

DESIGNERS, CLIENTS, AND KNOWLEDGE PRODUCTION

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Introduction

A technical system may be viewed as a locus of knowledge production. Knowledge grows through the design process, as the designer constructs new solutions to problems. Donald Schon (1983, 1990) describes a conversation between the designer and the materials of design, an interaction in which the designer makes a move – either with the actual artifact or with a sketch or other representation of it – and the artifact “talks back,” providing the designer with new information about actions and outcomes, which then shape future moves. Knowledge also grows as features of the new system are communicated to the designer’s professional community and becomes a part of the general knowledge base. Users may use a technical system explicitly to find information, and in the process not only add to their own personal knowledge, but find unexpected ways to use the system, which may then be communicated to other users. All such newly created knowledge moves, to a greater or lesser extent, out of the original situation and into new situations where it is accepted, modified, or rejected through additional interactions between people, things, and surrounding situations.

Theory

Works from three fields have been particularly useful to me in studying designers and users of various technological systems – sociological studies of science, technology, and art, practice theory, and design theory. Many of these are classics that still have generative value 30 or 40 years later, despite changes in rhetoric.

Sociology of Science, Science & Technology Studies, Sociology of Art

Design and use of technology can be studied as intellectual work analogous in some important ways to the conduct of science and other creative work.

Communication is central to the social context of intellectual work. Various studies have shown that informal communication is essential to the growth of knowledge. Herbert Menzel (1962) described the importance of informal, hallway-type conversations, in which scientists test arguments before they’re fully formed, ask questions, and get others’ reactions to half-baked ideas. Derek de Solla Price was the first to identify a stable pattern of informal networks by means of which the most productive scientists in a field are reasonably in touch with everyone else who is

contributing, and through them with most of the rest of the field. He called this inner circle an “invisible college.” Hagstrom (1965), Coser (1965), and Kadushin (1974) also found that almost all the ideas developed by various groups of thinkers either resulted from interaction with others in the field or were first tested out on them. Everett Rogers’ (2003) classic work on diffusion of innovation is often useful in explaining the social and material factors which influence the adoption of a new technology. Knowing who talks to whom, and what they talk about, can contribute a great deal to understanding the processes of system design and use.

Bruno Latour’s *Science in Action* (1987) is a rich source of provocative ideas about the way science is done, and the relationship between the way it’s done and what we consider to be legitimate scientific knowledge. An example of the thread of Science & Technology Studies that is known as “laboratory studies,” it presents the work of science as writing texts that will withstand the assaults of a hostile environment, and creating allies through translating the scientist’s interests into forms that will address others’ interests in order to enroll them in the construction and defense of the scientific fact. All of the STS literature explores the role of social structure in individual cognition, stressing the importance of the interactions between people (or interests) and the tools of work and the situations in which the work is done.

Several excellent explorations of the role of tools – why some tools are chosen and not others, how tools influence the way work is done, how the work influences the tools – can be found in Clarke and Fujimura’s *The Right Tools for the Job* (1992). James Griesemer’s chapter in this book, for instance, argues that tools are not merely material constraints upon the intellectual work done, enabling some activities and prohibiting others, but that selecting and using tools is itself theoretical work.

The idea of knowledge as social construction rather than the product of an individual’s genius is present in sociology of art as well. Becker (1981) and Wolff (1981) explore the ways in which the creation of works of art is inseparable from such social and material factors as the buying and selling of paper, the education of printers, the sweeping of stages, the reactions of critics and audiences, and earlier art.

Practice Theory

The label “practice theory” is applied to a variety of approaches which focus on “people’s actual, daily, embodied activity, often including skills, tacit knowledge and presuppositions, as well as their interaction with others and with material and other resources” (Van House, 2003).

The emphasis on the situatedness of all work practice allows practice theory to be combined easily with social studies of intellectual work. Lave (1988, p. 1) argues that “arrangements of knowledge in the head” are socially organized and not divisible from the social world outside an individual’s head; cognitive work (such as design, or the use of technology) should be studied as “a nexus of relations between the mind at work and the world in which it works.” Suchman and Trigg (1993, p. 196) describe the work of researchers in artificial intelligence as “skilled improvisation, organized in orderly ways that are designed to maintain a lively openness to the possibilities that the matters at hand present” (1993, p. 146). Tools interact with situations; they are not fully determined entities which are applied to situations. The process of work itself shapes the possible outcomes, and the means can’t be separated from the ends.

