

For a long time, design and research have been two separated conceptions. They have a different meaning, but with the rise of for example interaction design, rather than just designing a product, they have become more and more related and interwoven (Stappers & Giaccardi, 2017). They still differ in the way they are (typically) conducted and the values by which their outcomes are (typically) judged (Stappers & Giaccardi, 2017). This resulted in two ways of working.

1. Articulate the aims and principles of design research (*research through design, in Stappers and Giaccardi*) (and how it differs from user studies?).

### Two methodologies

One of them involves gathering information about a specific situation and provides information for an improvement or realization of a specific product or service in a determined situation. This method is called Research for Design, or in short RfD, since research is necessary in order to design a product (Stappers & Giaccardi, 2017). The second one involves designing for a general research question in order to retrieve and generate general knowledge and/or theories to get more information about broader phenomena. This information is meant to help for example, other designers. This method is called Research through Design or short RtD, since it uses a design to conduct research (Stappers & Giaccardi, 2017).

### Elaboration and differences

As one can see, there is a significant difference between those two methodologies. One of the most important differences is the outcome of the study and along with that the goal in mind while executing the study. RfD studies are searching for information that can apply to a related implementation of a specific product or service, often the user or human is centralized in this kind of method (Stappers & Giaccardi, 2017). However it does not involve usability testing (Bekker, 2018), since the studies are still focused on the discovery of knowledge and usability testing is focused on existing personal opinions and knowledge of users to improve a product.

RtD studies on the other hand want to generate general knowledge about (complex) situations. The knowledge is more widely, it affects more products, different contexts and other people (Bekker, 2018). It generates information that other designers can use in their products and services (Stappers & Giaccardi, 2017). Besides it answers questions that may concern designs, but it is not intended to improve a specific design.

The difference in goal and outcome of the two methodologies does also affect the way of working and with that examining a theory and the use of prototypes or artifacts in the design. Because of the difference in desired outcome, the tested theory is also formulated in different ways. Whereas in RfD studies a very specific theory about a function or application is examined, in RtD on the other hand the stated theory is way more general.

RfD is focused on an existing concept or theory and along with that a prototype (Stappers & Giaccardi, 2017). The prototype is used to examine amongst others, feasibility and user requirements (Stappers & Giaccardi, 2017). It is a fixed prototype in some way since it is more or less depending on the specific

situation. The prototype or artifact is used to gather more knowledge about the prototype or product itself.

In RtD the artifact has an important functionality in the research process. The research is not about developing the artifact itself, at least not for product purposes, but it is used to realize the (inter)action that is studied (Stappers & Giaccardi, 2017). Because of the artifact this (inter)action becomes observable (Stappers & Giaccardi, 2017). When the research proceeds the artifact can be adjusted or reshaped iteratively to keep addressing the desired (inter)action (Stappers & Giaccardi, 2017). An example of this can be seen in *How does increasing the time needed for opening a private message influence the threshold for reading a message?* (Bonekamp, Janssen, Rathke, Roelen, Stevens, 2019). The prototype that was first to be used is changed to a simplified representation of the prototype, that still realized the interaction that was desired to study.

2. Describe the properties and the strengths and weaknesses of qualitative, quantitative and mixed-methods approaches to design research.

There are three approaches to design for or through research: qualitative, quantitative and a combination of these two, called mixed methods (Cresswell, 2014). These approaches cannot be seen as different and distinct categories, but rather as a tendency towards one another where mixed methods is obviously in between (Cresswell, 2014). Every research approach has different properties, and those properties influence each other.

Often a research starts with a question or issue, the problem that comes from a void in the literature (Cresswell, 2014). Different research questions demand different approaches, since the kind of answer to a research question can differ as well. Searching for a correlation between measurable variables requires another approach, and thus design, then understanding a phenomenon or concept.

