and their role in help seeking [1].

Much of this work focuses on information seeking “events” or structured projects and tacitly regards information seeking as goal-driven, rational behavior. Many models assume people have well formulated goals and are driven to search in order to resolve some kind of information “uncertainty” [11, 30]. Indeed, many empirical studies of information seeking evaluate outcomes as either relevant or irrelevant [12]. While such models surely account for much of internet search—especially what have been called “informational” and “navigational” searches [5], of primary interest to our research are studies that address information seeking as a process, where results do not easily fit into the categories of “relevant” or “irrelevant,” where the development of information ontologies are part of an ongoing evolving process [2-4] and where information seeking, searching, finding and encountering are part of the ongoing practices of everyday life [26, 27]. In short, we are less focused on the search for facts and more focused on observing the practices of query evolution as people interact with information and with other people. There is much evidence that not only do people seek out others for answers to queries [1], but also that people develop internet literacy as a result of who they encounter in their everyday lives [15].

Further, we are interested in the nature of information seeking in the domains of art and craft. Studies of the information-seeking needs of artists have not addressed their engagement with online resources in specific detail [7, 8, 16]. Nevertheless, these studies offer insights into the kinds of information-seeking activities of artists and their motivations. Cowan emphasizes the search activities of artists as being driven by passion and curiosity rather than a gap in knowledge [8]. In a review of previous literature, Hemmig points out that artists get a lot of information from

browsing, particularly for visual images [16]. In general, these papers draw our attention to browsing activities that offer potentially serendipitous encounters with information that is both technically useful and inspirational.

PARTICIPANTS

We recruited interview participants through email lists such as dorkbot, craigslist, and the local etsy street team (<http://dorkbot.org/dorkbotsf>; <http://sfbay.craigslist.org>; <http://sfetsy.blogspot.com>). Interview participants were also recruited by posting fliers at an industrial arts school and at events in the San Francisco Bay Area; these included the Maker Faire in San Mateo and a Maker Meet-Up in San Francisco. Interview recruits were people who were interested in talking about how they took on a new project or tackled a new skill.

We interviewed seven men and eight women, ranging in age from early 20s to early 60s. We invited participants involved in any craft that involves a physical artifact. We interviewed several people working with electronics, cell phones, or other computer-related hardware. While this might not be considered a traditional studio craft, we take Bucciarelli’s stance with regard to engineering practices, that developing as an engineer may have many of the same challenges [6].

Those who responded were invested in a wide variety of craft practices (see Table 1). In many cases, the participant was an expert in one craft domain but was exploring new domains or new techniques. Participants felt there was always more to learn. There were differences in the amount of time dedicated by each participant to their craft. Nine of our interviewees are employed full time; one is a full-time student and one is retired. Of the remaining five, two hope to make a sustainable living from their craft. Nine of our participants have considerable overlap between their education, training and craft domain.

All of our participants use internet search; although we did not specify this as a requirement for participation. Only one of our interviewees was trained in computer science. Three interviewees work in the computer/internet industry.

METHOD

Once recruited, we met participants where they work on their crafts, typically their home or studio, or in a café of their choosing. Eight of the fifteen interviews were done in participants’ workspaces. In the case of the café interviews, we invited interviewees to bring examples and/or photos of the things they make.

Interviews were semi-structured and lasted between one and three hours, depending on the availability and interest of the interviewee. When the interview was conducted in the participant’s physical workspace, we also asked for a tour of their space. Wherever possible we asked interviewees to show us the online resources they used regularly—including content sites, communication sites

Pseudonym	Gender	Approx Age	Example Project
Ally	F	mid 20s	designing and sewing a stuffed monster
Bob	M	early 60s	building a computer-driven musical instrument
Cindy	F	early 50s	making a mobile from 100s of origami cranes
Elsa	F	early 30s	sewing programmed LEDs into a jacket
Evan	M	mid 20s	making clocks from antique electronics
George	M	mid 50s	building secret compartments
Jack	M	mid 30s	refurbishing vintage stereo speakers
Karen	F	mid 20s	making earrings from beads
Mandy	F	early 30s	plaster casting female torsos
Martha	F	mid 20s	sewing a pair of shorts for herself
Matt	M	late 20s	creating hand-cranked kinetic sculpture
Robin	F	early 30s	making puppets
Smith	M	early 50s	building a treehouse
Tom	M	mid 30s	blowing art glass
Wendy	F	early 40s	making silver rings

Table 1. Participant Information: Participants' interests in tools, materials, and techniques are quite varied.