Design Theory

Much of contemporary design theory reacts against Herb Simon’s (1973) argument that any problem, no matter how complex and recalcitrant, can be broken down into smaller, well structured, solvable problems. Donald Schon has been particularly influential in arguing that such decomposition is more often impossible than possible. Schon’s research (1990) indicates that such a rational, rule-based model often fits the later stages of design but does not reflect the reality of the early stages. Designers do their work in a world of uncertainty, instability, and uniqueness, and what they actually do is to make and remake their ideas about the design, carrying on an ongoing “conversation with materials.” Bucciarelli (1994, p. 123) also stresses the messiness of design work – design is by nature “an uncertain and creative process. In every design there is an opportunity for creative work, for venturing into the unknown with a variation untried before, and for challenging a constraint or assumption, pushing it to see if it really matters. Uncertainty both allows participants to exercise their creativity and ensures that there will always be unforeseen outcomes.” Schon points out that designers can never make a move which has only the effects intended; “each move is a local experiment which contributes to the global experiment of reframing the problem,” (1983, p. 101) and the design professional is engaged in a reflective conversation with the artifacts and situation of the work.

One particularly useful idea from the design literature is the recognition that the original determination that a problem exists and is in need of a solution shapes the subsequent design process. Lave, mentioned above (1988, p. 42) writes that problem solvers choose “whether to have a problem or not, and the specification of what constitutes the problem.” Boland (2002) asserts that “a problem representation structures the problem space with elements of the problem and its potential solution, and is the most potent explanation for if and how a design problem will be solved.” As Schon (1983, p. 40) argues, the central task in design is to set the problem – “defin[ing] the decision to be made, the ends to be achieved, the means which may be chosen. In real world practice, problems do not present themselves to the practitioner as givens. They must be constructed from the materials of the problematic situation which are puzzling, troubling, and uncertain. When we set the problem, we select what we will treat as the ‘things’ of the situation, we set the boundaries of our attention to it, and we impose upon it a coherence which allows us to say what is wrong and in what directions the situation needs to be changed.”

There is design involved in users’ information seeking behavior as well; a user sets a problem and designs a strategy for finding elements of the solution. Searching – the selection and employment of tools for solving the problem – has been described by Kuhlthau (1993) as a process of constructing information. A researcher brings to a collection a question which is an anticipation of the possible shapes of an answer; this anticipation guides her initial queries, and interaction with the documents retrieved leads to adjustment of the anticipated answer shapes. A better understanding of the relationship between problem-setting and the process of constructing a solution would involve the interactions of individual cognition, the choice and use of tools (information systems), and the changes in knowledge resulting from the encounter between the user’s existing knowledge and knowledge as captured in documents retrieved (Weedman, 2005).

Methods and Settings

In this section, I will describe my own research questions which have come from these theoretical approaches, and the methods I have found useful to address them.

The first study concerns cultural rather than technological artifacts; I’m citing it here because the method used is readily applicable to technology settings. In research on cultural gatekeepers – publishers, reviewers, and scholars of literature – I used social network analysis to ascertain the kind of communication that supported their work practice (Weedman, 1992). In a questionnaire, I asked questions

about various aspects of their work, and then three direct questions: with whom did they talk when they wanted to “think out loud” about their work, with whom they talked when they needed to sort out their thoughts about their work, and whether people inside or outside their own profession were most frequently a stimulus for their thinking. I had also asked about publications – books and journals – that were influential on their thinking.

Social network analysis is a tool for studying communication patterns (Wasserman et al., 1994). There is network analysis software available which creates a matrix for all the respondents in the study, and maps the communication between them. Social network analysis has been used to diagnose problems in organizational behavior, to study distributor/supplier relationships, to study community, and in many other settings.

I looked at technology more explicitly in a study of computer mediated communication in the middle 1980s (Weedman, 1991, 1999), when it was new. Discussions of users and technology has often been quite deterministic, and most of what was being published at that time asserted that email and discussion boards were information lean media, causing depersonalization because of the lack of body language, facial expression, and vocal intonation; researchers asserted that electronic media changed how human beings communicate. It seemed to me much more likely that people would take technology and find unexpected ways to use it for their own purposes than that they would be confined to a very limited range of practices. I studied a computer mediated conference (something like discussion threads, but more sophisticated) that was initiated by a group of graduate students.

In this case I combined a survey of the participants in the conference – both posters and lurkers – with a content analysis of 18 months of the transcript from the conference. The content analysis was based on a taxonomy of professional socialization issues that I developed based on the literature of the field. The results showed that the students were using the conference to simultaneously enter and construct the social world of their chosen profession during the course of their school experience. The survey data explored the daily embodied work of professional socialization – the interactions between the technology, individuals, and social setting.

