2. Designing as a part of research

Pieter Jan Stappers

The relationship between design and research has been the subject of lively debate for a long time. There are similarities and differences between the two activities. Both contain generative and evaluative processes, often a cyclic succession of the two in an interactive process: a spiral growth of knowledge. Both lead to the growth of knowledge, insight, and possibly useful things, such as products and applications. But they differ in their aims, accepted techniques, questions of what counts as success or evidence, and the types of people and work cultures that are involved in them. In the past decades, it has become the 'received view' that research deserves a serious role in design. In design education, we see a worldwide rise in the number of universities that offer programmes in industrial design.

However, the reverse view, that design is an essential ingredient in research, has received less attention. There are several ways in which design occurs within research. First, the term 'experimental design' suggests such a way but indicates a setup (mostly from a standard collection of established techniques), not a generative activity. Second, it is acknowledged that all science involves both generative and evaluative activities. But the official signs of academic culture, its journals, stress the reporting of its evaluative activities, experiments. The generative activities that require creative thinking are only presented as a small part somewhere between the introduction and the literature review. The third way, in which the activities of designing are themselves a way of generating knowledge that is important for the progress of science, has lately gained importance. It is this last way that is the focus here.

The growth of knowledge

The activities of designing often lead to generalizable knowledge that is of no less value than the assumed certainties that come from the experimental testing of hypotheses. The contribution of designers, and of a designerly approach within research, should bring the strengths of designers to the growth of knowledge. In Delft, over the years we have found the strengths of the designer - as a type of engineer - to be the following: the ability to integrate findings from different disciplines; to communicate with experts of different disciplines; to keep in mind the interests of all different stakeholders (e.g., user, technology, business); to take decisions and make progress in the light of incomplete information; to maintain a focus on the aim (the product). These are qualities which are well respected in industrial practice, and are of value for research as well, especially in human-centred research, or other places where many different disciplines meet (or should meet).

Typical of designing is the iterative spiral of generating and evaluating, sketching and reviewing, modelling and testing, brainstorming and discussing. Especially at the beginning phases, but also throughout the process, designing is marked by its integration of ingredients (theories, insights, methods) from many diverse disciplines. It selects from these disciplines, it confronts them with each other and with the phenomenon under study, it integrates and bridges disciplines, and makes compromises (not always to the liking of people working in those disciplines). In the figure, the spiral is a vortex which sucks in insights from other disciplines. This is sometimes seen as *the* research part of designing.

But equally in this confrontation, integration, and bridge-building, design yields outcomes which are of value for these other disciplines. The vortex can throw out insights that ought to be of value if they can be caught by these other disciplines. Unfortunately, the barriers between disciplines don't always make this easy. The past generation of researchers in design have often felt that they had to make dire concessions to the design quality of their work in order to communicate their findings in the traditions of the respective 'mother disciplines'.

Central to the vortex is the advancement of the design concept(s), often – I'd like to say, preferably – in the form of prototypes. In the vortex figure, it is represented by the central arrow. Prototypes have many roles: they are the physical place where the phenomena are confronted, where the theory comes down to earth, and *all* the decisions must be made to connect to the earth, not just the ones which fit nicely within the theory. Prototypes serve as a kind of working hypothesis, not necessarily a static one that is tested and refuted or proven to be 'true', but possibly a dynamic one that is adjusted, grown, and shown to work.

Cabinet: integrating and spinning off insights through a working prototype

Ianus Keller

In his PhD research, designer and researcher Ianus Keller wanted to gain knowledge on (1) how designers use visual material in their design process and (2) what new media tools can do to support the use of visual material. During his research, Keller extensively used working prototypes as a means to integrate insights from different disciplines, to test his hypotheses on his users and to demonstrate the effect of new media on his phenomenon.

The research started out building upon the results of an overlapping earlier PhD thesis, "Designing with Precedents" by Pasman, in which the designer's use of existing previous designs was explored using a working software prototype called "ProductWorld". ProductWorld allows designers to organize existing products on different criteria and represent them in a multi-dimensional interactive space.

A series of prototypes formed the spine of this project. With his first working prototype, the "TRI" setup, Keller explored the effects of new media tools when used in a different scale and context. TRI combined previous experiences in Virtual Reality setups, creating a platform through which users could interact with computer interfaces projected on a large vertical curved screen and on a table-sized horizontal area. TRI was used in the researcher's workspace as a platform to explore interaction and the effects of new media in a working context. It was used to informally share visual material, communicate user contexts in video collages and to simulate interfaces by projecting interfaces on physical models.