(e.g. newsgroups and forums) and commerce sites where they purchased supplies. In each interview, we talked about multiple projects within the craft domain(s) the interviewee worked in. Table 1 gives one example of a project we discussed with each participant.

We collected audio, video, and photographic recordings of our interviews, the workspace (if possible), and the participants' work. After transcribing the verbal content of our interviews, we conducted an open coding phase. Next, we revised and consolidated codes, where five high-level categories emerged. Our interviews approached information seeking quite broadly; consequently, our data offers extensive examples of interpersonal as well as online information seeking. In this paper, we focus primarily on participants' use of online resources and leave detailed discussions of interpersonal information seeking for future work.

FINDINGS

In this section, we describe our participants' use of online resources in more detail. But before we address each of our three research questions in turn, we offer a few examples illustrating the variety of our participants' information needs. Participants used online resources for creative inspiration as well as technical information. Seeing examples of other people's work can be inspiring, so one participant, Cindy, received a daily email alert for new search results with keywords related to her craft. In addition to seeking inspiration, participants also searched for technical information in preparation for a project. For example, Wendy searched for information about a metalworking technique called *broom casting* before she had any idea of what she might make. Our participants' information seeking was not always strategic however; participants sought information when they needed specific, immediate help, sometimes in the event of a mishap or unexpected outcome. For example, Matt was using a new tool with his milling machine and could not tell if it was working properly. He searched YouTube for a video of the tool in use and learned how to set it up and what to expect.

Supplementing Keyword Search

First, we were interested in how participants navigated the wealth of online information to locate information when they had a need. All of our participants were regular users of search engines, though they had a number of difficulties meeting their goals through keyword search. While clearly often frustrated, our participants were surprisingly patient with the process of iterative search and information overload.

Well I understand the concept of keywords. I also am very tenacious. I don't give up. So I'm the kind of person who will go in 25 pages to find something. – Cindy

While our participants continued to be optimistic about using keyword search, each of them acknowledged the limitations of searching for their chosen domain. Keyword search is limited for our participants for a rather obvious reason. When they are not familiar with a technique, a tool, or a material, they do not know what keyword to use when searching for more information about it. In one instance, Matt, a kinetic sculpture artist, did not know how to refer to a particular genre of kinetic sculpture. He was completely

stymied in searching for more examples, until he happened to overhear someone referring to them as “rolling ball sculptures.”

I didn't know that rolling ball sculptures were as big a thing until a couple years ago and I'd seen them around like what are they called? How do you talk about this? And then someone says, 'Oh, there's this great rolling ball sculpture at the St. Louis Science Museum.' Oh, it's 'rolling ball.' How obvious is that? But who would know? – Matt

When people do not know what an object is called, they use alternative techniques to triangulate and discover the right keyword. One participant looking for a skirt pattern did not know the name of the skirt she wanted. She conducted image searches using terms like “cheerleader skirt” and “poodle skirt” until she found a reference to a “circle skirt” which looked like the kind of garment she wanted. In this case, a picture might just be worth, not 1000 words, but one timesaving keyword.

Part of the problem is knowing what to search for and if I do an image search, I know that I am hitting the right term. Ok, now I know what people are talking about, because if you don't have the exact words to describe the skirt you're looking for and you're reading through all these instructions, you may get to the end and go, oh that's not what I'm making. – Mandy

Keyword search is also limited in that it is difficult for our participants to effectively constrain their results to meet their goals. When sewing historical costumes, Elsa found it impossible to find patterns online that were compatible with her standard for quality.

