Developing design research: the study of research as a tool for research

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Abstract

This paper will propose that learning - as occurring in all those circumstances whereby agents have an uncompleted understanding of the context in which they operate - has been an effective driving force that has characterised the reflection on design research itself. Some “forms of research” as “forms of learning” acquire even greater importance in those evolutionary environments - intended in the most generic terms - where heterogeneous agents display different forms of rationality, where there is a persistent appearance of novelties deriving from technological, behavioural and organisational innovations driven by the agents themselves, where out-of-equilibrium interactions may frequently occur among the agents. The general key to approach the theme shall be that “learning as a form of research” entails cognitive activities of construction and modification of mental models and behavioural patterns. But as learning may happen in different cognitive and behavioural domains as well as occurring through different processes, a significant emphasis shall be put on those strategic sites for design research that best perform this “learning as research” function in terms of:

• potential skills to capture key aspects of design research development,
• potential skills to manage the complexity of design issues deriving from the technology-society interaction.

The purpose of this work is intended as an informal reflection on the learning processes in design research. While trying an ideal framework for this reflection, an attempt will be made to stress the relevance of the Ph.D. programmes as research strategic sites, where crucial efforts are concentrated to produce collective learning. Observations derived from empirical experience stem from the research context of the Ph.D. programme in Industrial design of Politecnico di Milano. The parts of the paper focusing on this programme experience have limited generalisability.
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The knowledge gap and the problem-solving gap

In its wider sense learning may occur in all those circumstances whereby agents have an uncompleted understanding of the context in which they operate. Such an imperfect understanding may be “due to lack of information about it, or more fundamentally, to an imprecise knowledge about its structure: or, when they master only a limited repertoire of actions in order to cope with whatever problem they face - as compared to the set of actions that an omniscient observer would be able to conceive: or, finally, when they have only a blurred and changing understanding of what their goals and preferences are” (Dosi, Marengo and Fagiolo 1996: 2). Learning, so defined, can be thus recognised as one of the ubiquitous characteristics of most economic and social environments.

A fundamental aspect of learning regards most often cognition (Dosi et al. 1996: 10), that is to say the process by which decision makers form and modify representations in order to recognise some sense of a reality which is generally too complex to be fully understood. As a consequence a systematic gap is usually identified between the agent cognitive abilities and reality itself, the gap taking at least two forms: a knowledge gap (involving incomplete or wrong representations of the environment) and a problem-solving gap (between the complexity of the tasks to be faced and the agents’ ability to cope with them). A similar concept is introduced as “C-D (competence-difficulty) gap” (Heiner 1983).

Here, it is assumed that design research - as developed within academic contexts - experienced a knowledge gap in the last decade, a decade when the pace of contemporary industrial production dramatically accelerated, and a progressive, impressive shift in the nature and structure of industrial and social organisations took place. Turbulent, uncertain and evolutionary environments have driven industrial systems to quickly adapt to changes while ensuring in any case effective organisation; markets have evolved in unforeseeable and unstable ways, and most organisations have started learning to evolve in uncertain environments.

It is also assumed that - somehow adapting to turbulent environments - the domains of design research are now slowly progressing from a knowledge gap to a problem-solving gap. The expected sense and nature of design research will be consistent with its capability to face both a knowledge gap (improving the cognition of a complex reality) and a problem-solving gap (improving the competence and skill of agents having to face that complexity). In other words, it is proposed that the part of design research developed within our academic contexts is now slowly shifting from a condition of “substantive uncertainty” - a lack of isomorphism between the complexity to be faced and the agent’s model of that reality, as in Dosi and Egidi (1991) - to a “procedural uncertainty”, with or without substantive uncertainty.

As a premise for this reflection we will concentrate on the question: how cognition about design research may be formalised within academic contexts?

To approach some temptative answers we shall move within limited borders:

(i) we shall consider the past and present experience of the doctoral research in the domains of design at Politecnico di Milano as the empirical horizon for this reflection;
(ii) we shall assume as appreciable theories of reference the fields of technological and organisational learning;
(iii) referring to extra-disciplinary fields will imply a level of generality.
An empirical background: from “searching” to “learning how to make research”

A Ph.D. programme in industrial design in Italy was first opened by Politecnico di Milano in 1990. At that time the domains of research were mainly centred on large scale innovation-related phenomena, usually developed from a theoretical angle. Furthermore, proposed areas of research and training programmes overlapped. Similarly, no clear separation could be identified between subjective reflection and objective search.

If it is true that, “in the shortest form, research is a way of asking questions” (Friedman 2000: 18) we dare say that paradoxically a form of search was experimented in absence of a clear set of questions.