### **Quantitative approach**

The quantitative research approach focusses on experimental research. It seeks to determine if specific treatment influences an outcome (Cresswell, 2014). It is also used to test a theory and is based on finding correlations between data attributes. A group is giving a special treatment and is then compared to a control group (Cresswell, 2014). Data used in this research approach is gathered from surveys and observational and statistical data (Cresswell, 2014). Surveys contain instrument based questions, so closed ended questions or questions with limited answer possibilities. The data gathered is then statistically analyzed to determine if there are correlations between different attributes (Cresswell, 2014).

Specific questions need a specific approach to receive a desired answer. The type of research questions that can be answered using the quantitative approach are about the relationships among variables (Bekker, 2018). Those variables are determined and specific and are also stated in the research question this way. The quantitative research question can also contain a hypothesis that has to be examined (Bekker, 2018). When answering a specific question involving relations between two variables, the quantitative approach has some strengths and advantages compared to the other two research approaches. For example, when a correlation has to be examined or a theory has to be tested (Cresswell, 2014). Quantitative studies involve a lot of participants, which makes it possible to generalize

a theory. The large amount of statistical data can be the foundation of a conclusion, which can ensure an outcome as well. An example of this large amount of participants can be found in *Are tangibles more fun?: comparing children's enjoyment and engagement using physical, graphical and tangible user interfaces* (Xie, Antle, & Motamedi, 2008), where 132 children were examined.

A disadvantage is that in order to obtain this amount of data, an examiner needs a lot of participants and a representative sample has to be made (Cresswell, 2014), which can be time consuming. Furthermore, participants are less able to express and explain themselves since a survey or questionnaire gives quite limited possibilities for participants to give answers or suggestions other than the stated questions (Cresswell, 2014).

### **Qualitative**

The qualitative research approach focusses on the exploration of a specific phenomenon and finding patterns (Cresswell, 2014). This is done by focusing on a smaller amount of people than in the quantitative approach, but more individual and personal. It can be used to answer specific qualitative questions that include terms as 'what' or 'how' to indicate and open design (Bekker, 2018). It can be used if a researcher does not know what important variables are to examine, since it is more exploring (Cresswell, 2014). The mixed approach goes along with a research question that contains two phases, looking at both the quantitative and qualitative aspects of the problem, or that contains one phase, the most important one (Bekker, 2018).

Participants are interviewed rather than surveyed, this makes the researcher able to make the interview suitable to a certain participant (Cresswell, 2014), in order to get desired answers. This can be seen as an advantage of the qualitative approach. The researcher uses open ended questions (Bekker, 2018) in order to only send the participant in the right direction in order to let the information come from the participant itself. An example of this can be seen in *"I don't Want to Wear a Screen": Probing Perceptions of and Possibilities for Dynamic Displays on Clothing* (Devendorf et al., 2016), participants are asked about their visions on the technology and all interviews are personal. Another advantage is that the examined question does not require any sample or existing research (Cresswell, 2014).

A disadvantage of the approach is that it cannot investigate large processes and theories and generalizing is also more difficult. That is because the qualitative approach uses far less participants in order to collect data. Which makes it easier to gather participants.

### **Mixed methods**

When both approaches are insufficient on their own to understand a problem, one can combine them. The strengths of both approaches can lead to a better understanding of the question or problem (Cresswell, 2014). For example, a researcher may want to generalize the findings to a population as well as develop a detailed view of the meaning of a phenomenon or concept for individuals (Cresswell, 2014). A researcher could first survey a large amount of participants, make samples and groups and afterwards zoom in to a few individuals to ask about their view of the topic (Cresswell, 2014).

It can give insight in relations or themes that otherwise would not become clear, but it is obviously more time consuming.

Altogether, different research questions require different approaches to solve a problem or obtain knowledge. The approach to the research question influences the methodology of these approaches in turn. Depending on the goal of the question and the desired outcome, an approach and study design is chosen, considering the different strengths and weaknesses.

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