

What is this thing called “design” in design research and instructional design

Johannes Cronje*

Faculty of Informatics and Design, Cape Peninsula University of Technology, Cape Town, South Africa

(Received 9 October 2012; final version received 28 January 2013)

This paper will consider the phenomenon of design research. It will then consider four research positions in social science research. The paper will show how the design perspectives map onto the research paradigms and how by rotating through these paradigms, a design research cycle is formed. Finally, the paper will discuss four research questions that drive design and development research and illustrate this by way of a case study.

Keywords: design research; research design; iterative design; design paradigms

1. Introduction

In an academic environment where the production of creative outputs and academic research are often regarded as mutually exclusive, design research presents a useful tool for extracting publication value from the production process. The premise on which this article rests is that four of the perspectives of design thinking, as described by Rowe (1987) can be mapped directly onto Burrell and Morgan's (1979) four paradigms of social research, and that by addressing these paradigms sequentially a design research cycle is formed that follows the four stages described by van den Akker (2007).

2. Literature survey

Van den Akker (2007, pp. 45–46) distinguishes four stages in design research: Preliminary investigation, Theoretical embedding, Empirical testing; and Documentation, analysis and reflection on process and outcomes. Preliminary investigation amounts to a systematic search of a particular context for elements and connections, through literature surveys, case studies, etc., to arrive at an overview of the needs and problems of the intended users. Theoretical embedding relates to coming to an understanding of the rationale of the potential solution. Empirical testing determines the practicality and effectiveness of the intervention, while Systematic documentation, analysis and reflection on process and outcomes amount to a reflection of what has been achieved in order to strengthen future development. Of course it is easy to see that Van den Akker's framework can be cyclic. What is learnt from the analysis

*Email: johannes.cronje@gmail.com

in the last phase feeds into the primary investigation of the second phase. Nevertheless, it is absolutely possible to consider each of these phases in isolation.

Rowe (1987) presents a framework of four design positions that architects take in their design of spaces:

First there is a *functionalist* position, distinguished by an emphasis on the accommodation of activities and the influence of building technology. Secondly there is a *populist* position, characterized by an acknowledgement and interpretation of contemporary commonplace building practices and user preferences. Third, there is a *conventionalist* position, using a largely historical reference; and finally, a *formalist* position, using an architecture of formal possibilities for their own sake (Rowe, 1987, p. 124).

If one analyses Rowe's four positions along two dimensions, they would fit onto on a 2×2 matrix, as is shown in Figure 1. The first dimension relates to the existence or absence of a "best solution". At the one extreme of the dimension is the conventional belief that there is one implied best solution to a problem and that regardless of whether or not that solution can be achieved, reaching it remains the ultimate functional goal. At the other extreme is the belief that there may be an infinite number of solutions and that these solutions are dependent on an infinite number of contexts. These contexts could relate to people (populist) or to form (formalist).

The second dimension relates to the abstract or concrete nature of the design problem or message. At the abstract extreme lies the formalist desire to follow the possibilities that the form presents and the conventionalist practice of using a set of abstractions that have developed over time. At the concrete extreme lies the practical reality of popular acceptance or functional use.

Burrell and Morgan (1979) propose four mutually exclusive paradigms of social science research, postulated on two orthogonal dimensions. The dimensions are the nature of social science research and the nature of society. The nature of social science research varies between positivist and anti-positivist. It is my contention that the positivist dimension might also be called the objective dimension. The nature of society ranges from a society of regulation to a society of radical change. One could argue that the society of radical change is concerned with abstract views of reality, while the society of regulation tends to be concerned with more concrete realities. The end result is a two-by-two matrix as is shown in Figure 2. The following section will describe each of the paradigms in one sentence, and give my interpretation of the *aim* of each of the paradigms.