There's like two categories and one just wants the finished product to look good, doesn't matter what materials or process or anything and so a lot of their patterns will be really sketchy and their information will be really sketchy. And then there are people who are so committed to the history of what kinds of fabrics were available, what kinds of sewing techniques. And that's not always what I need either. You know, I kind of need something in between and so that's just too much for me to filter through for that. – Elsa

It is very difficult for people to describe tools, materials, and techniques when they are unfamiliar with an activity because they do not have the vocabulary. But even after becoming more familiar, our participants had difficulty constraining their search results to a particular aesthetic style, standard for quality, or the scale of their project. One participant, Tom, wanted to know how to attach two materials together using supplies he had on hand. He wanted to constrain his search for the situation in which “all you have is a hot glue gun and a jar of epoxy,” but as he knew, this is not easy to do with keyword search.

Because our participants struggled at times with keyword search, they supplemented with other strategies for gathering information. Two popular strategies were an ongoing practice of seeking and browsing potentially related sites, and socially positioning themselves to receive what we call “information gifts”. Participants using a

browsing strategy identified online sites of interest that they routinely browsed for bits of information. Participants also received gifts of information. They told their social network what kind of projects they were working on, and then let their friends forward them information as they came across it.

Browsing & Archiving Information

In order to deal with their limited exposure to the vocabulary, a lot of our participants browsed forums, blogs, and mailing lists. It reduced their effort because they did not have to specify a query. When browsing, new information prompts ideas, inspires new projects, and can possibly solve existing challenges.

I look at it, I might say 'spot welding.' Maybe I'll look at that. That's kind of a new idea coming in. It's from outside instead of from inside. I can't always think of everything. Right, so it comes in from the outside, and I look at it, and I say, "Oh that's an interesting tidbit that kind of relates to something else I might be working on, maybe I can use that." – Evan

Two-thirds of our participants identified forums, blogs, or mailing lists that they consistently read. Some lurk on these boards for years, listening in on the conversations. Others post regularly. Many participants archive their browsing activities, storing interesting threads or links until that information is activated by a project or a problem.

I do belong to a couple forums, costumer's forums, and I get digests emailed to me, and I do read those almost all the time. Some of them are just really tedious but every-just about every week I'll go, "Oh, I should save this cause this might come up some day". – Elsa

Receiving Gifts of Information

Our participants recognized that even with searching and browsing strategies, they were not finding everything that might be useful. Many of our participants had a social network that they kept informed about their projects. These contacts often provided pointers to online resources. Several participants work in a communal space, letting them absorb information incidentally from others.

And then I started volunteer teaching ... and teaching with different instructors, they all have this little piece of information everywhere around that you just, you know, you just grab at it. ... the Women's Jewelry Association (womensjewelry.org) or, you know, Ganoksin (ganoksin.com), or Rio Grande (riogrande.com) has resources. – Wendy

Participants that worked in more private settings kept their contacts informed about their projects in the hope that their contacts would pass along related information when they encountered it. As friends responded and passed along links and info, this opened up opportunities for conversation and potential collaborations. Mandy, who casts molds in plaster, was told by her friend of a new type of casting material.

He knows what I'm doing at all times, you know, so he's probably seen the plaster cast I assume. And he keeps up with

sort of more trends than I do. ... He's coming on—what's the newest thing I can do? And so, yeah, he wanted to use the Smooth-On stuff to see how it worked. – Mandy

Using One's Body to Make Sense of Information

Our second research question asked how information was interpreted after it was found—how a digital piece of documentation was transformed into action. We found that information about technique, for example, had to be enacted. Motions must be attempted. A material's resistance must be felt. Participants have to make the knowledge tangible and see what happens physically to the materials.

Because paper's volatile and the different weights of paper. And I had to learn through trial and error how long to let something dry before my next step and every paper is different so it was like constantly relearning. So now I know which papers do which things and it took a long, long time. – Cindy

Another aspect of the challenge of making sense of online information is that the materials and tools participants read about are not always identical to the materials and tools they are using. So even when following step-by-step instructions, often the information does not quite make sense to a reader until they have physically manipulated the tools. The instructions, as representations of actions done by someone else, need to be interpreted to the reader's specific context. Karen tried to learn how to tune her mountain bike but became frustrated trying to figure out “what on my bike might be different from theirs.”