The second prototype was built using the results from a contextual inquiry at five design agencies, which both in method and content overlapped and modified Pasman's earlier contextual inquiry. The prototype, called "Cabinet", was developed to specifically support designers in collecting visual materials. *Cabinet addressed the problem that designers keep two distinct collections: physical and digital materials.*

Typically, physical materials are collected continuously for inspiration without a specific goal and are often based purely on visual attributes. Digital material are gathered or scanned for a specific project or goal, often to support a presentation.

The prototype stands for an engineering goal, an effect to be achieved in the world, rather than a pure knowledge goal, a truth to be known in the mind.

Possibly more important than this confrontation with nature is the confrontation across disciplines: prototypes realize phenomena in delineated conditions, they embody processes and notions from theory and transform them into experience. As such, they enable experts from different disciplines to momentarily drop their respective jargons and frameworks and to meet in the common playing field of everyday language and experience.

Designers have known this for longer than scientists, and have produced various means of visualizing, representing and embodying ideas that would otherwise remain inaccessible to those who are not simultaneously fluent in all the relevant contributing aspects that merge in a design decision. My favourite example is the storyboard, as used in the movie industry and in interaction design: this is a visual/verbal expression tool that communicates the disciplinary concerns of literally dozens of specialists involved into a shared language, by appealing to a shared language of experience.

Magic and serendipity

Cabinet combines the physical and digital collections by making the interaction with digital material more physical and allowing for collecting digital material as easily as physical material is gathered. The digital collection is projected as compositions of thumbnails and stacks on a large table-sized surface, and the designer can organize these compositions and stacks by directly interacting with them on the surface. Physical material can easily be added to the collection by placing a physical image or object on the table and taking a photograph, using the digital camera overhead. The digitized image is then projected over the original in the same position and scale, offering a smooth and almost magical transition from physical to digital. Cabinet integrates the insights from theory and practice with the experiences from working with TRI into a working prototype that can work in practice.

To demonstrate and evaluate the value and relevance of the research, Cabinet was finally placed inside the design practice. For four weeks, three designers at well-known Dutch design firms used Cabinet in their own projects without experimental conditions. During this research the possibilities for such a radical interaction style in a directed functional tool was revealed. Apart from blurring the line between physical and digital material, the experiment also showed that designers combined their source and inspiration materials with their own sketches, concepts and drawings.

The insights from the research revealed that designers collect visual material as a way to keep themselves sensitive to the world around them. *This sensitivity enables serendipitous encounters: finding inspirational things you weren't looking for.* The insights delivered by the different prototypes are currently being applied to other tools and domains.

In its turn, Keller's research spawned partial innovations and ideas that were used in ID-StudioLab research outside of the Cabinet development. Combinations of physical models with digital projections are being explored through Daniel Saakes' research into material expressions. In addition, Remko van der Lugt and Daniel Saakes are exploring the applicability in creative group meetings of the new media interactions embodied by TRI and Cabinet.

Cabinet itself is currently in use at the ID-StudioLab as a tool for collecting visual material by researchers and as an instrument for further research. Furthermore, Keller is exploring commercial applications for Cabinet and Cabinet-inspired interaction devices with different industrial partners.

For more information visit: www.forinspirationonly.com

(Opposite page): an original, the image and archiving the images with the Cabinet

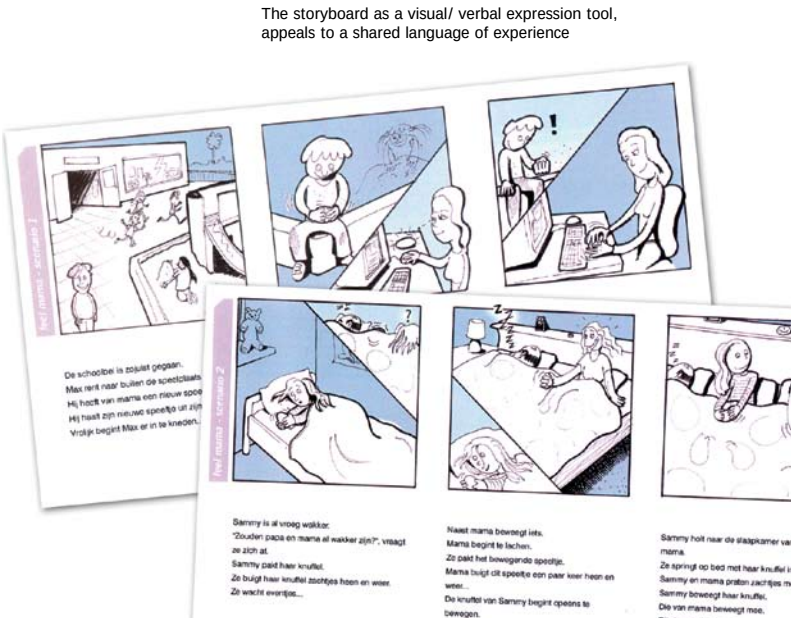
Varied and informal visualisations are characteristic of the design studio