Radical humanists aim to *explore* alternatives. They are interested in the subjective world, but feel the need to transcend or even overthrow current societal arrangements. Interpretivists aim to understand and *explain* alternatives. They

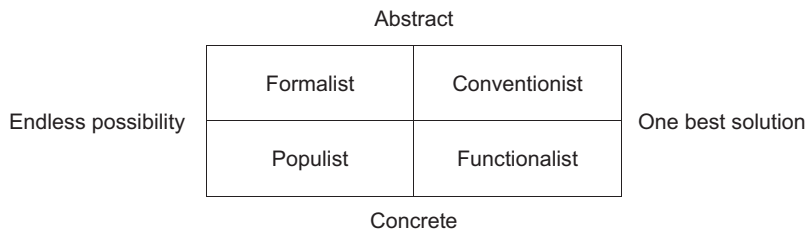


Figure 1. Four design positions – developed from Rowe (1987).

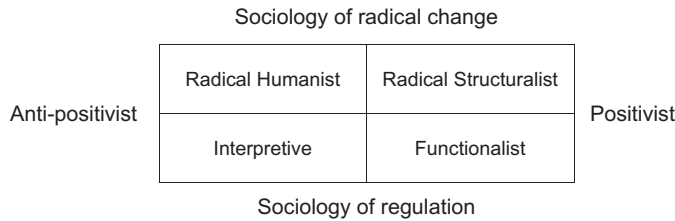


Figure 2. Four paradigms for the analysis of social theory.
Source: Burrell and Morgan (1979, p. 22).

believe that the human experience of the world is subjective, and they have a concern to understand it as it is. Functionalists aim to *develop* solutions. They believe that the world is objectively discoverable and that things can be improved by “tightening up” the rules. Radical structuralists aim to *describe* the position as it is. They have an objective world view. They concentrate on structural relationships, believing that radical change is built into the very nature of society.

Roode (1993) uses Burrell and Morgan’s model to argue that research questions and methods can be developed for each of the paradigms, and that such research could take place sequentially through each quadrant to form a framework for process-based research. He identifies four research questions that could be asked *What is; how does; why is; and how should?*

Roode’s questions map directly onto Burrell and Morgan’s model if one were to associate *How should?* with the positivist dimension, and *How does?* with the anti-positivist. *What is?* Relates to a society of radical change, because “In a society of radical change, it is essential to know what the current situation is, so that it might be overthrown or transcended” (Cronje, 2011, p. 4). *Why is?* goes with a society of regulation because “it is essential to know what the rules are meant to achieve” (Cronje, 2011, p. 4).

It is now possible to generate one combined matrix of design thinking and design research in the social sciences, by combining all the positions discussed thus far (Figure 2).

The model described in Figure 3 shows a related set of design positions, research aims, research paradigms, and research questions. Burrell and Morgan’s assertion that these paradigms are mutually exclusive would imply that one can do

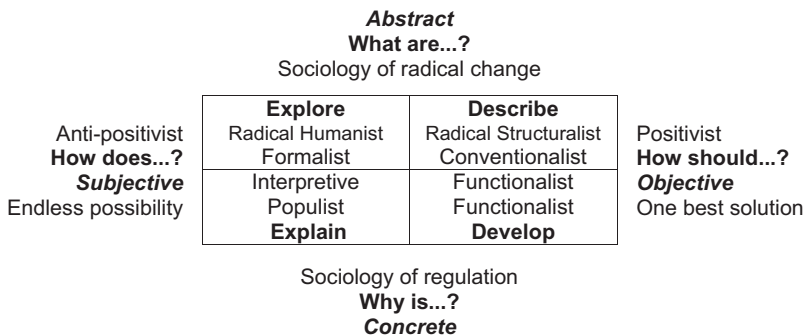


Figure 3. Research aims and research questions.

only one research project at a time. Roode (1993), however, advocates that although one can only work in one paradigm at a time, it is certainly possible to work in each paradigm sequentially. In determining the sequence in which these paradigms could be addressed, Van den Akker's (2007, p. 45–46) stages of design research: *Preliminary investigation*, *Theoretical embedding*, *Empirical testing*; and *Documentation, analysis and reflection on process and outcomes*, become relevant. *Preliminary investigation* amounts to an exploration of terrain, and would, therefore, map onto the "Explore" quadrant of Cronje's (2011) combined model. Since a theory is meant to explain, the *Theoretical embedding* phase would map onto the "Explain" quadrant, while *Empirical testing* amounts to development. Finally, the *Documentation, analysis and reflection on processes and outcome* map directly onto the "Describe" quadrant (Figure 4).