They can't necessarily judge who their audience is. It's hard to predict every viewer's needs and wants. – Karen

Acknowledging that there is a need to make sense with one's hands when working with physical crafts, our participants take different approaches to managing the time spent doing research and managing the time interacting with their materials. We observed two different approaches to this challenge among our participants. Participants who are willing to set a project aside use what we refer to as a *backburner* approach. Participants who jump in to try to make sense of things in action use what we refer to as a *just keep moving* approach.

The Backburner Approach

Some of our participants engaged in a consciously iterative process of researching, letting ideas sit in the back of their mind, making a bit of progress, and then setting that project aside for awhile. Tom, working on a project that combined several of his areas of interest, described how pieces of information from different sources came together bit by bit to provide an idea and a path for success.

I don't decide on a project right away. They sort of sit and stew. It was sort of a perfect storm. All these things came together. – Tom

Participants that put projects on the backburner let themselves take on multiple projects at once, in various

stages of development. They have the choice to pick up whichever project seemed promising at the time.

A lot of these projects sit on the back burner and then maybe I'll see something or I'll find something at the flea market that kinda gets me going again. – Evan

Participants taking a backburner approach had the space that allowed them to physically set projects aside. Participants with this approach were also likely to consider themselves “packrats”; they kept extra materials on hand, just in case.

The backburner approach only made sense for participants with long-term deadlines. It is an approach that typically appealed to people who were interested in taking on challenging projects, who had the space to let the project sit to the side and simmer, and who were anticipating that more information would come along.

The Just Keep Moving Approach

In contrast to the backburner approach, other participants just wanted to get their immediate project done. These participants were often working toward a specific, short-term goal. This group of participants had a more limited amount of working space at their disposal, and generally, they restricted their stock of tools and materials. Limitations around this combination of factors—time, materials, and workspace—influenced the kind of projects these participants took on.

I want to know there's an end product. I don't like leaving things half done and not knowing how to finish something. – Karen

Participants that want to just keep moving on their projects engage in online research knowing that they are not going to find exactly the right thing. Robin chose a generic puppet pattern online and decided to modify it, rather than continue to look for something that was closer to what she wanted.

I actually found a pattern online ... I basically needed a shell and that's all I needed the pattern for and like after that everything else was like all—I sort of winged it. – Robin

Some participants in this group feel like deliberation about how to do something can actually dampen their enthusiasm for a project. Elsa told us that she had taken up fabric dying without doing any background research at all. When she later took a class that trained her in the various nuances, Elsa then saw dying as too complicated to be enjoyable.

If you don't know how hard it is, you can just do it sometimes. Like after I learned about dying I never wanted to do it again, but before that I was like this is fun. – Elsa

Belonging to One of Many Craft Communities

Our final research question asked how participants engaged in social learning around their craft practice. We observed one group of participants that were extremely interested in connecting with other craftspeople, in much the same way as the traditional apprenticeship model of craft education. The energy of this group of participants focuses on issues of

quality and beauty. But we found across our sample that other participants did not wish to engage with a community around those specific values. We observed another group of participants that did not emphasize the professional quality of their work but wanted to connect with others around the simple act of making. And we observed a third group of participants that emphasized uniqueness in their interactions as a community. Instead of focusing on professional quality or amateur activity, like the first two groups, this group was oriented around bringing diverse kinds of knowledge and artifacts to one another.

Connecting with the Gurus

We talked to people engaged in their craft with a serious, professional intention toward gathering knowledge. These participants wanted to know how to do their craft “the right way.”

When you touch a surface that you have hand planed ... when you drive that last spike in and you know it's done, and it feels good and you have taken no quarter for your quality, it's good. If the quality of that can be measured, and that's probably the most ephemeral thing, because it's not personal taste, it's the solidity. – Smith

Participants identified particular websites or forums to browse regularly and used these avenues to establish social connections with experts in their domain. Participants in this group were committed to connecting with the best in their field. Jack, who was interested in refurbishing stereo equipment, sought out another member on his online forum who he felt was “shedding light” on what it meant to build good audio equipment. Matt built kinetic sculpture and could not immediately find other good craftspeople in his area, so he started this group himself.

