



Prototyping spoken here: artifacts and knowledge production in design

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The title of this paper comes from a sign on a door in the London office of the IDEO design company. As I interpret it, it says two things: it is both a declaration about preferred design methods, and a statement on the communicative – or even linguistic – properties of prototypes in a design process. This is also the topic of my paper: how prototypes and other design artefacts (sketches, ready-mades, inspirational objects, concept ideas, artwork, mock-ups, prototypes) become endowed with extra layers of meaning as they get connected to each other as arguments in a discourse – not primarily a discourse on design but a discourse that is design, at least in one particular understanding about how design is made.

I have a feeling that the things I try to express are really simple and commonplace, with few surprising views. As the program text of this conference says, no one doubts the role of artifacts in art and design. In HCI/Interaction Design, the research field I have been working in for some years, artists and designers are often invited to participate in research projects. Within HCI and Participatory Design there is also a kind of consensus about the importance of practice-based knowledge and reflection in action.

Why then, in such a state of consensus, write on prototyping and artefacts in design/design research?

Donald Schön's work in describing practice-based knowledge is motivated by a personal quest: the question of what kind of knowledge is produced and distributed by universities:

I have become convinced that universities are not devoted to the production and distribution of fundamental knowledge in general. They are institutions committed, for the most part, to a particular epistemology, a view on knowledge that fosters selective inattention to practical competence and professional artistry” (Schön, 1983)

Bengt Molander is even more pessimistic when he writes about the perspective of scientific thought expanding in order to incorporate practice-based knowledge:

Attempts to incorporate different types of practically transmitted knowledge in a scientific context has generally led either to the erosion of these types of knowledge, or to isolation between the practice and the new scientific discipline about the practice.” (Molander, 1995).

Molander's statement points to a vicious circle, where valuable practice-based knowledge will be translated into theoretical knowledge - because this is the only way its value can be acknowledged within the scientific system.

So, there is a problem. It is not primarily an epistemological problem in expressing practice-based knowledge, but a problem related to cultural patterns deeply imprinted in all of us and in our educational institutions, stating that theoretical knowledge is worth more than practical knowledge. One of the challenges in design research is, I'd say, to trace and describe these implicit value judgments, and their role in shaping the fabric of knowledge cultures, both within and outside of academia.

Even if there is a consensus – in words, not always in practice – on the virtues of practice-based knowledge, such as the knowledge to create, discuss and refine artifacts, there is no consensus whether this kind of knowledge can be research in itself, or if it needs an infusion of “scientific” thought in order to merit the status of research. My arend in this paper is to offer some snapshots of how artifacts are used for knowledge production in design, as an input to this discussion.

Theoretical background: knowledge in action

In order to give a theoretical framework of the issue of practice-based knowledge I would like to mention the work of Donald Schön, Edwin Hutchins and Bengt Molander.

When somebody reflects-in-action, he becomes a researcher in the practice context. He is not dependent on the categories of established theory and technique, but constructs a new theory of the unique case. His inquiry is not limited to a deliberation about means which depends on a prior agreement about ends. He does not keep means and ends separate, but defines them interactively as he frames a problematic situation. He does not separate thinking from doing, ratiocinating his way to a decision which he must later convert to action”(Schön, 1983)

Donald Schön remarks that reflection-in-action is not generally accepted as a legitimate form of professional knowing. Professionals take action based on experience, intuition, recognition of the problem – seldom based on the checklist they once learned in school. The common understanding of knowledge fits the theoretical format of knowledge in school, but it fails to understand the reality of practicing knowledge “in action”, in real situations. Based on studies of practitioners within architecture, urban planning and psychology, Schön attempts to formulate an epistemology of “reflection in action” of practice-based knowledge. He emphasizes the importance of dialogue with the material. The material “responds” to the practitioner's questions.

From a different point of view, cognitive anthropologist Ed Hutchins has written about distributed cognition (Hutchins, 1996). His point is that cognitive activities take place in time, and in social and physical space. In order to understand the rationale of cognition in real-life situations it is not enough to study what happens inside the head. Artifacts, traditions, social circumstances, place, other persons – all are part of the “cognitive system” around a specific task. The tools we use are internalised in the way we reason,

and our reasoning is externalised into time, social, and physical space. He remarks that “systems of socially distributed cognition may have interesting cognitive properties of their own....”, properties that cannot be reduced to the cognitive properties of the individuals.

