Interaction design, research practices and design research on the digital materials

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IN THIS ESSAY, I INTRODUCE INTERACTION DESIGN, EXAMINE THE NATURE OF RESEARCH IN INTERACTION DESIGN TODAY AND ITS DILEMMAS, AND FINALLY DISCUSS WHAT RESEARCH IN INTERACTION DESIGN COULD (AND PERHAPS SHOULD) BE LIKE.

I view interaction design as the act of shaping digital products and services, considered as design work. The second part of the sentence is significant, since digital products and services have been developed for many years in several fields of academia and industry but generally based on other foundations. In my view, interaction designers are not very closely affiliated with engineers and system developers, but rather with industrial designers and architects.

Unlike industrial designers and architects, however, interaction designers specialize in the digital design materials: software, electronics, and telecommunications. Examples of what an interaction designer might work on include web sites, cellphones, media products, spatially located information in public spaces, e-commerce, interactive art installations, rehabilitation technology, and enterprise systems. We must hence ask what it means to consider one’s efforts in such areas as design work.

Design work is distinguished by the following characteristics.

• Exploring possible futures, starting from a situation at hand.
• Intending to change the situation for the better by developing and introducing some sort of product or service, i.e., the concrete outcome of the design process.
• Considering practical and technical as well as aesthetic and ethical qualities.
• Developing an understanding of the task – the goal of the design work – in parallel with the space of possible »solutions.«
• Thinking by sketching, building models, and expressing potential ideas in other tangible forms.

The most significant differences between interaction design and other disciplines developing digital products and services are found in the latter items: The interest in aesthetic and ethical qualities, the growth of goal understanding throughout the process instead of freezing it in an early specification, and the importance of making ideas explicit.

Design is usually seen as a relation of service, where the designer creates an artifact – a product or a service – for one or more clients. There is an emerging design culture in the digital field, where companies such as Apple and Kai Krause’s MetaCreations played important formative roles early on and where the dissemination of mobile services and computer games in recent years has contributed to creating a class of consumers looking for design quality. Similarly, there is a growing research culture in interaction design, with its roots going back to the academic disciplines of informatics and human-computer interaction, and a core interest in the relation between design and research. My purpose here is to discuss how design can be seen as the construction of knowledge, or, more specifically, how interaction design can lead to scientific knowledge about the digital materials. Another way of phrasing my concern is to ask: What is research-by-interaction-design?

First of all, we may note that design frequently leads to new pieces of knowledge of relevance to other designers and to future design situations, sometimes closely related to the original situation and sometimes more remotely connected. A classic example from the field of software is the spreadsheet, first introduced in 1979 by Dan Bricklin and Bob Frankston in the VisiCalc product as a way to sum the columns of numbers in financial accounts. The design and construction details of VisiCalc may not have been very influential, but the core idea of a dynamic spreadsheet has proven to be a viable and valuable piece of knowledge subsequently used not only in other accounting software but also in other areas where users are supposed to construct their own computation models.
Another example of a viable piece of knowledge in design (a design meme?) is the organic and translucent formal language developed by Jonathan Ive for the Apple iMac in 1998, which has inspired a broad range of styling projects for all sorts of consumer products.

The spreadsheet and the Bondi Blue style are quite different examples in many ways, yet they both illustrate how design can lead to new knowledge about function and form that can travel to other designers and other design situations. This is certainly nothing new to readers familiar with design education, where design examples have always played a central role. A design teacher introduces a new field by presenting design examples from that field; students spend hours studying the canonical examples of their field; student projects are examined in crits where the work is presented to the whole group, thus introducing a new example.

Moving from the everyday use of examples in a design culture towards more theoretical perspectives, we find significant evidence in design theory to indicate that one of the most important elements of design ability is a repertoire of abstracted examples that is used to spawn ideas in new design situations. On a general level, it seems straightforward to claim that design can create knowledge of value to other designers.

Moreover, it follows that designers and other actors in a design field, together with their communication and the artifacts of the field, can be seen as a community for collaborative knowledge construction. When a designer develops a new idea and presents it to the community as a possible knowledge contribution, she is making a statement in an ongoing debate. Some statements receive a great deal of attention, many colleagues appropriate the idea to try it out in new design situations or elaborate it in different ways – other statements go more or less unnoticed. What the community finds right and true changes over time, sometimes gradually and sometimes more abruptly, as the cooperatively maintained body of knowledge develops. The communities of design employ several communication channels, from mainstream venues such as magazines, exhibitions and prizes to subcultural expressions questioning the mainstream ideals.

