Artificers, satisficers and optimisers: Echoes of Simon and 'ways of being' in Design and Technology Education

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ABSTRACT

Herbert Simon created the neologism 'satisficing' in order to address a particular issue he found regarding problem solving in organisations. His work also included such concepts as 'bounded rationality' and has influenced many areas of human endeavour including, at times, the theorising of problem-solving in Design and Technology (D&T) education.

The paper gives an overview of Herbert Simon's work and neologism, drawing on his landmark text *The Sciences of the Artificial* (Simon, 1969/1996). Context is offered with comparisons between the (positivistic) problem-solving of the technical-rational 1960s zeitgeist and subsequent human-centred design practices and genres.

Imagining three 'ways of being' in the field of D&T, the paper explores how the roles of *artificer*, *satisficer* and *optimiser* can play out for pupils, teachers and D&T's problematic (sic) curriculum. Whilst echoes of Simon's work can still be found in D&T education, and the three roles can contribute to the design repertoire of pupils and teachers alike, it is argued that any application of them should be understood for their limitations as 'problem-solving' cannot equate designing – in theory or in practice.

Keywords Satisficing, Design history, D&T curriculum, The artificial, Climate emergency.

1. INTRODUCTION

The great materialist expansion of the post-World War Two years warrants reflection in the context of today's climate emergency; not least because the *practice of design* was/is central to all technological and material development, that is, the development of *the artificial.* (This includes the associated political decision-making and policy formulation which are also 'artificial').

The post-war period was one of dominant technical rationality with burgeoning developments in social and natural sciences, technological creativity, capitalist growth and consumerism, alongside great optimism about what could be achieved globally. Despite all the creativity,

optimism and growth, the period was not without its siren critics. Papanek opened his 1972 text with these words:

> There are professions more harmful than industrial design, but only a very few of them. And possibly only one profession is phonier. Advertising design, in persuading people to buy things they don't need, with money they don't have, in order to impress others who don't care, is probably the phoniest field in existence today. (Papanek, 1972:9).

(For more on post-war mass consumerism and waste see Packard, 1962 & 1963).

In 2005, Thakara reflected on matters thus:

> Many of the troubling situations in our world are the result of design decisions. Too many of them were bad decisions…The parlous condition of the planet, our only home, is a good example. Eighty percent of the environmental impact of the products, services, and infrastructures around us are determined at the design stage…we designed our way into the situations that face us today. (Thakara, 2005:1)

In the 1960s design itself had been undergoing re-design. Cross (2007) reports that these were the years when there were aspirations to 'scientise design'. Polymath Buckminster Fuller had called for a 'design science revolution' naming the 1960s as the 'design science decade.' (Cross, 2007:119). Dorst & Dijkhuis (1996), report the emergence of 'first generation' design methodology in the early 1960s and the rationalising nature of its positivist background. 'Criticism of these models raised interest in the fundamentals of design theory, the logical form and status of design. It also fostered a need for more detailed descriptions of the design activity…' (Dorst & Dijkhuis, 1996:253). A key protagonist of an analytic approach to design was Herbert Simon.

2. OVERVIEW OF SIMON'S NEOLOGISM AND RELATED WORK

Herbert Simon (1916-2001) held a PhD in political science and his extensive research addressed (amongst others) artificial intelligence, organisation theory, decision-making, cognitive science, information processing and complex systems. His influential text *The Sciences of the Artificial*, appeared in 1969 and ran to three editions (1969, 1981 and 1996), each being revised and updated to incorporate contemporary developments or to revise Simon's theoretical position. This paper references the third edition (Simon, 1996) although the concepts addressed are from the original.

Simon's significant contribution towards the culture of the times (and subsequently) included the theorising of problem solving and decision-making across organisations, engineering and emergent computer science; and design is at the core of this work. His problem-solving theories; '…provided a framework for (an) extension in the scope of design studies…within the paradigm of technical rationality…(as well as providing)…a sound, rigorous basis for much of the existing knowledge in design methodology.' (Dorst & Dijkhuis, 1996:253). This paradigm remained dominant for many years and traces of its influence remain today.