Bengt Molander (Molander, 1995) talks about how specialized knowledge is maintained within “knowledge cultures”, Continuing the line of thought from Schön, he describes the knowledge process of the practitioner as a dialogue.

### Case 1: The Department of Metal Design

“Sankt Adolf: Schluckt Gold und Redet Blech” John Heartfield, text on a propaganda poster against Hitler.

“If I speak in the tongues of mortals and of angels, but I do not have love, I am a noisy gong or a clanging cymbal.” Corinthians, 13:1.

In this section, I will attempt to apply the perspectives above at an existing design environment; the Department of Metal Design at Konstfack, the University College of Arts, Crafts and Design, Stockholm. The students of Metal Design can choose to specialize within silversmithing, jewellery or product design. The department is well-equipped with furnishings and machines for working with metal, including the ability to cast in titanium. This last month of May I had the occasion to follow the work of the first-year students in Metal Design as a guest teacher in sketching techniques. I had the idea to include my impressions here, since Metal Design comes through as a good example of a specialized knowledge culture (Molander, 1995) characterized by an emphasis on the handicraft, and the use of artefacts as a means to step forward in the design process.

The sketching technique course was a small part in a longer course focusing on design of tableware. The tableware course is given to all first-year students. Their assignment is to develop a concept and a prototype for a set of tableware: knife, fork and spoon, or some other configuration depending on the context chosen by the students.

### Design process

Assignments in Metal Design are roughly divided into three steps: research, sketching/ concept development, and implementation.

### Research

The workspaces of the Metal students are filled with photocopies from art/handicraft books, drawings, small simple models in metal or clay, drafted models in full size. The sense of touch is important. Many use books on art and handicraft as a source of inspiration. Knives and forks from the flea market are also used as inspirational material. One of the students has a special interest in the “old French” style of silver tableware. Interviews, with professionals or their own friends, are also part of their research activities. In making their models the students emulate traits from traditional or folkloristic designs (decoration, details in other materials, thick balloon handles), examine the effects, and figure out how they can be accomplished.

### Sketching

Drawing and modeling in clay are used as sketching methods. However, several of the students say that they usually get their ideas “in their heads” or when working directly with the material. All six work individually. For most of the students, concepts evolve through many variations of a single idea.

Even though a large part of the student's inspirational material relates to industrial design and mass-produced tableware, the professional role that they investigate in their work is the role of a silversmith – someone who creates original pieces based on their own designs.

## Realization

At my second visit, about mid-term in the course, most students have rough versions of their final tableware. The making of the tableware seems to start before the concept development phase is over. I guess this is related to the fact that they are still new to the silversmithing skills. They will have to develop new skills in order to realize their idea for the tableware. The models and try-out pieces are both concept studies and a way to approach questions such as: how difficult is this? Can I get it done in time?

## Metal design as a system of distributed cognition

The Metal Design department is an example of a specialized knowledge culture (Molander, 1995) or with the words of Hutchins (1996): a system of socially distributed cognition with some specific properties that cannot be reduced to the properties of the individuals.

As a cognitive system, the Metal Design department involves persons, both present and absent (students, teachers, former students). It also involves time and physical artifacts. Time is present in the tools and in the way know-how is imprinted in their design. It is also present in the silversmith's repertoire: tableware, jewelry, silverware – connected to cultural schemes of rituals and social behaviors. The intersection of work process, the properties of the material, and the specific design is also a focal point of knowledge for new student to acquire through re-enactment or reproduction of work procedures and designs. Reproduction in this context is not comparable to copying. It is a prerequisite for keeping the cycle of “knowledge-in-action” in movement.