The role of the critic should also be mentioned in relation to the notion of design-knowledge communities. Critics and criticism in a design field contribute to the collaborative growth of knowledge by placing design examples in broader historical, cultural and societal contexts; by examining ideas from perspectives other than those of the designers; by putting unexpected questions; by pointing out unexpected consequences.
Critics and designers are complementary actors in the knowledge community of a design field.

The second step of the argument is more specifically concerned with design as the construction of scientific knowledge. Every scientific discipline has its community, engaged in the collaborative construction of knowledge. A particular trait of scientific knowledge communities is that they spend a good deal of collaborative effort on the question of what »scientific« means, i.e., what counts as acceptable knowledge contributions. The criteria vary between scientific disciplines, and I obviously cannot claim complete knowledge of the practices in all scientific communities. However, I have spent many years as a researcher, participating in a number of different scientific communities, and I think I have developed a certain sense of scientific norms. On a general level, I would suggest that scientific criteria are about novelty, relevance, groundedness, and criticizability.

- A contribution to scientific knowledge – a statement in the ongoing knowledge construction of the scientific community – must be new in the sense that the idea, claim or concept proposed is not already a part of the body of knowledge maintained by the community.
- A contribution to scientific knowledge must be relevant – it must be deemed interesting and making sense. If the contribution is of interest to the scientific community, we may call it internally relevant, whereas a contribution of interest to the world outside academia is externally relevant. Contributions may, of course, be both internally and externally relevant, but sometimes they are only internally relevant.
- A contribution to scientific knowledge must be grounded in something that the community finds acceptable. The most common options are empirical grounding (where a statement is based on observations), theoretical grounding (where a statement is based on a theory that is part of the knowledge body of the community or a theory that the community finds to be an acceptable extension of the knowledge body), and analytical grounding (where a statement is based on reasoning that the community finds acceptable).
- A contribution to scientific knowledge must be criticizable to enable other members of the community to scrutinize the foundations, sources and arguments that the contribution is based on. The principle is that another researcher should be able to assess a scientific contribution by identifying and criticizing every step in the conceptual construction that the contribution rests upon.

If we accept the idea that design can lead to knowledge, then there is nothing in the four general scientific criteria to preclude the idea that design can lead to scientific knowledge. In principle, it would seem possible to construct new, relevant, well-grounded and criticizable knowledge by design. This is, in fact, the main point I wish to make, and I shall spend the rest of the text on elaborating it somewhat.
But first, I need to make a historical digression. The concept of interaction design has not been used for very long – it has been mentioned occasionally from the early 1980s, but it did not really spread until the mid 1990s – but it is already reasonably well established. Many companies in ICT, telecom and media have employees with the title of Interaction Designer (even though terms like Interaction Architect and User Experience Designer are also commonly used to refer to similar job descriptions). Many universities are engaged in teaching and research in interaction design, sometimes in its own name and sometimes under the umbrella of informatics, industrial design or computer science.

To simplify matters slightly, we might say that three main intellectual traditions define the conditions for interaction design today. The field of informatics has nurtured an interest in design science ever since the 1970s, with an emphasis on design methodology and user participation. The academic field of human-computer interaction (HCI) emerged in the 1980s as a combination of applied psychology and computer science, and it is characterized by a focus on individual use of digital products and services for instrumental purposes. Concepts such as usability, utility and relevance are central in HCI and the traditional context is the use of ICT in work-oriented settings. The third main tradition, and the most recent one, is industrial design. Only in the last ten years has industrial design developed an interest in the digital materials, along with the growing importance of integrating physical form and digital »contents« in mobile and handheld computing. In Sweden and perhaps in some other countries, it is also the case that industrial design has historically worked in the domain of applied arts and only recently has been forced to start orienting itself in relation to academic research environments.

At least two areas of the three forming the intellectual ancestry of interaction design – informatics and HCI – are relatively well-established academic fields with strong scientific traditions. Thus, the emerging practice of research in interaction design tends to be shaped by norms originating in informatics and HCI research. Here are a few examples of such norms.