If the wheel described in Figure 4 was turned in an anti clockwise direction it would generate a spiral pattern that cycles through the four design activities. Such a cycle would closely match the one described by McKenny (2001) shown in Figure 5.

The question now remains, "what happens in each of the cycles?"

3. The relationship between research and design in design research

As was stated in the introduction the central problem driving this study lies in the integration of design and research. The solution lies in separating out two streams a design stream and a research stream. What this means is that research will be the result of design, and design will be the result of research, as is illustrated by Figure 6.

In order to clarify these processes, one could use some poetic license and replace the word "develop" with "build". It could be argued that nothing can be described unless it has been tested. A graph or histogram, for instance, is the plotted result of some test or another – so "describe" might be replaced with "test". Similarly to

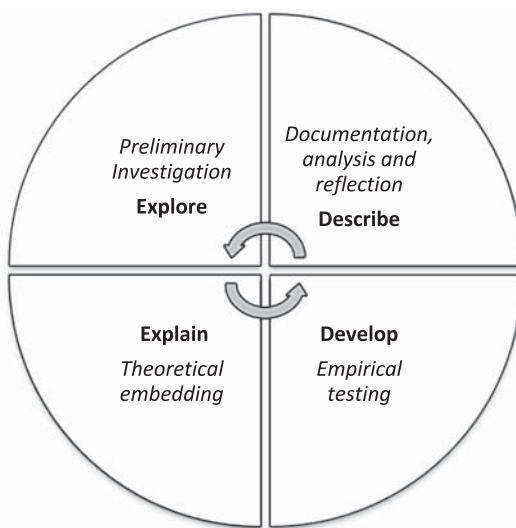


Figure 4. The design research cycle.

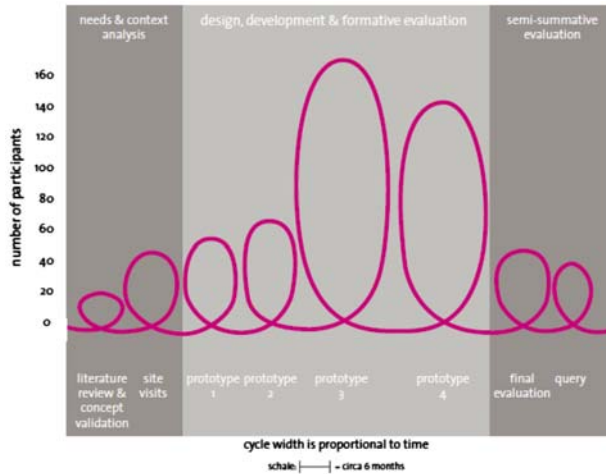


Figure 5. A typical design research cycle (McKenny, 2001).

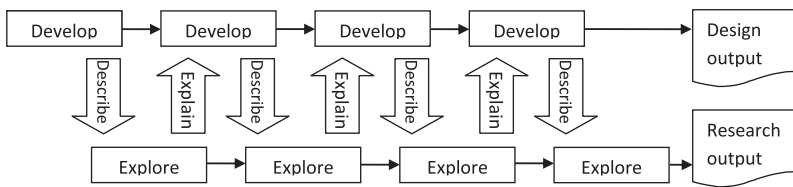


Figure 6. The design-research cycle.

explain really means to apply knowledge to a context. And by some stretch of the imagination, it could be argued that the end product of any exploration is learning. We explore to learn what is there. Thus, by replacing the words *develop*, *describe*, *explore* and *explain* with *build*, *test*, *learn* and *apply*, respectively, a very simple model can be developed of a process in which design and research are two parallel streams, connected by testing and application (see Figure 7).