From my observations of metal design, it seems that the artifacts are inscribed in a number of discourses or lines of inquiry. Here is a tentative list of the inquiries that are at play in the tableware assignment:

Personal taste: who I am and what I like

Silversmith /tableware tradition (short and long traditions: design history, works of previous students)

What I can manage to get done or learn to do in a limited time

The qualities and properties of the material

There are several possible reasons why models and visualizations are so central in the elaboration of a new design proposal. One reason is, of course, that this is a design/handicraft education. Acquiring the skills of making is an important part of the education. Where a more concept-oriented designer would prepare models to test concepts, the Metal students use models to test both the material and their own skills in mastering them. Artifacts are positioned not only in relation to concept ideas but also to strategies about what is feasible, what the risks are on a material level.

Another reason for making artifacts is that the silversmith tradition “speaks” through artifacts in metal. The vocabulary consists of knives and forks, jewelry and silver jugs, etcetera. T.S. Eliot describes literature as an exchange of letters that stretches over centuries. Using the same metaphor, silversmiths may be said to participate in an exchange of arguments, disguised as artifacts, that also spans centuries.

On one hand these artifacts enter a dialogue with the “grand tradition”, on the other they enter a dialogue with the recent tradition of what students did last year and the year before that.

## Case 2: The Narrative Toys Project

My second case is a design-oriented project within the research field of HCI, Human Computer Interaction. In this case I speak on my own behalf: I initiated the project and worked as a project manager throughout the project's time span.

### HCI/Interaction Design and K3

The Narrative Toys project is closely related to the research environment at K3 (Konst, Kultur och Kommunikation, the School of Art and Communication) at Malmö University. This institution started in 1998 as a new initiative in the direction of research and education based on problem-based learning and practice-based research in the intersection of technology, media, art, and design. The educations cover fields from interaction technology to media studies and design. From the start two interdisciplinary research studios, the Space and Narrativity Studios were planned as a resource where research and education could meet. The research studios were built as a collaboration between K3 and the Interactive Institute, an independent Swedish research institute with similar goals toward innovation-oriented research within digital media. Today, six years later, Interactive Institute has withdrawn from its engagements in Malmö, however there are still a number of research studios at K3 driven by the Malmö University.

With its roots in systems design, computer science and engineering, HCI/Interaction Design is an emerging research/design discipline which is design-oriented, interdisciplinary and innovation-oriented. The aim is to develop computer applications for work and daily life with input from a variety of standpoints: ethnography, sociology, engineering, arts, design, etc. In the early days professional applications were at focus in HCI. Today the focus has shifted towards everyday applications for leisure or learning. There has also been a movement away from the desktop computer, in the direction of computing resources integrated in everyday objects and environments (ubiquitous computing). Research institutes that work within interaction design are for example CID at KTH, the Interactive Institute in Stockholm, and the Interaction Design department at the Royal College of Arts, London.

### The Project

The Narrative Toys project started in 1999 at the Narrativity Studio in Malmö. The aim of the project was to explore the potential of computer-based toys as a medium for narrative play. Together with artists and designers from various disciplines we wanted to design prototypes for toys and play environments, and to test and develop them further together with “users”: children and pedagogues. Where the tradition of participatory design

emphasizes that the users design the product, our standpoint was more “designerly”. We wanted to explore digital toys as a place where professional artists and designers could create for and with an audience of children at play.

Our research activities consisted mainly of the development of prototypes. Our prototypes were both original artistic works and proposals for future designs. In an engineering context a prototype carries a specific meaning: the prototype addresses issues of form and function, but also how the intended product is going to be mass-produced. In relation to this understanding of the word prototype, our prototypes were midway between an original artwork and a design proposal. They did not address issues of mass production. As part of the development of prototypes we also prepared large numbers of artifacts of different sorts: sketches, concepts, scripts for dialogues, stories, characters, a nonsense language, illustrations etc. etc. – as a way to feel our way forward, test and discuss.