I subscribed to another person's videos on YouTube who's another kinetic artist and then he subscribed to my videos and then his friend subscribed to my videos and then I looked at their videos and we all met each other at Maker Faire, and it was great. – Matt

Supporting Craft as a Satisfying Hobby

Rather than producing true experts in a domain, there was another kind of group we observed that simply wanted to be supportive.

All the things you're doing right they'll let you know. Or if there are minor things you can improve that won't hurt your feelings, they'll tell you those kind of things. – Ally

Participants in this group believed that making things is valuable and wanted to support other people in the act of creating.

Well I told people [on her video blog] I made my own shorts. Cause, you know, a lot of people they don't want to cook, they don't want to sew because they think it's hard and if you can be there and tell them, “hey it's not that hard.” – Martha

Participants in this group wanted to connect to other people interested in making things, but they did not necessarily want to become professionals. Their communities were

more general, involving many different kinds of craft activities. Participants in this group enjoyed giving their handiwork away to friends and family.

And just liking, I don't know, making small stuff for like friends. I made, I think, three pairs of this type of earring with three beads for three of my friends in an afternoon and they're like oh it's great, it's unique, and it's just fun.
– Karen

Sharing the Unique & Hard to Find

Finally, there was a group of participants that valued new approaches and unique artifacts. These participants tended not to do a lot of browsing online for information. Instead, they relied heavily on their social network for links to good information. The diverse areas of expertise within the group offer opportunities for an informal version of the reference interview, during which the information seeker's query is shaped by the process of articulation [9]. For these participants, online pursuits involved searching, filtering out what they needed, and learning just enough about a craft to make their project work. So unlike the first group, they were not trying to be accepted in the professional communities; they were not interested in doing it the established “right” way.

For me, I'm like well why would I do that? I can do it perfectly well this way. Why would I keep trying to learn it this harder way? I don't plan to be an industrial body cast maker for the movie industry, right? – Mandy

Unlike the second group, this group valued being able to offer something unique to the community, a new skill, a creative artifact, or a different perspective. The other members of the community were also working on projects; so they tried to keep one another updated about their status. The community may have some overlap of knowledge and skill but was diverse in expertise and experience.

So I'd also take it to class with me and like work in my painting stall so people would walk by and be like that is really weird ... they were also kind of like they respected me cause they liked my work so and we liked each other's work so we would talk about it and stuff. – Robin

Summary of Findings

We looked at how our participants found information and discovered that although all the participants use keyword search, they all had trouble with it as well. To supplement their information search, our participants connected to specific sources of online information to browse regularly. They also used their social network and engaged in reciprocal gift giving of online information.

After participants found information, we explored how they made sense of it in a practical way. We observed a major translation process between the online representation and the craft activity. Participants approached this necessary step in one of two ways. They took a backburner approach, setting the project aside for a time, or they took a just keep moving approach, working through problems with trial and error.

Finally, we investigated the issue of community. We were interested in exploring how searching for information about craft knowledge can engage information seekers in the culture of craft. We found this to be a motivation for some, and they seemed to be successful. But this was not where all our participants aspired to be. Instead, they wished to engage in other types of communities, and the knowledge they retrieved online allowed them to do that.

DISCUSSION

What distinguishes search for craft knowledge from any other kind of information? Craft knowledge is about how physical objects are seen, handled, and used. After finding craft knowledge online, it must be translated from online representation to bodily action. Online representations of craft knowledge are frequently found in images, video, and diagrams, which makes the domain of craft differ from the textual domains that are frequently studied in the information-seeking literature. This is part of the reason why the craft domain is not well captured by keyword queries. Regardless of the difficulties, our participants are gleaning craft knowledge from online resources. They are engaging with craft practices they have never encountered before.