As Friedman (2000:19) further observed: “What distinguishes research from reflection? Both involve thinking. Both seek to render the unknown explicit. Reflection, however, develops engaged knowledge from individual and group experience. It is a personal act or a community act, and it is an existential act. Research, in contrast, addresses the question itself, as distinct from the personal or communal. The issues and articulations of reflective practice may become the subject of research, for example. This includes forms of participant research or action research by the same people who engaged in the reflection that became the data. Research may also address questions beyond or outside the researcher”. The approach to design research opened by our very first Ph.D. programme seldom exceeded the reflection borders.

This approach was motivated by various factors, partly internal to the dynamics of the discipline of industrial design as articulated by the programme itself, partly deriving from the historical approach to design studies that had been developed within the school, and again partly depending on the perception of the growing complexity of the innovative process in the nineties - a systematic gap in the definition we used above.

A relevant number of investigations carried out within the doctorate emphasised the importance of technological change, orienting the direction of conceptual analysis towards systemic, evolutionary, complex approaches. Whatever the motivations for the analysis of technological change and innovation, this field of enquiry highlighted the factors and fundamental ingredients of the process of development and transformation of industrial products, services and systems, around which the doctoral programme was activated as a pole of concentrated theoretical reflection. Moreover, as a starting point, a broad view of innovation was assumed, considered as a dynamic process related to achieving competitive advantages involving the development or improving of new products, services, technology, processes, institutions, systems, solutions. This view of innovation encompassed not only science and technology, but the range of economic and social activities competing in the marketplace and relevant to design in areas such as communications, corporate organisations, education, institutions.

Research addressing research

In 2000 the Ph.D. programme was radically revised from the former intention and training articulation, adopting the overall idea of the Ph.D. programme as a highly advanced, partly taught programme in design research. The present doctorate programme task was elaborated as the training of a high profile researcher, whose aim is to develop design research either in academic or industrial contexts. Relevant steps connected with such a training are the refinement of analysis techniques, the development of critical abilities, the organisation of an original contribution to the knowledge in technological and industrial culture, the proposal of innovative approaches and visions of the theory and practice of industrial design and multimedia communication and the
building of increasing skills in research planning, research strategy building and research management.

In the continuity with the activity carried out in the previous decade, the complex of issues investing the theme of innovation still represented the conceptual trajectory of the whole programme. As before, an extensive approach allowed to be open to that horizon of activities and entities (communication, firm strategies, dynamics of the market, education and public institutions) that are part of the area of action of industrial design as physical or immaterial artefacts themselves.

In doing that, attempts were made to foster interpretations of innovation and its relationships to social, technical, organisational factors on one hand, and market processes on the other, arguing that such interpretations are essential for the understanding of differences in the mode and degree of innovativeness and, specifically, for the understanding of the role of design as a discipline and design research as a coherent component of that discipline.

Although a strong element of continuity with the past still marked the nature of this Ph.D. programme, the transition was obvious when the training programme moved from the overall intention of “searching in design” to that of “learning how to make research in design”. Moreover, this research activity is expected to go “beyond or outside the researcher” (Friedman 2000: 19). Such a transition is now generating a form of knowledge - addressing the core questions of the nature of design research itself - that the training programme had never known or experienced before.

**Learning from experience, anticipating experience**

The process of learning and the nature of knowledge may not be necessarily completely understood: nevertheless, there is wide agreement that knowledge creation requires experience. Kolb's (1984: 38) definition of learning as "the process whereby knowledge is created through the transformation of experience" offers a perspective in this direction, while emphasising the relationship between experience and knowledge as a dynamic process of continuous reproduction and regeneration. Friedman (2000: 13) recalled that, as Bunge suggests (1996:104-107), knowledge arises through the interaction of many forms of learning. Thinking, experience and action all are part of a process. Moreover, a fundamental distinction between information and knowledge (reported by Dosi et al. 1996: 23) states that while information entails codified propositions about states-of the world (know-what), properties of nature (know-why), identities (know who), explicit algorithms on how to do things (know-how) (Lundvall 1995), knowledge includes cognitive categories, codes of interpretation of the information, tacit skills, search and problem solving heuristics (Dosi et al. 1996: 24).

That is the definition of knowledge that more broadly includes visions and rules of search common to most activities of scientific discovery or technological and organisational innovation. Furthermore, Dosi et al. (1996: 24) state that “In this definition, knowledge is to varying degrees tacit, at the very least in the sense that the agent itself, and even a very sophisticated observer, would find it very hard to explicitly state the sequence of procedures by which information is coded, behavioural patterns are formed, problems are solved”.

The static model of learning as acquiring knowledge external to and independent of the learner is contradicted: human knowledge is not only the product of past experience, but also the product of anticipating the future. Knowing things involves feedforward as well as feedback, anticipating how things may be conceived and used in the future.
We believe that the process of learning in design research may positively be coherent with these observations and such an approach might significantly benefit from that branch of cognitive studies focusing on the nature and changes of categories and mental models (Johnson-Laird 1983, Lakoff 1987, Margolis 1987, Holland 1986, Bateson 1972).