Within the Narrative Toys project, five or six different prototypes were realized, connected through thematic similarities, reuse of media or technologies or through intentional dissimilarities: the problems met in one prototype being the starting point for the following one Here is a list and a short description of the main prototypes/design proposals:

The Beastie Box. A concept sketch for a computer-supported toy – an interactive puppet theatre in a box, where characters respond with sound and speech when they are moved around on the “stage”. Visualized in sketches and in a slideshow demo. [Figure 1]

The Video Sandbox. A sandbox with sound effects and image projection on sand. The Video Sandbox was developed for a design session with a group of children. After this session, we prepared a short video describing what happened when the children used the video sandbox. The content consists of images and sound representing different landscape types. [Figure 2]

Psst – The Programmable Soundscape Toy. A play environment with six boxes with loudspeakers, a database with sounds (event sounds and nonsense “talk”), nine doll characters and a number of play formats exploring different setups of the resources above. The play formats experiment with different formats for open-ended, non-linear and character-based storytelling. Psst was developed as a fully working prototype, and tested in child daycare centers. In developing the concept, we also produced a large amount of images, stories, drawings, character profiles, scenarios etc. Some of these materials have been reused in Cirkus Gluff-Gluff and CoDo. [Figure 3]

AudioTheatre. An interactive talking puppet theatre, built on the Psst technical platform. Script and design developed by Sanne and Martin. The functionality is close to Psst, but the storytelling represent opposite choices in relation to Psst. In Audio Theatre there is a prewritten linear piece on one hand, and the possibility of inventing new theatre pieces on the other. [Figure 4]

Cirkus Gluff-Gluff. A development built on the Video Sandbox and Psst. A circular sandbox in a circus tent, where children could play with image projections on the sand using an interface with white china plates. Max, one of the Psst characters, had a role as the “mad cook” creating disorder in the “food” preparations in Cirkus Gluff-Gluff. Fully working installation. Cirkus Gluff-Gluff was part of the attractions of the Malmö Festival in 2002 and ran for a week. Documented in video, sketches, etc. [Figure 5]

CoDo. Communicating dolls built on wireless blue-tooth technologies. A collaboration with two external partners. Due to technical problems, CoDo was never fully realized. However, preliminary work on the CoDo project spawned many other design activities like the Robot School.

Robot School. A proposal for a narrative framework for Codo, developed in collaboration with a school-class of 8-year old children in Malmö. The Robot School story world tells stories about the robot children and how they use their technical talents to play at school. The Robot School is documented in a storybook with pictures collecting the stories and drawings made by the children.

The home as a playground – student projects. Play environments using video projection. Student project by Interaction Design students at Malmö Höskola. As a course assignment students were introduced to Cirkus Gluff-Gluff and the Video Sandbox, and then given an assignment to develop design proposals for home play environments using video projection. One group presented a proposal built on Microsoft Paint, but connected to sensing technologies. This proposal was realized as a “wizard of Oz” play session and as a video demo. A second group presented “The Flying Carpet”, a concept built on vertical video projection of a landscape seen from the air, projected around a carpet that serves as navigation tool.

#### Observations from the Narrative Toys project

The prototyping activities took most of the time and resources in the Narrative Toys project: concept development, implementation, and documentation. Between prototyping phases, we were a very small project group of one to two persons, but when prototypes were built many new persons were recruited to the project: students, technical people, artists, children and teachers, industrial partners and colleagues from the Space and Narrativity research studios. Here are some observation on the effects of prototyping in the Narrative Toys project, each followed by a short description of a situation related to the headline:

Prototype production did more than producing prototypes. It also served as a way to structure the work process, and organize collaboration.

Building something together is a concrete activity where goals and decisions are negotiated in view of a shared goal understandable to all participants. Long-term goals may differ and different people have different understandings of what they accomplish. However, a short or middle-term goal creates a temporary arena where the reasoning of participants can be seen in relation to a concrete goal.

Example: In Psst we worked with sound artist Hanna Hartman. Her art focuses on associative sounds, rich in texture information, often balancing on the edge between hyper-reality and abstraction. How would they interact with the characters and stories in the prototype? The preliminary run-through ended with give-and-take on several levels. Hanna had to shorten and simplify her sounds – they were too rich in information to mix with the rest. On the other hand, we decided to use high-quality sound in the platform instead of the simple loudspeakers often used in toys, since the immersive power of sound has a strong relation to sound quality.