It should be noted that Simon eschews the colloquial negativity often associated with talking of something being 'artificial'. He wrote of using '…"artificial" in as neutral a sense as possible, as meaning man-made (sic) as opposed to natural.' (Simon, 1996:4). (This simple dualism is not, of course, unproblematic.). Also, in line with others, Simon observed that the natural sciences are concerned with how things *are* and with *analysis;* whereas, engineering is about *synthesis* and that:

> Synthetic or artificial objects, and more specifically prospective artificial objects having desired properties – are the central objective of engineering activity and skill. The engineer, and more generally the designer, is concerned with how things *ought* to be - how they ought to be in order to *attain goals,* and to *function*. (Simon, 1996:4-5. Original italics)

He also considers that: 'Everyone designs who devises courses of action aimed at changing existing situations into preferred ones' (Simon, 1996:111); a definition Margolin describes as 'deceptively catholic' (Margolin, 2002:236). However, such statements do contribute to the defensible case for design education as a component of general education (for all students).

2.1. Simon's neologism

Key to designerly practice is the weighing up of competing variables, a form of decision-making well engaged by Simon. This paper cannot address the detail that Simon applies to the decision-making involved in bringing anything artificial into being. However, it does take a focal interest in a neologism that Simon coined; that of *satisficing*.

According to Simon, try as we might to get the best possible result when designing the 'artificial' we can rarely achieve this. We seek the optimal (he calls it optimisation) but we can only compare 'better' or 'worse' or '…(we accept) "good enough" alternatives, not because less is preferred to more but because there is no choice.' (Simon, 1996:29). He says: 'Since there did not seem to be any word in the English language for decision methods that look for good or satisfactory solutions instead of optimal ones, …I introduced the term "satisficing" to refer to such procedures' (Simon, 1996:119). His term combines two words, *satisfy* and *suffice*, to create the verb *to satisfice*. Vincenti (1990) describes how one group of aeronautical engineers, using their judgemental skills to address the complexities and uncertainties in a problem, '…probably saw themselves as optimising…' whilst actually only achieving satisficing solutions. (Vincenti, 1990:220).

Simon shows that one of the reasons that satisficing occurs is that, no matter how rational our decision-making may be, when applied to multiple variables (in what he calls the *problem space*), our rational options are necessarily limited if success is to be achieved; thus, we satisfice rather than optimise. He describes this as *bounded rationality*. He offers two examples of 'triumphs of bounded rationality': the writing of the American constitution; and, the landing of humans on the moon (Simon, 1996:140), suggesting elsewhere that '…bounded rationality…is most comfortable with clear-cut and limited goals.' (Simon, 1996:150).

Satisficing, then, comes into play when all design variables in a given design situation have been

satisfactorily met. If all variables can be optimally satisficed, then optimisation would be reached. This, says Simon, can rarely happen. Equally, should some variables not be satisfactorily addressed, then satisficing itself cannot occur.

2.2. Further context to Simon's work – alternative paradigms and perspectives

Simon's approach can be further contextualised by considering other theorisations of designerly practice over subsequent years. This is useful for framing our questions regarding education. For example, Dorst & Dijkhuis (1996) draw on the work of Simon and of Donald Schön to compare two paradigms: respectively, the 'rational problem-solving paradigm' and the 'reflection-in-action paradigm'. (Dorst & Dijkhuis, 1996:255)

Schön (1983) resisted the prevalent positivist-analytic framing of 'problems' and 'solutions' and took a human-centred approach, seeing design as a reflective conversation with the situation. He suggests that:

> If the model of Technical Rationality is incomplete, in that it fails to account for practical competence in "divergent" situations, so much the worse for the model. Let us search, instead, for an epistemology of practice implicit in the artistic, intuitive processes which some practitioners do bring to situations of uncertainty, instability, uniqueness, and value conflict. (Schön, 1983:49)

In line with positivist tendencies, design practice had been heavily influenced by the 'form follows function' dictum from the outset of the 1900s. Archer (2006) describes how that dictum, along with other significant 'advances in design thinking' across the Century, all failed to compare with the 'paradigm shift' (after Kuhn, 1962) he saw taking place in the late 1990s.

