Contemplating Design Pedagogy in Computing Education

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Overview

- The Design Heritage In Computing Systems
- Adopting A Designerly Way Of Knowing
- First Principles For A Designerly Way Of Knowing
  Computer Systems Design
- Pedagogy To Nurture That Designerly Way Of Knowing
- Demonstrating Principle Through Pedagogy
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Simon, Herbert (1996), The Sciences of the Artificial, 3ed, M.I.T., Cambridge, MA, USA.
The mathematical genealogy of computing is stamped with the philosophy of *technical rationality* and epistemology of science.

## Conceptions of Design

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<th>Phenomenon</th>
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<td><strong>Science</strong></td>
<td>The natural world</td>
<td>Controlled experiment, classification, analysis</td>
<td>Objectivity, rationality, neutrality, “truth”</td>
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<td><strong>Humanities</strong></td>
<td>Human experience</td>
<td>Analogy, metaphor, evaluation</td>
<td>Subjectivity, imagination, commitment, “justice”</td>
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<td><strong>Design</strong></td>
<td>The artificial world</td>
<td>Modeling, pattern-formation, synthesis</td>
<td>Practicality, ingenuity, empathy, “appropriateness”</td>
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(Cross, 2007)
Technical Rationality

According to Herbert Simon … the process of rational decision-making is an act of choosing among alternatives which have been assigned different valuations based upon a pre-existing idealization of quality.

Commonly practiced as “problem solving,” it involves:

1. Listing all of the alternative strategies.
2. Determining all the consequences that follow upon each of these strategies.
3. Comparatively evaluating all these sets of consequences.
According to Herbert Simon … the process of rational decision-making is an act of choosing among alternatives which have been assigned different valuations based upon a pre-existing idealization of quality.

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2. Determining all the consequences that follow upon each of these strategies.
3. Comparatively evaluating all these sets of consequences.

Total rationality is an unattainable idealization in real decision-making – who can be aware of all existing alternatives?

(Simon quoted by Skyttner, 2005)
The “Wicked Problem” Of Design In Computing

The multi-dimensionality and psycho-social nature of computing system’s denies the possibility of a computable “right answer” hence, the focus on stakeholder satisfaction, “satisficing,” acceptable approximation.

(Design is always satisficing!!)

Satisfaction depends upon individual appreciative systems
{personally held epistemologies (world-views) that guide our attention and choices in every day life}. Each human’s appreciative system evolves both consciously and tacitly through life experience – the “simple” act of living!

(Vickers, 1965)

“... decision makers can satisfice either by finding optimum solutions for a simplified world, or by finding satisfactory solutions for a more realistic world.”

(Simon, Nobel Memorial Lecture, 1978/12/8)
The “Wicked” Context Of Computing Systems Development

Distinct World-Views

Technological Feasibility

Social Aspiration

Perspectives in Conflict
Typical Computing Pedagogy’s Emphasis On Problem-Solving Eviscerates “Quality”

“...[the] distinction between design and implementation has faded from the structure of computing education. To ignore the conceptual distinction between the design and an implementation is tantamount to accepting any ‘solution’ without even considering whether ... there is a solution out there that is an order of magnitude ‘faster, smaller, simpler, cleaner and produced with less effort’.”

(Waguespack quoting Brooks in a 2011 review of curriculum guidelines for computing and SA&D textbooks)

Computing education should nurture a “designerly way of knowing” as a practical skill but also, an ethical disposition for computing professionals by teaching design as:

a) indwelling in the stakeholders’ world-view,

b) engaging metaphor to elicit, refine, and enhance intensions,

c) engaging intensions and the medium of construction in reflective conversation to reconcile artefact with aspirations.
First Principles For A Designerly Way Of Knowing Computer Systems Design

- Human Knowing and Conscious Expression Are Imperfect
- The Operative Appreciative Systems Determine the Whole of the Design Space
- Design is Continuous Exploring and Learning in a Dynamic Environment
- The Medium of Construction Delimits the Design Choices
- Design Reconciles World-Views
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- The Medium of Construction Delimits the Design Choices
- Design Reconciles World-Views

"We know more than we can say."
"Knowing ‘how’ vs. knowing ‘what’."
"A prime function of design is teasing out tacit knowledge."
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Human Knowing and Conscious Expression Are Imperfect

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The Medium of Construction Delimits the Design Choices

Design Reconciles World-Views

“Culture is a shared appreciative system.”