4. The bigger picture

Figure 8 shows the cycle with the new verbs included. The aim of the preliminary investigation phase is to explore the terrain so that the researcher can learn (or get to know) the basic issues that come into play. Once those issues are on the table,

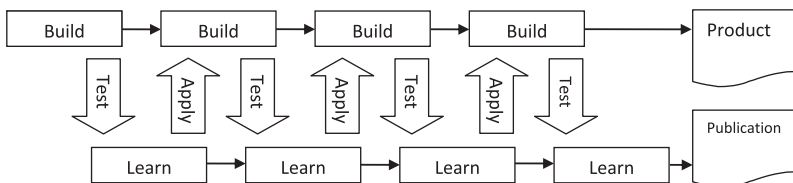


Figure 7. Build, test, learn, apply.

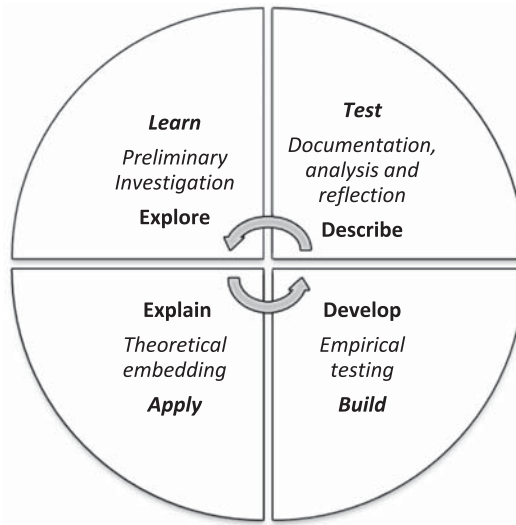


Figure 8. The revised design research cycle.

the aim of the phase of Theoretical embedding is to apply those issues to theoretical situations in order to explain them. Once this is done the aim is to develop a prototype that will be built to perform an empirical test of the theory.

The complete research design/design research model is shown in Figure 9.

5. Worked example

Say one wants to design a solution for disadvantaged single mothers in a fragile community. One could then start the cycle at “Learn”. One could ask “What are the problems confronting single mothers in a fragile community?” and, “How do these mothers cope with those problems”. This would lead to an exploration of the problem, from which the researcher would learn about those coping skills. The question could then be modified slightly to “How do various mothers cope with different situations, and why do they do so differently?” This would allow the researcher to explain how the knowledge acquired can be applied. The next phase

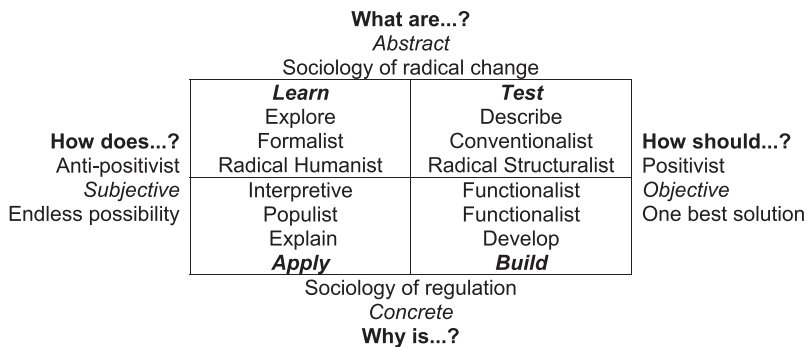


Figure 9. The research design/design research model.

would be to develop a solution by asking “Why do the various solutions satisfy (or not satisfy) the needs of the users, and how can these be automated or scaled up?” The answer to such a question would give rise to the design and development of a solution. Finally, the question will be “How should the designed solution impact the lives of the users, and how does it, in fact do so?”

The result of this subtraction sum will be some kind of description of the result of the investigation and amount to an evaluation of the design. The first design research cycle will now have been completed, and the next question would be “What problems have not been solved by the solution (or what new problems have been caused)? And, how do these problems affect the users?” And the story continues.

6. Case study

The domain of jewelry design is arguably one of the fields in which one is most likely to encounter the argument that the creative output stands on its own and that there is very little evidence of research. Moreover, when a specific piece is entered into a competition and wins such a competition, one could argue even further that such a piece constitutes a peer-reviewed output and thus the outcome is equivalent



Figure 10. The prototype (Oberholzer, 2006).