Their information-seeking behavior is driven by their aspirations. The people we talked to were making information seeking a part of their craft; they did it consistently as part of their practice. Online, their information seeking originated primarily with a search engine and with a small set of favorite forums, blogs, or mailing lists where our participants felt confident. But the larger motivation for their search was in participating with a community of people like themselves. We identified the diverse kinds of groups people aspired to belong to and found they were not always identified with being the best craftsperson in a particular domain.

The search for information around craft knowledge might be said to conclude when the project is complete. However, in our interviews with craft practitioners, the resolution of search is not clear-cut. A project may be a prototype, and the pursuit of craft knowledge may not conclude with a single project. It is difficult to define a problem's resolution in this area; there is only what is satisfactory for an individual's current purposes. So the problem of judging whether a piece of information is relevant becomes quite difficult. In the rest of our discussion, we explore implications for search, evaluation, and community in online domains of craft knowledge.

How can the search experience be improved?

Searching for knowledge about craft using keywords is difficult because the names of tools, materials, and techniques are flexible and are not known by novices. Developing literacy in a domain takes time. In many innovative domains, terms are being invented all the time. Improving keyword search for information about tools and

supplies would involve understanding the semantic relationships between related words, when more than one term is frequently used. Search interfaces could suggest terms that seem to be interchangeable, such as silk-screening and screen-printing. It might involve being able to expand one's search for all tools related to an activity, so that newcomers can browse when they do not know the right word to use. It might allow searchers to specify how much confidence they have in the term they are using, expanding the search criteria when appropriate.

Improving keyword search for technique would involve structuring sequential information into the underlying steps of the procedure. Making the information more modular would allow searchers to find a single sub-step within a much longer set of instructions. Even if the entire project being described is not specifically appropriate to the search, there may be sub-steps that are worth bringing to the forefront of search results. Finally, adding tags to pictures and video that highlight the technique being used, as opposed to only the objects in view, may make image search more useful in the craft domain.

There is an opportunity here for a search engine specialized for information about techniques and craft domains. Recent "vertical search" engines like Octopart are addressing searches for people interested in purchasing component electronics and computer hardware (<http://octopart.com>). One can imagine a specialized interface for exploring online tutorials and other kinds of information about making things. A search interface of this kind might offer a number of filters or ways of viewing the search results.

Skill level. There are many techniques that can be engaged in at multiple skill levels. People want to find things they will be able to do. Currently, searchers must scan online content to determine if the technique is within their skill range. Certainly, content creators and, possibly, commenters add informal skill level information, but this is not usually a factor in search results. A filter could help crafters evaluate the difficulty of a technique and its appropriateness for them.

Tools and supplies. Many techniques can be attempted with different sets of tools. Some people want information that makes use of the tools and materials they have on hand. Others may be looking for instructions that include only cheap, easy-to-find materials. A filter could remove search results that make primary use of tools that the information seeker does not have.

Aesthetic values. Looking for patterns or project ideas online can be frustrating if you have not found the right keywords to define your aesthetic. Desirable do-it-yourself furniture results for one person may be completely undesirable for someone else. Social search strategies could group related links together, as one approach to helping people find more links with their preferred aesthetic.

Standards for quality. One approach to a technique might take an hour, another might take a week, depending on the quality of the work being done. Some people work on short-term projects, and they want to find quick solutions. Other people want to make something that lasts. A filter of around quality standards is another place where social bookmarking and other social approaches may be successful.

How can success be evaluated?

We want to understand how to evaluate whether someone's search for knowledge in this domain has been successful. We have described people's work styles and people's aspirations, two things that make the concept of evaluation very tricky. The notion of information relevance is complicated, and we are not going to solve the question of evaluation in this paper. We can point to some dimensions that any notion of success will have to acknowledge.

Time frame. When we talk about success we have to talk about how long we are willing to wait for a judgment that something is successful. The results of a search are not necessarily a terminal action. Results are often put into context only after other search results have been consumed. Search results may be sought to triangulate, which means the results are not themselves the most valuable thing. The important outcome is the sensemaking that comes from multiple searches.