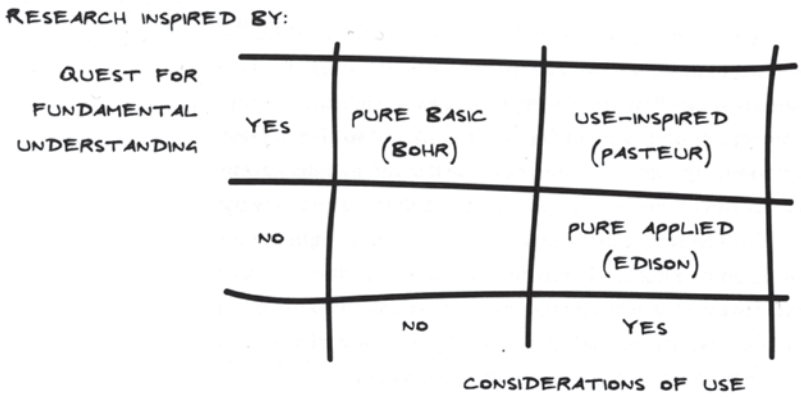
Organizing design research beyond projects

The model of the vortex, which sucks in and spins out knowledge and insights, has implications for the way we organize the practice of doing research. Many of the findings in design research (or in any research) do not get reported in the final publications. At all kinds of levels, insights on theory, technique, tricks, etc. are made which can be shared in informal ways by those close by. It is often the informal channels that work best: possibly due to the hybrid nature of design decisions, the majority of decisions are taken 'on the move', without producing a full documentation which can be frozen, and referred to later. This is the same in industrial practice, where most of the design decisions cannot be retrieved later.
A lot of knowledge tends to seep through the 'cracks between the woodwork'.

Maintaining the undercurrent of ideas, considerations, solutions, and insights-in-progress is the strength of the design studio, where different designers work, sometimes on different projects with different aims, but constantly learning from the corner of their eyes, by peeking over each other's shoulders, and by commenting on, disagreeing with, or borrowing from all these little insights buzzing about the place. We should learn more from this as we form research projects, by promoting insights to spill over disciplinary barriers, rather than restricting interactions within strictly delimited projects. Many insights are carried through informal channels, and are carried implicitly in the experience of the people involved, or get lost. In the vortex model, a studio can be a pool of different vortices, each receptive to the insights that the others spin out, and giving back in the same manner.

The storyboard as a visual/ verbal expression tool, appeals to a shared language of experience





Pasteur's quadrant: comparing different types of research (and researchers) based on what motivates them (from Keller, p. 150)

Design research between basic and applied

There is another way in which the concerns of design and research are related and thought different, and that is in their objectives. Because of its dedication to applicable results, it is often regarded as 'only' applied research, valuable work, but of short-term and local value only. In my experience, that view is too narrow, although the problem is true that 'research insights' of many design projects do not get communicated outside the project and fail to find their way back to the disciplines that ought to deal with them.

The arguments that Donald Stokes (1997) developed for the US research funding policy, shed a light on this relation between basic and applied research, helping (at least for me) towards a better understanding of the potential place for designing within research. Stokes argued as follows. In the traditional, linear view of science, popular since World War II, basic research is put at one end of the spectrum, applied research at the other extreme. Fundamental science yielded generalizable knowledge. Design research would be counted among the applied, because it is close to application and, in the linear model, generalizability and applicability are opposites. The value of applied science for the growth of knowledge would be only to provide new questions for fundamental research. Stokes argued that the linear model is mistaken, and that generalizability and applicability are not opposite poles, but rather independent dimensions on which research can be scaled. Next to the two earlier extremes, characterized by Niels Bohr and Thomas Edison, he puts Pasteur's research as an example of research that is both strongly fundamental and strongly aiming for applicability. That is where the best of design research can be located. In its aim for applicability, it can take on the phenomena head-on; in its aim for innovation and quality, its findings can be used beyond the product aim in a current project.

Conclusion

It has been noted that many of the great fundamental thinkers were heavily involved in realizing applications. Aristotle, Galileo, Leonardo, Newton, Huijgens, Pasteur, and the Wright brothers, did not confine their work to 'mere' theory or plain application. They had an'effects' agenda which drove their development of knowledge and application in unison. It is in this way that design research, designing as a part of research, and design skills within research, can make the most fruitful contribution. We haven't seen designers in research for very long. In the past decades, we've seen designers starting their way in PhDs. Let's see what they can contribute. Our expectations should not be low.

References

Stokes, Donald N. (1997) Pasteur's quadrant: Basic Science and Technological Innovation, Washington DC, USA: Brookings Institution Press