

Designing science

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1 Science of designing

The title of the editorial has two meanings, the first of which is a ‘science of designing’—the verb; to be sure I focus on the process of designing and not anything else. Now I can ask:

Is designing a science? Is designing a scientific activity? Is there a science of designing? Would it be one science or many?

Over the last 100 years, many design scholars have occupied themselves with questions like those. Walter Gropius, an architect, the founder of the Bauhaus, strived to create a unity of the arts and weave it with technology. The Bauhaus curriculum was intended to provide the foundation and practical experience to create creative artisans. Gropius stated that

at the Bauhaus we tried, with the co-operation of many artists, to find a common denominator for design, to develop, so to speak, a design science... (cited in Westphal 1991).

For Gropius, design science as he construed was the means to achieve his goals.

Buckminster Fuller, an extraordinary architect, designer, and inventor, put forward his idea of comprehensive anticipatory design science that is

...the effective application of the principles of science to the conscious design of our environment in order to help make the Earth’s finite resources meet

the needs of all humanity without disrupting the ecological processes of the planet (Fuller, original source unknown).

Fuller taught a course at MIT in 1956 on this subject. Several years later, in 1965, he inaugurated his ‘World Design Science Decade’ whose goal was to make better use of the world resources to help humanity. Fuller’s design science program and the content and tools he embedded were set to achieve his goals.

Another advocate of design science was S. A. Gregory as part of the design methods and design methodology group. Their Design Methods Symposium in Birmingham, 1965 and the book that followed included Gregory’s ‘Design Science’ chapter where he suggested that

Design science is concerned with the study, investigation and accumulation of knowledge about the design process and its constituent operations. It aims to collect, organize and improve those aspects of thought and information which are available concerning design, and to specify and carry out research in those areas of design which are likely to be of value to practical designers and design organizations (Gregory 1966).

In this suggestion, Gregory started moving from a pragmatic interpretation to an activity that sets its own standards and motives that might end up influencing practice.

We can close the 1960s decade with the publication of ‘The Sciences of the Artificial’ by Herbert A. Simon in 1969. Simon proposed that

The possibility of creating a science or sciences of design is exactly as great as the possibility of creating any science of the artificial (Simon 1969).

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The content of this science would be

a body of intellectually tough, analytic, partly formalizable, partly empirical, teachable doctrine about the design process (Simon 1969).

For Simon designing was problem solving. “The rational problem-solving paradigm, based on the conceptual framework that Simon introduced, is still a dominant paradigm in the field” (Dorst 2006). However, it has become clear through many critical studies that problem solving does not capture the essence of designing (Dorst 2006; Hatchuel 2001; Hatchuel et al. 2013). Consequently, design science so construed, has no chance to impact the core of design practice only to become an academic study for its own sake.

Through these sources, we observe a definite development in the concept of design science. From a pragmatic entity whose goal is to provide better foundation for impacting practice and the world (Gropius, Fuller), through a gradual organized activity for knowledge accumulation that may be valuable to designers (Gregory), to a new branch of science concerning itself with studying artificial objects that has its own merit as a scholarly activity (Simon). This move in the meaning of design science might not be surprising. First, it echoes a similar shift in engineering education during the previous century. Second, the proponent in the extremes of the range were on the earlier side Gropius and Fuller—two active design practitioners—while on the later side was Simon—a prolific social scientist and Nobel Prize winner in economics.

There have been many other design scholars in the 60s that discussed those introductory questions; in the years since, scholars such as Wojciech Gasparski, John N. Warfield, Vladimir Hubka and W. Ernst Eder, Donald Schön, Nigel Cross, and Nam P. Suh, have put forward significant contributions with many others. Those views fall in the range mentioned before: between a pragmatic endeavor to an academic activity with its own merit.

To illustrate this point I add two examples in that range that might seem different but are not far from each other on the academic end of the range. Vladimir Hubka and W. Ernst Eder proclaimed that

With the introduction of Design Science we can achieve neither spectacular and rapid successes, nor double-digit percentages of savings. With certainty we can say that Design Science is a decisive step in the direction of progress and will bring a long-term improvement of designing, both in the procedures of the designers and with respect to the quality of the manufactured products. But, as for any science or theory, it is not expected that it can be directly applied to the real problems of designing engineers.

Improvements must on one hand be derived from science and adapted to the practice, and on the other hand where improvements originate from the practice, they must be inserted and absorbed into the science. Technical knowledge presented in a new order, totality and form then becomes a striking and productive tool for designers. Essential positive effects are to be expected in a relatively short time in engineering education, and through suitable derivations and adjustments of this science for particular purposes (Hubka and Eder 1996).

While Nigel Cross concluded in one of his papers on the subject that

The ‘science of design’ refers to that body of work which attempts to improve our understanding of design through ‘scientific’ (i.e., systematic, reliable) methods of investigations (Cross 1993).

In that paper, Cross (1993) proposed a distinction between the terms ‘science of design’ and ‘design science’, creating a dichotomy that is related to the range I proposed.¹ ‘Science of design’ relates to the earlier interpretation but not entirely because it adopts the standard view of science rather than questioning it and designing it afresh. The term ‘design science’ relates to the latter end—the academic end of the range. Since the terms are the same in English, I do not differentiate them but present different interpretations given by different scholars.