- A PhD dissertation is an argumentative text, starting with an introduction and a research question, moving on to the choice of research method and the results of applying the chosen methods, and finally a tentative answer to the research question.
- A PhD dissertation is a book of around 200 pages with a lot of text and a few pictures.
- An innovative idea for a new digital product or service must be tested with users before its value can be assessed.
- An ideal scientific contribution is universally valid, which means that it is true in all contexts and situations as far as we know.

Readers with research experience are likely to recognize these norms. They are all more or less institutionalized in the scientific disciplines that shape the conditions for interaction design research today. However, if we compare them to the four general criteria above (new, relevant, grounded, criticizable), we find that the norms are more confining than necessary.
For example, imagine if an artifact could be part of the argumentative structure of a scientific knowledge contribution (instead of merely being re-presented in a piece of text and a few pictures).

Or, what if a PhD dissertation could consist of a digital product plus a layer of textual grounding and a layer of textual reflection and abstraction?

What if an innovative idea for a new digital product or service was made criticizable through analytical grounding instead of empirical grounding?

What if a scientific knowledge contribution was framed as a semi-abstract? That would mean to propose a contribution with the intention that others could appropriate it for other situations than the original design situation, but without any claims to universality. Most importantly, it would be understood that appropriation would require a certain amount of work, even though it is the task of the contributor to facilitate the appropriation work by reporting foundations, sources and reasoning, i.e., by making the contribution criticizable. Moreover, the contributor can help the appropriator by discussing the scope of the contribution and outline the types of situations where it would most likely make sense to try and appropriate the contribution.

All of these hypothetical situations, and many others that can easily be envisioned, comply with the four general scientific criteria while violating the institutionalized norms in different ways.

In other words, interaction design research seems to be caught in the tension between the scientific norms of informatics/HCI and the aim to make design a part of the knowledge-construction process under more general scientific criteria. In this section, I outline five discernible strategies that researchers use to handle the tension.

1. **Designing prototypes for empirical evaluation with the intention to study the qualities of the new design ideas in use.** This is the dominant strategy in HCI and it draws in turn on many years of engineering and experimental-psychology practice. Some prototypes are built in order to demonstrate the technical feasibility of the idea (such prototypes are, quite tellingly, called proof-of-concept prototypes), whereas others serve as vehicles for hypothesis testing in a more or less rigorous experimental methodology.

   The knowledge contributions coming out of this strategy may be supposedly universal or semi-abstract, depending on which perspective the work is based on and which empirical methods are used.

2. **Exploring the potentials of a certain design material, design ideal or technology.** In this strategy, design work is performed as a way to explore the space of possible new artifacts. The knowledge contributions are generally semi-abstract. A useful example of this strategy is Tomas Sokoler’s PhD dissertation (see sidebar) where a criticizable knowledge contribution is
Sokoler develops a design perspective on ubiquitous computing with an emphasis on human skills and abilities, where he argues that digital technology ought to be placed alongside other physical and social resources for skilled human action. This design ideal is expressed through a reflective text discussing five design projects in the areas of peripheral mediation of situational awareness, a tool for navigating physical space through tactile feedback, a personal information appliance for wastewater plant operators, paper cards for controlling video playback in creative collaboration settings, and a mobile phone for “talking silently.”

Krippendorff has pointed out, analytical grounding of a knowledge contribution in the contexts of design research may include the reporting of several possible new artifacts (several design alternatives) and a coherent argumentation around their qualities as a way to motivate the choice of one of the alternatives. Such approaches to grounding ought to be highly relevant in this strategy.

3. Exploring possible futures which are rather far from current situations. Here, the work typically entails designing central artifacts and their use in a possible future, and examining that future through a combination of analytical reflection and quasi-empirical assessment using envisioning models and dramatizations. The knowledge contributions consist of semi-abstractions addressing the likely properties and qualities of the proposed artifacts.

An example of this strategy might be post-hoc worknotes, a project I managed a few years ago on the topic of office work in a possible future where all meetings, documents and other work-related information are stored in multimedia archives. The design work consisted in shaping tools for accessing and managing the huge amounts of information, and constructed out of five cycles of design and reflection on the design ideal of ubiquitous computing.


The post-hoc worknotes project started from the assumption that knowledge workers in a fairly distant future would have access to an infrastructure where meetings and other face-to-face communication are stored as video recordings, together with documents, email and other asynchronous communication. Apart from integrity and security issues, there is also a crucial question concerning how to access this potentially huge mass of material as needed. We told a story about such a use situation by designing a suite of information management and access tools and placing them in an envisioned work situation that we presented in a movie. The knowledge contributions consisted of a new way of combining image search, text search, semantic information analysis and information visualization, as well as conclusions on the importance of context-specific metadata and ways of extracting metadata from manual information management without overhead.
in making them assessable by envisioning them in a movie showing possible use of the tools in knowledge work at an advertising agency.