The paradigm Archer refers to is that of the *semantic turn*, attributing its roots to Krippendorff & Butter (1984) and foregrounding the individual and cultural meanings of things rather than their form, structure and function. Krippendorff (2006) puts it this way:

> The semantic turn challenges designers' blind submission to a stable functionalist social order, which is anachronistic to the kind of society experienced today…(and, citing Simon, he argues that)…(The) producer-product-profit logic dominated decision-making during the industrial era…an era of scarce material resources and hierarchical social structures, coupled with an unwavering belief in technological progress... (Krippendorff, 2006:6-7)

Krippendorff, like Schön, advances a human-centred design culture as a response to the functionalist society and offers a basic proposition that: 'Design constitutes being human' (Krippendorff, 2006:74). Indeed, he proposes design as: '…a fundamental human right, the right to construct one's own world, interact with fellow human beings in theirs and make contributions to the ecology of humanly accessible artifacts.' (Krippendorff, 2006:322). He advocates *participatory design* where all stakeholders are co-designers sharing and advancing a common design culture.

For further critique and context of Simon's approach to design see Margolin (2002), in particular, two of his essays. First, *The Two Herberts* in which he sees Herbert Simon's scientised definitions of design theory and practice exemplifying Herbert Marcuse's (1968) 'technological rationality'. The essay alerts us to the dangers of conceiving of a design 'discipline' based on such a framework; '…an unwelcome reference point for the legitimation of design as an academic subject' (Margolin 2002:234-243). Margolin's preference is for '…a much more open conception of design activity that is not preoccupied with justifying a separate sphere of domain knowledge, as the primary purpose of (design) research'. (Margolin 2002:237). Second, is Margolin's titular essay The Politics of the Artificial which he himself describes as a polemical play on Simon's original. (Margolin 2002:5 and 106-123).

Notwithstanding the critiques and perspectives on Simon, we can summarise by saying that: a) his work was very much 'of its time'; b) his work was hugely influential across many fields, of which, design was one; and, c) his attempts at establishing a *science of design* have not stood up to universal acceptance; particularly by designers themselves.

(For more on the *relationship* between design methodology and science, see de Vries et al., 2003).

3. SIMONIAN 'WAYS OF BEING' IN D&T EDUCATION

Drawing on Simon's neologism, three roles as 'ways-of-being' suggest themselves. The first is that of *satisficer*, that is, those who work to *satisfice* in any given situation of learning or change. They strive to address to a satisfactory level all variables in a situation whilst possibly optimising some variables. Satisficers recognise that totally optimal outcomes are rare. Thus, satisficers could operate on a 'that'll do' (minimalist approach) or a 'that is the best that can be done' (maximalist approach). In the game of 'design as the weighing-up of competing variables' the satisficer is ever-challenged to treat all variables symmetrically, that is, with equal consideration.

Thus, second, it remains possible to conceive of players as *optimisers* – those who strive for the optimum for all criteria. However, while an optimiser might be judged naïve in trying to optimise all variables, there is another potential dimension to their approach. Drawing on the related sense of *optimism* – a positivity that enables a vision or a goal – the optimiser brings something that the utilitarian satisficer need not entertain. It may be that the optimiser envisages criteria that are beyond those of a situation's requirements at the utilitarian level. An optimiser may arrive at a *possibility* that reaches beyond satisficing because they are reaching beyond a 'that'll do' level into an area of risk-taking.

'As soon as we introduce "synthesis" as well as "artifice" we enter the realm of engineering".' (Simon, 1996:4). It would seem reasonable to consider a third group who have over millennia contributed to technological development and its (positive and negative) outcomes – the *artificers*. The term is less-used now but an artificer was a skilled craftsperson, someone clever at devising things, possibly an inventor. The artificer is the doer, a producer, a person who delivers. An artificer may simply 'make to order' – creating, to a high degree of quality, that which has been specified by others. Or, they may be an independently inventive creator or problem-solver who delivers what is required, but has perhaps not been fully specified, by others.

Artificers may simply follow/fulfil orders or they may embrace a critical ethic, weighing-up the consequences of their works in the world-at-large.

3.1. Pupils and teachers as satisficer, artificer, optimiser

A pupil or student can, through their design education, learn the differences amongst the *acts* of satisficing, artificing and optimising; as well as their limitations. When weighing-up a design situation or considering pathways to pursue in a particular project they can act strategically in how they move amongst the roles. By learning of the potentials and pitfalls that each role offers, they gain design experience. To apply Schön (1983), by reflecting-in-action they can understand that these are more than just strategic roles but are potentially ways of being in the world. Further, they may learn about differences between positivist problem-solving and designerly choice-making (see, e.g. Keirl & McLaren, 2013). They may identify with a particular role or they may understand how others play such roles in life. Further, understandings about how designs and technologies come into being as a result of human agency can develop alongside a knowledge of the differing impacts players can have on technological developments.