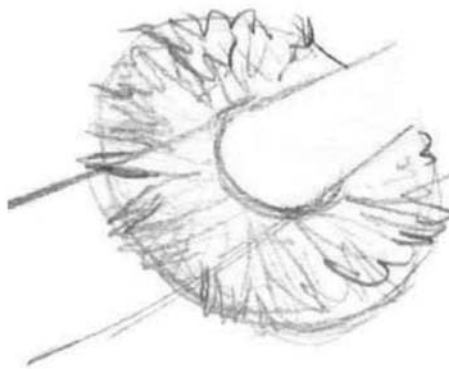


Figure 11. The visual analysis (Oberholzer, 2006).

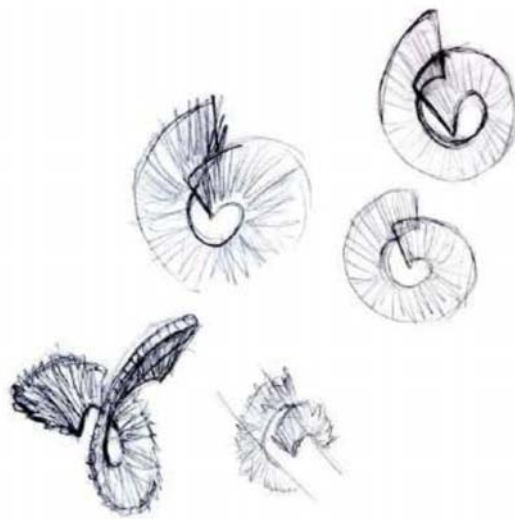


Figure 12. Further exploration (Oberholzer, 2006).

to a research output. However, as this article has pointed out thus far the production process and the research process run parallel. This brief case will explain.

The story begins when Oberholzer, in her final year of study was faced with the challenge of designing a unique, avant garde piece of jewelry. The piece had to explore the boundaries of gold as a medium, as well as explore contemporary issues in design and society.



Figure 13. The award-winning piece (Oberholzer, 2006).

In this instance, the first step in the process was exploration. The two research questions were “What reference materials are out there that could act as inspiration for a unique jewelry design?” and “How do these elements combine to form interesting patterns?” The first question is very wide, as is the case in the exploration