By analyzing the search trends in Google for the terms ‘design science’ or ‘science of design’ in the last decade we could see a decline in the interest of scholars in this topic. Why then do I bother to raise the issue now? The reason is pragmatic, based on an urgent need to offer solutions to major crises we see around us. The vision is that designing can offer insight into these world challenges. We also observe that multiple disparate communities are working on issues of design without exchanging and building upon each other’s knowledge. Given the global context and dispersed interest, it seems that progress in solving major real problems could result from a renewal of the subject. Therefore, let us come back to the introductory questions, and ask why do we bother to ask questions about designing science? Why do we care about whether there is a science of designing or designing science? Why do we want to have such a science?

There are standard answers to these questions. First, many people perceive science as a means to get true understanding and knowledge about the world that may

¹ In contrast, the two terms are clearly equated in an introduction to Simon’s paper by Diani (1988): “Many attempts have been aimed at creating a scientific environment for design or, to put it bluntly, to create a science of design, a design science.”

subsequently be used to control and influence the world. Second to be considered a science means legitimacy from fellow researchers in scientific disciplines such as physics and other ‘hard sciences’ as well as recognition by the public including industry and funding agencies. But are these answers correct or instrumental to our cause? And what is our cause? I’ll come to this important question later.

Clearly the meaning and value of science is exaggerated on several grounds in these answers. First, we tend to believe that science leads to uncovering truth, unquestionable facts about the world. But considering titles such as: “Inner Contradictions of Rigorous Research” (Argyris 1980), “The Business of Science” (Fishlock 1975), “The Great Betrayal: Fraud in Science” (Judson 2004), and more specific titles such as “Why most published research findings are false” (Ioannidis 2005), we should be very cautious in accepting blindly the results of scientific activities as ‘truth’. To claim the search for the science of designing is a search for a single truth cannot be a driving goal for design research.

Second, some of us look at the sciences with envy as we are often made to believe that their goal is to uncover the single truth; to uncover the ‘one unified theory’ that explains all phenomena. But even in physics this single truth has been elusive and there is no agreement on the grand theory. To date, there are incommensurate theories in physics (Smolin 2006) and even one of the greatest physicists of our times reversed his early opinion and has called for a multitude of theories (Hawking and Mlodinow 2010).² Therefore, thinking of science as a road to reach a grand theory of design is moot. Sometimes, and in particular in design, it is also unclear whether results in one study, assume for a moment to be ‘true,’ translate at all to another context. Moreover, each result of a study is subjected to multiple interpretations. This multiplicity has already been acknowledged (Konda et al. 1992; Subrahmanian et al. 2011; Ziman 2003). Consequently, thinking that science will help us resolve this inherent multiplicity, or what some of us might consider that this ‘confusion’ is misguided misses the point. Especially for the science of designing a quote from the pragmatic philosopher Richard Rorty captures the essence of an inquiry,

We cannot regard truth as a goal of inquiry. The purpose of inquiry is to achieve agreement among human beings about what to do, to bring consensus on the end to be achieved and the means to be used to achieve those ends. Inquiry that does not achieve co-

ordination of behavior is not inquiry but simply wordplay (Rorty 1999).

Would it be surprising for readers to realize that mathematics, sometimes referred to as the ‘mother of all sciences,’ advances in the same way through agreements and consensus (De Millo et al. 1979; Reich et al. 2008)?

Third, I would like to challenge the perception that science has some higher status than design as perceived by many even in our circles. When physicists study physical phenomenon, like gravity, it makes sense to ask questions like “is gravity influenced by the mass of the objects?” But we need to remember that we do not see the gravity force. In fact, force is a concept invented by us and there could be alternative ways to conceptualize it. The question then becomes not what is a force, but how can we design force better so that it could be measured and will enhance our understanding of natural phenomena. So the language of science is not about what exist but what metaphors could be designed to improve our understanding (Gregory 1990; Lakoff and Johnson 2003). Clearly design goes deeper into the sciences as the means to devise all the instruments for collecting data. In fact, there are discoveries such as the Higgs boson particle or far away stars that are solely based on measured traces that are used in calculations and interpreted as discoveries of never-to-be-seen objects. Design is therefore the framing tool and the source of instrumentation. If we consider that even mathematics the tool employed in the sciences is also a design discipline (Reich et al. 2008), then science is nothing but designing.

2 Designing a science

Since science has no supremacy over design, and as science has evolved and accumulated extensive experience related to designing research methodologies and practices, there is value in exploring science in relation to designing. Consequently, I turn to the second interpretation of the title of the editorial—designing a science—the science of designing. For us, designers, the way to approach answering the introductory questions is through designing. In doing so, we merely return to the ideas of Gropius and Fuller.

Such an interpretation burdens us, because we have to think of the meaning we wish to ascribe to this new science or specify what the cause of our designing is. If we wish to create a body of knowledge about how single designers solve simple design problems, we can create the research methodology to support this. If we want to develop a science to help humanity solve its pressing problems, we need a very different science and research methodology than for studying a single designer (Reich 1994). If we try to convince each other that one interpretation of science is better

² The choice of title for Hawkins’ book—the grand design—is very revealing.

than another, we fall in the trap that I already discussed in another editorial (Reich 2010a): for if there is no selection method better than another, we should not expect that there is one interpretation of design science that is better than others. Rather, we each need to adopt an interpretation of design science that fits the purpose of our research program, leading to embracing a science of designing that allows plurality of theories, methods, and interpretations to co-exist and be woven together (Subrahmanian et al. 2011). Science here is a systematic exploration of the object of study whichever lens we choose to look at from; it is also a designed object; all else that is dogma is religion (Reich 2010b).

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