Central to all activity in the classroom is the teacher who is, de facto, the arbiter of curriculum, school policy and students' learning. Teachers can readily be seen or positioned in any of the three roles. It may be a matter of personal professional philosophy to choose to work in a particular way or it may be that the individual merely does what is expected of them at a basic level. Compare, for example, the teacher who sees themselves as deliverer (to the best of their ability) of a syllabus to get their students through an exam, with the teacher who works to educate students about the three roles and their significance to D&T projects as well as to the wider world. The former sees teaching as the efficient delivery of content, a teacher-centred approach, while the latter uses D&T projects to enhance understandings of these ways of being in the world using student-centred pedagogies. In the classrooms of the latter, students and teachers alike may be any or all of satisficers, optimisers and artificers.

4. ECHOES OF SIMON IN DESIGN AND TECHNOLOGY (D&T) CURRICULUM DESIGN

While we can see pupils and teachers playing out their Simonian ways of being, we cannot ignore the bigger curriculum context which shapes just how, and how far, the roles may be enacted. Reviewing Simon's considerations of *the creation of the artificial* and recognising that curriculum itself is a designed artifact, the following topics resonate as familiar issues, that is, locators for curriculum contestation, design or re-design. Each *could* be thought of as a 'problem' seeking a satisficing solution. The list is neither comprehensive nor prescriptive.

Design and Technology education's role in:

- improving the damaged world that our children are inheriting - and for which they will be responsible;
- general education and in supporting designing as a way of *being human*;

- raising public awareness of the centrality of design to any technological development;
- deepening public participation in design decision-making;

D&T's marginalisation by:

- instrumental-functional economic and educational policies;
- OECD/PISA-driven testing regimes (Organisation for Economic Cooperation and Development/Programme for International Student Assessment);
- STEM agendas;

D&T's identity issues:

- the case for dropping/maintaining the 'D&' in D&TE;
- the value, or otherwise, of trying to locate D&T around a defined body of knowledge;
- 'subject'; 'discipline'; 'field of education'; 'learning area'; or, 'a literacy';

D&T's pedagogical challenges:

- holistic rather than reductionist approaches to learning;
- positivist valorising of technological 'problems' to be 'solved';
- the problem of teaching singular design 'processes' that do not mirror the realities of designing – epistemologically or praxically.

Such a list invites the question: "So can satisficing work here?" We might say these are problems that cannot be satisficed because, to adapt Simon's term, any associated rationality is un-bounded. Whilst all such curriculum issues interrelate, to re-design any one is to influence others. After all, curriculum is, as Pinar (2004:188) says, a 'complicated conversation'.

When the issues listed are unlikely to be resolved by even the most enlightened of satisficers we might say that their resolution is impossible. However, the teacher-as-satisficer who is allowed the professional freedom and judgment to more truly be the arbiter of curriculum and learning has a better chance than the teacher with dictated curriculum constraints. Alternatively, the issues might be reframed by the adoption, at macro and micro levels, of design genres more appropriate to the task than 'problem solving' (whose 'solutions' often beget yet more 'problems'). Some candidate methodologies here would include ecological design, speculative design, participatory design, and critical design – all human-centred approaches.

5. SUMMARY

It would be unreasonable to dismiss the educational potential of Simon's approach and neologism. It clearly has a role in *some* design education situations. However, its limitations lie in its technical-rational context which cannot entertain design strategies that are necessarily open and messy. What interweaves the challenges on the list are matters of philosophy and politics for

curriculum designers and teachers alike. This calls for an enlightened and critical D&T profession and a curriculum liberated from many of the current instrumental constraints (see, for example, Pitt & Webster, 2021 on hope, democracy, experience and reflection).

There are many ways that designerly pupils and teachers can 'be' in this world and Simon's work has pointed to just three. Design and Technology Education has an undoubted role to play in helping educate a populace of citizen-designers (Resnick, 2016) who understand both the centrality of design to all technological developments and the non-neutrality of technologies (including its problem-solving strategies!). While echoes of Simon's work in some ways fade, they can still resonate in some of D&T's own complicated curriculum conversations.

6. CODA

The motivation for this paper arose from seeds sown by Howard Middleton (1998) and colleagues (e.g. Stevenson, 2003) in the Australian Technology Education Research conferences of the early 2000s. An itch has been scratched!

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