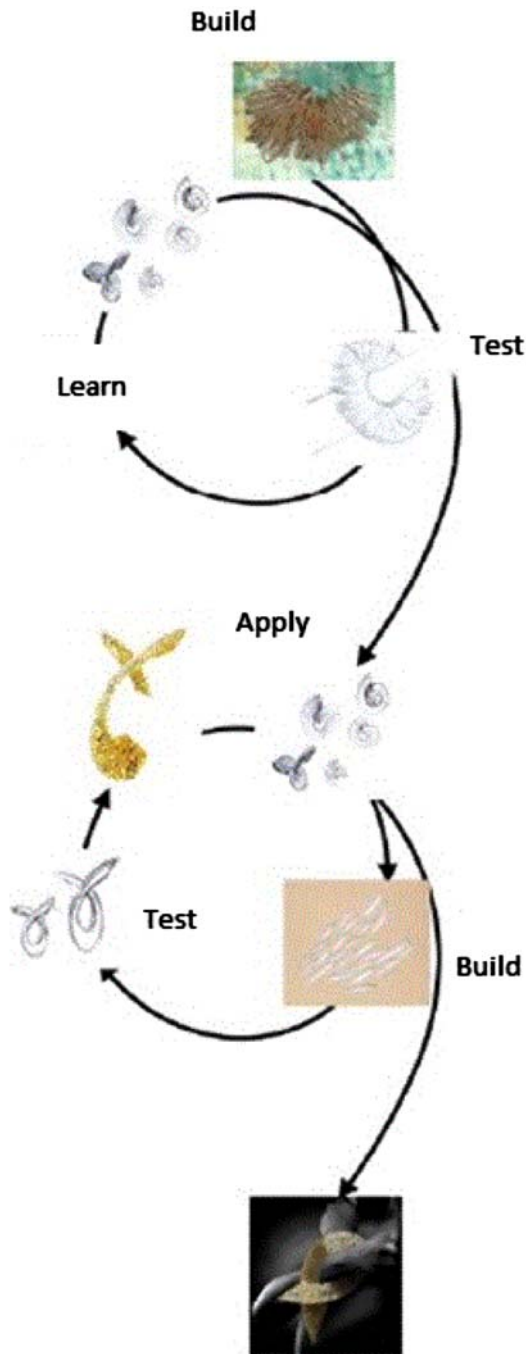


Figure 14. The design research process in the case study (Oberholzer, 2006).

phase. The second question therefore acts as a filter. The question was limited further by narrowing down the reference material to organic materials and then to plant material. The research method was observation and experimentation. From the various plant materials selected, the designer eventually settled on some blades of dried grass. These were spread out in various ways, and the results were observed.

Once the exploration was over, the next phase was to understand the possibilities and constraints of the medium. Working in the *understand* quadrant. The second question remains the same, but now, a concrete question is added, which is “Why do some combinations work better than others?” The research method involved experimentation and observation, as well as sketching in pencil. Once the designer had reached an understanding of the combination of the elements from the sketches it was time to move to the *develop* quadrant. Here, the next question was added: “How should these designs be translated into gold”. The method was experimentation and observation by constructing a prototype as is illustrated in Figure 10.

Once the first prototype had been constructed, it was analyzed in the “describe” phase. The question that was added this time was “What are the visual possibilities of converting the prototype to a bangle?” The method was to sketch, and the output is shown in Figure 11.

The visual analysis showed that, while it was possible to form the shape into a bangle of sorts resulted in a flat surface. Further exploration would be necessary, and thus, the second phase in the design research cycle commenced with a number of sketches to answer the next question. This time it was decided to add a social dimension to the research. The two questions now were “What are the current social issues that could be explored to assist in finding a relevant shape” and “How do these shapes function when they are transformed into jewelry?” The social issue that was eventually selected was HIV and AIDS, and the visual image of the “Aids ribbon” was used as a guiding principle, as can be seen in Figure 12.

After the exploration, there was a need to understand why the prototype was still not visually developed. The question was “Why does the prototype still seem unchallenging” The answer lay in the fact that it was a too obvious representation of the original leaves of grass. More development in followed with the question “How can the situation be reversed” and the answer lay in emphasizing the negative space. From this refinement, then, came the final brief to the manufacturer which resulted in the award-winning piece shown in Figure 13.

7. Conclusion and recommendations

The process as described by the case study is illustrated in Figure 14. From this it can be seen that the iterative design process does indeed allow research findings to be distilled from the development of the product. It is recommended that students be encouraged to diarize their reflections during this process and in doing so develop a culture of design research.

References

- Burrell, G., & Morgan, G. (1979). *Sociological paradigms and organisational analysis*. London: Heinemann.
- Cronje, J. C. (2011, March). *The ABC instant research question generator*. Paper presented at the 4th Building the scientific mind colloquium, Stellenbosch, South Africa.

- McKenny, S. (2001). *Computer-based support for science education materials developers in Africa: Exploring potentials. Doctoral dissertation*. Enchede: University of Twente.
- Oberholzer, I. (2006). *'n Ontleding van die rol wat formatiewe evaluasie in die rol van kritiese denke het* (Unpublished B.Tech essay). Peninsula University of Technology, Cape.
- Roode, J. D. (1993). *Implications for teaching of a process based research framework for information systems*. Department of Informatics, University of Pretoria, 0002, Pretoria, South Africa.
- Rowe, P. G. (1987). *Design thinking*. Cambridge, MA: MIT.
- Van den Akker, J. (2007). Curriculum design research. In Tjeerd Plomp & Ninke Niveen (Eds.), *An introduction to educational design research*. Amsterdam: SLO.

Copyright of Educational Media International is the property of Routledge and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.