Physical action. When we talk about success we have to determine whether we are talking about the information making sense intellectually or whether we mean the artifact is built. Developing physical skill has a lot to do with what features of the environment deserve attention. So one's understanding cannot be tested until one is really in the environment. Success cannot be evaluated until sometime after the search results are put into action.

How can a culture of craft knowledge exist online?

Finally, we want to understand the social aspects of learning a craft and finding a craft community. By observing the work of others' and receiving feedback from the group, one can implicitly learn what the group sees as well made and beautiful. This is where much of the education occurs in a studio craft class. We found online communication around craft activities to be, without a doubt, plentiful, but we were interested in the nature of these interactions and how newcomers to a craft would develop a sensibility about the practice.

Some of our participants were very successful at engaging with an online craft community that was focused on specific materials and specific methods. We talked to participants that used mailing lists, forums, and blogs to find expert mentors. We talked to other participants who mentored others in online and offline spaces. In short, we talked to people devoted to their material and their craft much as anyone might be if they were formally trained. What struck us about the online medium in particular was

the affordance of anonymity, when participants desired it. One of our participants found a forum where people were seeking knowledge in his domain in a very serious way. He watched that board for years before starting a project. When that first project was complete, he posted pictures to the forum. By approaching the craft via this online forum, this participant was able to gradually establish himself as a member of this community while maintaining his distance in the early, difficult stages of his learning.

But we observed alternatives to a simple re-creation of studio craft culture in the online environment. We talked to several people who were simply not interested in becoming professional craftspeople. They engaged in craft activity because it was enjoyable, not because they wanted to be an expert at any particular craft. One participant working on a graduate degree in an unrelated field made things simply because it was satisfying. We also spoke to people who were interested in taking the knowledge within a craft domain and appropriating it for another end. We talked to a participant who had taught herself avian taxidermy, not with any intention of becoming a taxidermist, but because she wanted to do something new with a traditional process. Her independence from any established group allowed her to innovate and explore different applications of the technique.

There are multiple communities with rich cultural values from which to learn a craft online. Information about craft knowledge online is destined for communities beyond traditional, genre-focused craft cultures. Some groups of crafters are establishing a new sensibility about craft knowledge; they creatively combine bits and pieces from many different craft disciplines. Designers of tools for online community and knowledge sharing may not be able to please these disparate communities simultaneously, but they should be aware of the different motivations of groups within their particular audience.

CONCLUSION

In this paper, we have investigated the use of online content in the development of our participants' craft practices. We described how information is sought and found, how information is understood by taking physical action, and how different kinds of craft communities value different aspects of their craft activity. We used our description of information-seeking behavior to suggest ways that search can be improved and evaluated in this domain, and we used our description of craft communities to emphasize the diverse audiences that exist for online representations of craft knowledge.

ACKNOWLEDGMENTS

We thank our participants for inviting us into their workspaces and talking with us about their craft practices. We would also like to thank our CHI reviewers, as well as Judd Antin, Cameron Jones, and Ayman Shamma for their thoughtful comments and support.