In a small study of image digitization projects (Weedman, 1999), I used questionnaires to gather information (N=15) followed by interviews with eight of the respondents. Rogers’ (2003) 5 factors which influence technology adoption worked quite neatly to explain why some people take on the challenge of

initiating a digitization project while others do not. Observability had a strong impact. Awareness of other digitization projects had created a sense of inevitability about the technology. Trialability was also an important factor – the equipment needed is relatively low cost, and it’s not difficult to identify a small, discrete part of an image collection which can serve as a pilot project. Complexity was a factor working against the initiation of digitization projects – imagebase projects involve copyright law (about which there are a variety of conflicting opinions), image manipulation techniques, large amounts of storage, time, data structures, and vocabularies. Many of these aspects are not yet a well-established part of the professional knowledge base. Relative advantage is Rogers’ fourth factor, and it often worked against adoption; slide libraries have gotten along with rigid filing systems, small labels, limited-access lightboxes, and projectors for decades; there is little incentive for a change which will affect existing teaching practices. Unexpectedly, the ability to provide increased subject access which came with database technology appears to be a more revolutionary innovation in visual resource collections than digitization. Users have always had images available to examine, and the change from a slide drawer to a monitor is one of improved convenience rather than of change in the practice of their work. It is a much greater change to go from providing access by country, time period, and creator (which requires the user to know in advance what artist’s work is wanted) to providing access by subject. Subject metadata describing the content of an image allows a user to search for the unknown rather than for the known.

A current study of metadata design – subject metadata specifically – also combines questionnaires with a smaller number of interviews for a mix of quantitative and qualitative data (Weedman, forthcoming). I posted queries to five professional listservs, asking for people who had done vocabulary design for image collections and were willing to participate in the project. Thirty-four respondents completed questionnaires, which collected descriptive information about their subject metadata. I’m now in the midst of interviewing a subset of the respondents, using the design literature reviewed above to ask about the process of metadata design – the cognitive, intuitive, and emotional dimensions of the work, uncertainty, the occurrence of conversations with the materials of design, and the relationship between the problem setting process and the ultimate form of the product.

Both these studies revealed a healthy tension between professional standards and local practice. Each professional must solve the problems of innovation in the context of a specific organization with needs and expectations which have evolved over time. The growing knowledge base which is codified in the

published literature and standards of a field may or may not be instantiated in its individual members. Reciprocally, new local knowledge sometimes does and sometimes does not move beyond the walls of the institution, becoming available to others. These two components of the professional knowledge base stimulate, modify, and constrain each other, leading to yet more knowledge growth.

In a study of image use, I conducted a 2 1/2 hour interview with a sociologist who studies the history of built environments – canals, gardens, etc. (Weedman, 2002, 2005). The subject described three ways of using images for her historical research – as tools for thinking, as tools for investigation, and as tools for remembering. The strongest impression that emerges from reading the transcript of the interview is the variety and strength of the verbs the subject used to describe her use of images; the heart of the data analysis was a fine grained discourse analysis focused on these verbs. Information contained in images is not resting there waiting to be found. Rather, images form a sort of ground or territory for the work of constructing questions and answers. Her discussion of searching for images in a collection was inseparable from her discussion of using them. A new description of browsing searches emerged from the analysis, distinguishing between different kinds of searching based on the interactions with the documents encountered. One kind of search is for pre-existing information which the searcher hopes to locate within documents; another kind, as described by this subject, is a search for information which comes into existence as the searcher retrieves documents and uses them (Weedman, 2002, p. 381).

The final project I will describe here (Weedman, 1998) is a study of a collaboration between designers and users of computer technology. In this project, I was a participant observer and used questionnaires and interviews to gain additional data. Sequoia 2000 was a collaborative, multimillion dollar research project in which a team of earth scientists served as a client group for a team of computer scientists. Both groups were university faculty and researchers. At the problem-setting stage of the process, it appeared that the needs of the two groups were complementary and would create a stable foundation for the collaboration. The computer scientists were at the end of a major development project and looking around for a new problem to solve, while the earth scientists had major data handling problems that required advances in computer technology. In fact, the meanings that these incentives had for the participants were more complex than was initially understood. The study explores the structure of the incentives present in the project, the effect of differing work practice within the two disciplines, and the balance of costs and benefits of

participation. Costs to users were much higher than expected, particularly at the points of requirements analysis and testing, and the benefits were defined primarily by the computer scientists. The conclusion of the research was that there are asymmetries inherent in the user-designer relationship that destabilize collaboration, and that a fundamental task of project management is the structuring of incentive to support an alignment that on its own is neither balanced nor stable.

Conclusion

These studies of knowledge growth through the design and use of various technologies draw on a theoretical approach which gives importance to the interactions between people, artifacts, and situations. The processes of growth are multivariately messy. Innovation often takes place without clear-cut goals and objectives; rather, there may be only a sense that this is something too important to ignore, or an opportunity may present itself which must be responded to. Whether the initial goals are clear or not, they serve to define the solution. Subsequent interactions between the people, artifacts, and situations will often shift the problem definition, and various kinds of “back talk” inform the process. Advances are uneven. Each individual solves the problems of innovation in a specific context, both drawing on the existing knowledge base and contributing to it as he communicates his own experiences.

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