To paraphrase some of the above statements, an elementary level of cognition of the sense of design research may thus take place at least:

(i) when an imperfect understanding of the (relative) world is recognized;
(ii) when actors involved are aware they can master a limited repertoire of research actions;
(iii) when actors are aware that design research goals may change in progress;
(iv) when thinking, experience and actions interact;
(v) when experience is both transformed and anticipated.

**Visions of learning dynamics**

It is also proposed that a number of basic regularities on cognition, decision-making and learning - stemming from contributions outside design disciplines (for example Bateson 1972, March 1994, Nelson 1993 and 1994, Kauffman 1993, Freeman 1982, David 1975, Thomson 1993, Winter 1987, Simon 1988, Nelson and Winter 1982) - could be among the building blocks of emerging theories of design research, so to open the horizon of its learning dynamics.

Moreover, in our opinion, a further general hypothesis may take shape: the one stating that learning through design research entails cognitive acts of construction and modification of conceptual and behavioural patterns hardly reducible to well defined problems.

The above hypothesis reminds similar observations developed around the experience of management facing product development in changing environments, where two sharply contrasting approaches - analytical and interpretive - can be detected (Lester, Piore and Malek 1998: 88-89). Although both approaches are valid, each serves different purposes and asks for different skills.

Under the analytical approach the design of a new product is essentially seen as a problem that has to be solved. A clear objective, identifiable resources, constraints are the factors that need to be integrated in some optimal combination presumably leading to an ultimate solution.

But not all product development can be accommodated within a structured analytical framework: cases are given in which non-preexisting needs are detectable, while product features emerge from back-and-forth interactions, on going give-and-take between companies and customers: to say it differently, nothing is fixed at the outset. When such a degree of uncertainty is assumed, product development is an open-ended process rather than a problem-solving project, whose aim is to interpret a situation while discerning possibilities instead at aiming at a definite solution.

We leave as an open question the hypothesis of a similar “interpretive” approach suitable for design research.

**Sites for research accumulation**

Dosi et al. recognized (1996: 27) that a relevant achievement in understanding the functioning of contemporary systems of production and knowledge accumulation has involved taxonomic exercises (Pavitt 1984), trying to map families of technologies according to their sources of innovative knowledge, while implicitly recognising firms as major, albeit not unique, repositories of knowledge.

It has been observed (Manzini and Pizzocaro 1999: 231-232) that Ph.D. programmes could serve as “strategic sites” and parallel repositories for design knowledge production and accumulation. Our
meaning of research strategic sites somehow paraphrases that of Bijker, Hughes and Pinch (1999: 191) when stating that there exist “research sites at which the complexity of the seamless web is manageable but which at the same time serve to capture key aspects of technological development”. Furthermore, the sense of strategic site is proposed for those doctoral programmes in design where the web of research and society is rewoven by breaking down the frequently encountered too rigid divisions among different domains (science and technology, technology and social impacts, invention, marketing and consumption). Our meaning of design research accumulation still implies obtaining something similar to shelf innovation as formulated within the dynamics and approaches of concurrent engineering. Shelf innovation consists of the anticipated development of technological solutions and components so that a heritage of innovation can be created, available at any time for possible use in new products, being the shelf concept that of storing solutions ready for future applications (Wheelwright and Clark 1992 and 1993). Following this model, the activities of component invention and testing are separated from product development: in this way advanced technologies can be incorporated in new products avoiding the risks associated with innovation.

A possible hypothesis still remains that it may be possible to conceive design research accumulation as similar to shelf innovation, accepting that it can generate "research components or portions" that can be shelved for future utilisation.

Here we will simply suppose that the nature of these research components might be generalised, assuming that they can be considered as “objects of learning”.

It is proposed that at least four broad classes of “objects of learning” can be stored or accumulated within Ph.D. programmes as research strategic sites:

(i) the states-of-the world (related to design domains),
(ii) other agents’ behaviour (in the domain of design),
(iii) how to solve selected design problems,
(iv) one’s own characteristics (preferences in research paths).

It might well be that these classes of learning objects map into different representations of the dimensions where learning connected to design research itself may act:

(i) the space of representations of the world,
(ii) the space of agents’ behaviour in a given system,
(iii) the space of actions and realised (or expected) outcomes,

where each level generates the following one: learning in the space of world representations implies learning other agents' behaviour, implying selecting design actions and preferences among a number of possibilities, resulting in design outcomes.

Still lacking a robust background to sustain this vision, here we will not emphasise this point. We are simply working at the hypothesis that learning through design research may be reasonably founded on the idea of learning as a co-evolutionary process.

It is straightforward from our earlier discussion of the general view of learning that here where it is approached for design research it rests on the co-development of cognitive representations, behavioural repertoires and preferences in actions.
References