REFERENCES

1. Adamic, L. A., Zhang, J., Bakshy, E. and Ackerman, M. S. Knowledge sharing and Yahoo Answers: Everyone knows something. In *Proceedings of the International Conference on World Wide Web (WWW)* (2008), 665-674.
2. Bates, M. Where should the person stop and the information search interface start? *Information Processing and Management*, 26, 5 (1990), 575-591.
3. Bates, M. *An integrated model of information seeking and searching*. Keynote presentation at the 4th International Conference of Information Needs, Seeking, and Use in Different Contexts, 2002.
4. Belkin, N. J. Interaction with texts: Information retrieval as information-seeking behavior. In *Proceedings of the First Conference of the Gessellschaft fŷr Informatik Fachgruppe Information Retrieval* (1993).
5. Broder, A. A taxonomy of web search. *SIGIR Forum*, 36, 2 (2002), 3-10.
6. Bucciarelli, L. L. *Designing Engineers*. MIT Press, Boston, 1994.
7. Cobbleddick, S. The information seeking behaviors of artists: exploratory interviews. *The Library Quarterly*, 66, 4 (1996), 343-372.
8. Cowan, S. Informing Visual Poetry: Information Needs and Sources of Artists. *Art Documentation*, 23, 2 (2004), 14-20.
9. Crabtree, A., Twidale, M. B., O'Brien, J. and Nichols, D. M. Talking in the library: implications for the design of digital libraries. In *Proceedings of the ACM International Conference on Digital Libraries* (1997). ACM Press.
10. Dormer, P. The language and practical philosophy of craft. In *The Culture of Craft*, P. Dormer (ed.). Manchester University Press, Manchester, 1997.
11. Ford, N. Modeling Cognitive Processes in Information Seeking: From Popper to Pask. *Journal of the American Society for Information Science and Technology*, 55, 9 (2004), 769-782.
12. Ford, N., Miller, D. and Moss, N. Web search strategies and retrieval effectiveness: an empirical study. *Journal of Documentation*, 58, 1 (2001), 30-48.
13. Gamble, J. Modelling the Invisible: the pedagogy of craft apprenticeship. *Studies in Continuing Education*, 23, 2 (2001), 185-200.
14. Greenhalgh, P. The Genre. In *The persistence of craft*, P. Greenhalgh (ed.). Rutgers University Press, 2002.
15. Hargittai, E. Informed Web Surfing: The Social Context of User Sophistication. In *Personal and Global Contexts of Life Online*, P. Howard and S. Jones (ed.). Sage Publications, 2004.
16. Hemmig, W. S. The information-seeking behavior of visual artists: a literature review. *Journal of Documentation*, 64, 3 (2008), 343-362.
17. Levine, F. and Heimerl, C. *Handmade Nation: The Rise of DIY, Art, Craft, and Design*. Princeton Architectural Press, 2008.
18. McCullough, M. *Abstracting craft: the practised digital hand*. MIT Press, Cambridge, 1996.
19. Metcalf, B. and Kennebrew, C. *Connect/(Dis)connect*. American Craft Council, Summer in the Salon Series, July 24, 2008. Audio/Video available at: <http://www.americancraftmag.org/zoom-entry.php?id=5156>
20. Needleman, C. *The work of craft: an inquiry in to the nature of crafts and craftsmanship*. Kodansha International, New York, 1993.
21. O'Connor, E. Embodied knowledge in glassblowing: the experience of meaning and the struggle towards proficiency. *Sociological Review*, 55, 1 (2007), 126-141.
22. Pickens, J., Golovchinsky, G. and Ringel Morris, M. Collaborative information retrieval. In *Proceedings of the ACM/IEEE-CS Joint Conference on Digital Libraries* (2008). ACM Press.
23. Pirolli, P. and Card, S. K. Information Foraging. *Psychological Review*, 106(1999), 634-675.
24. Polanyi, M. *The Tacit Dimension*. Anchor Books, New York, 1962.
25. Pye, D. *The nature and art of workmanship*. Herbert Press, London, 1995.
26. Savolainen, R. Everyday Life Information Seeking: Approaching Information Seeking in the Context of "Way of Life". *Library and Information Science Research*, 17(1995), 259-294.
27. Talja, S., Tuominen, K. and Savolainen, R. "Isms" in information science: constructivism, collectivism and constructionism. *Journal of Documentation*, 61, 1 (2005), 79-101.
28. Torrey, C., McDonald, D., Schilit, W. and Bly, S. How-To pages: Informal systems of expertise sharing. In *Proceedings of the European Conference on Computer Supported Cooperative Work, ECSCW* (2007). Springer-Verlag.
29. Wagner, A. *Behind the scenes things are heating up! What do you think?* American Craft Magazine, March 14, 2008. Available at: <http://americancraftmag.org/zoom-entry.php?id=1735>
30. Wilson, T. D., Ford, N., Ellis, D., Foster, A. and Spink, A. Information Seeking and Mediated Searching. Part 2. Uncertainty and Its Correlates. *Journal of the American Society for Information Science and Technology*, 53, 9 (2002), 704-715