4. **Designing artifacts for instantiating a more general theory in a specific design material and assessing the results.** The knowledge contributions are normally semi-abstracts, even though universal contributions may result in the event that the design work provides reason to modify the underlying general theory. An illustrative example here is Andreas Lund’s PhD dissertation (see sidebar) combining a universal theory in cognitive science on image schemata and metaphorical projection with design and assessment of new digital artifacts.

5. **Performing a participatory design process where the future users act as experts in their field of practice,** rather than as objects of study or participants in evaluation sessions. The designer/researcher normally assumes the dual roles of expert on the design material in question and design process facilitator. Knowledge contributions are semi-abstracts concerning the practice where the design process takes place and the implications of sociotechnical interventions. The designer/researcher’s ways to act and reason are often closely related to those of action research.

The Kliev project is a recent and clear example of this strategy, resulting in knowledge contributions on the design ideals of embodied interaction and local media production as well as on the social practices of knowledge management in healthcare.

More or less all available examples of interaction design research seem to consider the written publications as the real results – a design process is not really research before a paper or a thesis has been written about it. The standard procedure is to describe ideas and argumentation in text and add a few pictures of a prototype or a model. The »lots of text, a few pictures« norm seems strongly engrained and the whole infrastructure of scientific communication is built around written texts. Such structures are, of course, not easy to change even though some academic conferences experiment slightly with exhibitions and other formats.

However, the existing norms create a general problem for interaction design research since the digital materials are temporal as much as they are spatial. In other words, the qualities of a digital product or service depend...
not only on its two- or three-dimensional form but equally on how it behaves in use over shorter or longer periods of time.

A digital product has a certain feel in use. Some products may feel awkward and rigid, others more malleable and fluent. For instance, it is possible to talk about the pliability of an interactive visualization with reference to the user’s sense of shaping the presented dataset as a tactile and responsive material, encouraging exploration and serendipitous discoveries. Some digital products demonstrate their whole scopes in concise overview right at the initial touchpoint, others hint at depths of complexity that will require time and effort to penetrate. Some products feel powerful, others are weak and blunt. The interaction has a rhythm that may be sluggish or hectic, hesitant or insisting.

Pliability and similar qualities are the results of interaction design and they are generally not visible in the form of the product. They appear only in use. It is rather obvious that a presentation based on a lot of text and few pictures cannot convey such temporal qualities. Unlike the designer of chairs and other material objects, we have the possibility in principle to include a copy of our product in the argumentation we construct and disseminate in scientific communication, for example by constructing a PhD dissertation around a digital artifact with a textual layer of grounding and another textual layer of reflection and abstraction.

Even though we may hope for new norms for publishing interaction design research, it is also interesting to consider what the prevalent »lots of text, a few pictures« norm affords in terms of constructing knowledge contributions. One possibility is to formulate semi-abstractions in the form of experiential qualities, i.e., concepts that identify desirable properties in genres of products in such a way that other designers can appropriate the concepts and use them to design new products with the same qualities. The concept of pliability that I mentioned earlier is an example of an experiential quality.

Another idea that has gained some attention recently is to formulate patterns, which refers to central design ideas that appear in several products and can be semi-abstracted for use in new design situations. The design-theoretical foundation for formulating patterns is the insight that design work is driven by a repertoire of examples that are matched against new design situations; the idea is that a designer can develop her repertoire and thus extend her design ability by appropriating patterns for-

THE CHAIRS SUPERLEGGERA AND TULIP ARE VERY DIFFERENT TO USE. YOU CAN FEEL IT IN YOUR BODY MERELY BY LOOKING AT THE PICTURES.

THE COMPUTER GAMES SIMS 2 AND GRAND THEFT AUTO ARE ALSO VERY DIFFERENT TO USE. THAT IS HARD TO TELL FROM THE PICTURES.
mulated and communicated by someone else. The idea of patterns comes from Christopher Alexander’s work in urban planning in the 1970s and it has been used in interaction design mainly as a way to capture proven standard solutions to recurring problems (so-called best practices). However, it is perfectly feasible also to summarize experiences from exploring previously uncharted design spaces in what we might call inspirational patterns, aiming at providing material for other designers to grow their knowledge.