Artifacts, after they were finished, served as a common track record, and were frequently referred to by participants. Some project activities are remembered and referred to, other project activities dissolve into the totality of activities of a design project. My point here is

that the project activities that are materialized through artifacts, or through an anecdote that can be retold, are those that will be remembered and referred to, thus influencing the development of the project.

Example: New design ideas often started in discussions of alternative solutions to earlier prototypes. AudioTheatre started in a discussion of a Psst problem. The children that played with Psst often started a quite systematic exploration of the interaction possibilities in order to understand the functionality and intentions of the toy. In designing Psst we had tried to provide it with resources for associative, open-ended narratives. This unfortunately resulted in a kind of communication break-down: the toy was not understandable. In order to rectify this situation, we simplified the Psst software, and we started the AudioTheatre Project to explore what would happen if we started from a linear story.

The professionalism of the designer extends to other project participants. It enables non-designer participants to express themselves through drawings or model

The people trained in design contribute through the creation of a project culture where artifacts are “listened to” with attention as statements in a design discussion. When artifacts are in center of the discussion, they become accessible as a mode of expression also for people that are not designers by training. In a learning context, this is sometimes referred to as legitimate peripheral participation in a community of practice (Lave and Wenger, 1991).

Example: Sanne, an interaction designer, prepared a “style sheet” as part of the collaboration with the school class in CoDo. The style sheet illustrated the characters developed by the children in an earlier session. The drawing style proposed was simple enough for the children to master it, more based on flat characters than three-dimensional. The children took positively to the attention paid by a “real” illustrator to their characters and stories. Sanne took the time to elaborate on their ideas, and the style sheet matched their drawing abilities quite well. The style sheet also made it easier for the researchers to read the drawings. Together with the style sheet the children were also given papers with pre-printed picture frames and a few lines for text next to each image. It was notable that the sequential format inspired some of the children to leave the “make a drawing” context in favour of another context “draw a film”, bringing in structural and stylistic elements from their experiences as viewers of video and television.

The artifacts were useful in introducing newcomers to the project.

Example: The two student projects mentioned above were made by people who knew the Narrative Toys project through its prototypes. The “artifact discourse” provided the student groups with a context where they could add to the discussion through new design proposals.

### Design discourses in the Narrative Toys case

In the Metal Desing case, the design discourses revolved around issues of material, skills, tradition and personal relevance. In the Narrative Toys project, we used prototypes and artefacts to approach similar issues, and to orient our work.

What are we able to get done, on a technical level?  
A dialogue with traditional child culture.



A dialogue with other HCI research projects on similar topics (expressed in doing things that are similar or dissimilar).

There is yet another discourse that needs to be mentioned, a discourse on another level: the artifact discourse that emerges from all the prototypes and artifacts taken together. This project discourse manifests itself both in artifacts and in verbal arguments. It is shaped in discussions within the project – and in presentation of the project to new people.

## Final discussion

The students of Metal Design participate in a knowledge culture where a good deal of the “talking” is done through artifacts in metal. The knowledge culture is reproduced when new students are introduced to the same tools, shaping (more or less) the same repertoire of objects, and discovering little by little the depth of experiential knowledge layered into the minute procedures of how things are done.

The Narrative Toys project uses activities and artifacts in a way that is quite close to Metal Design. However, the Narrative Toys project does not aim to work within one tradition or profession, but in the intersection of many professions and traditions. It is short-lived compared to the design institution with its project life of three years.

The Narrative Toys project initiates a temporary, project-specific design culture, which resembles the culture in Metal Design, but with the important distinction that it is open for short-time memberships and contributions from lay persons. A kind of mini-tradition is established through a series of prototypes and other design artifacts, and within this discourse project members are invited to fill in with new arguments or artifacts. The limitations in time and scope are also a way to allow for collaboration, - the project operates in a “small world” that can be, at least in principle, shared by all participants.

There is no doubt about the importance of artifacts in knowledge production and distribution in a knowledge culture focused on producing artifacts – how could it be otherwise? My point in this paper is to demonstrate that artifacts, and the circumstances surrounding their production, can also be useful knowledge resources in other research contexts, for example in relation to innovation, knowledge exchange or organisational learning.

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