“Each world-view contributes to the whole of design concerns.”

“Divergent perspectives signal the need to re-conceptualize the design space.”
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“Markets, politics, legislation, technology, stakeholder communities evolve.”

“Appreciative systems evolve as they learn from the experience of engagement with the artefact.”

“Artefact and aspirations co-evolve.”
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“Design skill is enriched by a dexterity with the tools and materials of implementation.”

“Tool skill sows the seeds of imagination that equips designers to envision artefact possibilities.”
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5. Design Reconciles World-Views

“Design reconciles intensions among stakeholders.”
“Design reconciles the domain of intensions with the domain of artefact technology.”
“Successful design enables (empowers) each constituency to recognize their own intensions in the artefact.”
Have you ever looked through a magnifying glass? The clear glass (or plastic) in a magnifying glass is a lens, like the lens that's inside your eye. Using the lens of a magnifying glass, you can bend light to make an image of the world. Look at the photo on the left. We used a magnifying glass to produce an inverted image of a candle. The photo on the right shows how. You can try the same thing at home. For instructions on how to make an image with a magnifying glass, click here.

What's Going On?

Suppose you use your magnifying glass to make an image of a tree on a sunny day. You hold your lens between the tree and a piece of paper. You move the lens to just the right spot. Voilà! There's an image of the tree. That image is made of light. Sunlight bounces off the tree and spreads out in all directions. Your lens gathers the light shining out in all directions from each spot on that tree and bends that light so it all comes back together on a single spot on your piece of paper. So light shining from a leaf at the top of the tree ends up on one spot on your paper. Light shining from a spot on the tree's trunk ends up in a different spot on your paper. All these spots of light blend together in your eye to make an image.

This works because the lens in your magnifying glass is carefully shaped to bend light in a particular, predictable way. The lens is shaped to bend light rays so that they come together and then spread apart to make an image. The lens of your magnifying glass is probably fat in the middle and thin at the edges. If you took the lens out of the magnifying glass, it would look like this: The surface of this lens is curved. It's that curve that makes light bend when it shines through your lens.

Learn more about lenses.
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Pedagogy To Nurture A Designerly Way Of Knowing

- Practice knowledge of the domain
- Technology theory and practice
- Distinguishing design choices from intensions
- Collaboration and development methodology
- Incubating creativity
- System life cycle project practice
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“In a technically rational world a designer would be omniscient in the stakeholders’ domain.”

“Ideally, design continually explores and learns the domain or at least accesses domain expertise.”
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“Understanding artefact construction is about ‘knowing how’ as well as ‘knowing what’ in the medium of construction.”

“A tacit grasp of the technology enriches the visualization and then reinforces the validation of prospective design ideas.”

“Indwelling in the tools exercises ‘knowing as’.”
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“The goal of a shared appreciative system is to attend to essential aspects of intension.”

“A clarity distinguishing efficiency from effectiveness derives from recognizing ‘design choices’ that are expedients of construction rather than essentials of intention.”

“Intensions must be honored and protected from arbitrary change, while ‘design choices’ must be challenged as candidates for improved implementation, ‘refactoring’.”
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"Team skills, communication and negotiation, are keys to effectiveness in a practical development methodology."

"Open, free and honest communication are critical to the satisfaction of everyone in the design community."

"The development methodology must serve the intensions that commission the artefact – not vice versa!"
"Creativity is essential to design, most definitions add 'especially in artistic work'."

"Satisficing 'wicked problems' is as much art as craft."

"Naming and framing in the design space exposes the essence of intensions that reflect the shared appreciative system."

"Creativity is more about 'seeing as' than 'knowing what'!"
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"Every artefact is destined to be a subsystem of the stakeholders' world-view."

"Design must be mindful of the ongoing interplay between the artefact and its domain so as to sublimate surprise into agility."

"Witnessing artefacts evolve, responding to changes in intensions and technology in an ongoing cycle of artefact 'life,' discourages complacency."

"A robust and challenging design experience is a singularly effective 'teacher.'"
Demonstrating Principle Through Pedagogy

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Q? & A!

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