At this point, I have argued rather extensively that design can lead to knowledge and specifically that interaction design can lead to scientific knowledge. To me, research by interaction design appears to be an interesting and exciting possibility. Two further questions thus need to be addressed. First, what is required of a designer/researcher in an academic environment? Secondly, what could interaction design research be like?

The first question essentially concerns design ability. If the goal is to construct scientific knowledge, is it then necessary to be a good interaction designer? The history of the discipline suggests that design ability is not essential. A recurring argument from the field of experimental HCI research (strategy 1, above) is that a design that is tested empirically with users can be incomplete and deficient in many ways, as long as the parts relevant to the research question are realized in an acceptable way. This argument strikes me as questionable, since I would assume that users participating in an experiment are affected by the whole situation, including the incomplete and partially unacceptable prototype, even though the purpose is only to test, say, a new way of navigating certain information structures. Moreover, testing an isolated part of a product in a situation that is not very similar to the intended use situation seems like an unreliable way to gain insights on the qualities of the product in actual use.

In the strategies 2 to 4 above, the designed artifacts are themselves essential parts of the knowledge contributions. It seems obvious that they need to be of acceptable design quality. The fifth strategy, where the designer/researcher facilitates a participative design process, normally requires that she provides expert knowledge on the properties of the digital materials as well as a rich repertoire of design examples of relevance for the design situation in question.

It would appear that design ability is an asset for the designer/researcher, even a requirement for some of the strategies identified above. More generally, the task of assessing design quality would befall the scientific community along with the assessment of other aspects of the knowledge contribution. But doesn’t that imply a chicken-and-egg situation? Design is not an established part of the scientific community and the knowledge needed to assess design quality is not very well represented in the body of knowledge maintained by the community.

However, this does not imply that the necessary assessment knowledge is nonexistent. In interaction design as well as in other design disciplines, assessment ability is strongly related to experienced designers and their
roles in the community. Interaction design is a very young field without much apparent entrenchment, and with a strong mutual interest in bringing the design culture and the scientific culture closer together. I think there are some possibilities to make design quality into one of the routinely used assessment criteria for knowledge contributions involving design. On the other hand, such a move might be controversial since it would entail certain modifications of the prevalent power structures in the scientific community.

The second question concerns what interaction design research could be like, and I have already touched upon parts of a preliminary answer. The five strategies identified above are all examples of interaction design research, where design work plays a more or less prominent part in the actual knowledge construction. But I still see significant potential for further developing our scientific instruments and our research practices. More specifically, there seem to be four main items on the agenda of building a stronger community for interaction design research.

The notion of semi-abstract knowledge contributions must be established along with an appropriate practice of triangulating empirical, theoretical and analytical grounding. Such notions are already quite familiar to researchers with experience in qualitative research methodology, where concepts such as grounding and criticizability are part of the everyday scientific discourse.

The possible roles of the artifacts in scientific argumentation and publication practice need to be elaborated. This is most likely a concern for design research in general, but I find it particularly urgent for interaction design, and the reason is that digital artifacts are particularly difficult to re-present in »a lot of text, a few images« due to the temporal character of the digital materials.

The artifacts that are presented as parts of knowledge contributions must be assessed holistically in terms of their design quality. The danger of isolating a research question and trying to answer it through incomplete design work is that the artifact, which may be inadequate with respect to aspects outside the research question, is disseminated as a joint knowledge contribution (since design examples are easy to appropriate as wholes) and thus carries a baggage of inferior knowledge.

Finally, we need to learn from the role of the critic in more mature design disciplines, and specifically the interplay between creative practice and criticism in fields such as architecture. With a few exceptions, interaction design lacks a discipline of criticism and I would argue that a good deal of the assessment that is currently done through empirical testing of isolated hypotheses would be done better in a community that included interaction design critics and their multi-perspectival analytical assessment.

These are merely a few suggestions without any claims of completeness. However, for me they presently represent the most urgent steps towards an interaction-design research practice that would contribute even more
valuable knowledge to society on the properties and possibilities of the digital materials.

The original version of this chapter did not have any references. In order for this version to work as a standalone document, I would like to list a few key references used in the writing.


Nelson, H., Stolterman, E. (2003). The design way: Intentional change in an unpredictable world. Educational Technology Publishing. [This is where the notion of design as service comes from.]