The Promise of Systemic Designing: Giving Form to Water

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Abstract

The world is understood to be more complex and dynamic than previously thought. Design is understood to be a deeper mystery than previously assumed. Design creates reality. Humans have engaged in design activities – designing – from the beginning of history, but little is known of its true nature or full potential. Familiar approaches to design and design education no longer match the real-world necessities and expectations of modern societies. Everything is connected, and it is difficult, or it seems often impossible, to determine what course of action is prudent when designing within such complexity. *Systemic design* is an emergent means for creating desired change that takes a broader stance and deeper approach to designing than is the norm nowadays. Creating educational experiences that prepare designers for competent professional practice in the world today requires a systemic design approach.

Keywords

Complexity · Design · Design praxis · Design scholarship · Systems · Systemics · Systemic design · Design learning · Systems learning · Systemic design education

Overview

> There are these two young fish swimming along and they happen to meet an older fish swimming the other way, who nods at them and says, "Morning, boys. How's the water?" And the two young fish swim on for a bit, and then eventually one of them looks over at the other and goes "What the hell is water?" (Wallace, 2005)

> No one really understands water. It's embarrassing to admit it, but the stuff that covers two-thirds of our planet is still a mystery. (Ball, 2008)

Today more young fish are asking "what the hell is water?" – along with other big questions that weren't answered in their "schools" (pun intended). Water is a deep mystery even to science (Ball, 2008). With a rising tide of interest in design, younger fish as well as their elders are asking more frequently: "what the hell is design?"

Stakeholders, academics, practitioners, and students, all have struggled to figure out design well enough to be confident enough to engage in it while gaining advantage in the process. Progress in understanding design is made through ongoing approximations of what is true about its nature and what is desirable. There are many faces and facets of design only dimly perceived. Design, like water, is a deep immersive mystery. To make an assessment of, and give form to, "the mystery of designing" requires both analytic and systemic thinking. Like water to the fish, designers are entrained in an immersive environment of invisible assumptions, beliefs, and assertions that form what is accepted as the context and environment of designing. How can this invisible form be made more visible? How can it be re-formed or trans-formed? What form should the activity of designing take in order

to successfully swim within this immersive context? What form do designers need to take to become qualified swimmers?

What the Hell Is Design?

In order to improve design practice and education to better meet today's challenges, attention needs to be focused on designing better formal and informal design learning and training experiences. Success in doing this can only really be achieved if educational programs are well designed and situated within the realities of complex and rapidly changing dynamics found in contemporary social, cultural, and political environments. The conundrum is that improving design praxis and education is itself a systemic design challenge. As in any design project, the undertaking unfolds through the phases and stages of a systemic design process. The outcome will not be fixed definitions of design but will be the unfolding of an ongoing collaborative process of designing the next best stances and approaches for becoming designers and for being designers.

As a noun, design references things that are real – particulars and ultimate particulars – which are often created with only a dimly perceived reality of the immersive context of designing. Designs can be visible or invisible, material or immaterial, yet still be real. Something as abstract as a belief system is as real as a brick and will leave a mark if bumped against – the same as would happen by running into a brick wall.

As a verb, design is often considered to be either a form of applied science or applied art – two distinct immersive cultures of inquiry. Design is also often regarded as a midpoint between these two dominant cultures of inquiry – part functional art and part technology. In other contexts, design is considered to be a profession, or less grandly, a practical utilitarian approach to making stuff – particular things for others, including services and experiences.

Giving Form to Water

Design, as both a verb and a noun, is a term used to describe many diverse activities that lay claim to being design activities. *Systemic design* is one of these activities. It is a compound concept that includes the immersive context within which designing takes place – the processes of designing and the outcomes of design action. In order to begin to give form to the mystery, that is, design, this chapter introduces systemic designing as one of many design narratives sharing the term design nowadays. Systemic design is inclusive of the compound field of systemics, designs as real systems in part or whole, designing as the cause of desired realities, designers as agents of prudent change, and design education as the formal and informal processes for becoming competent designers. Systemic design can refer to either a synthetic action or a holistic descriptive explanation of manifested intentions.

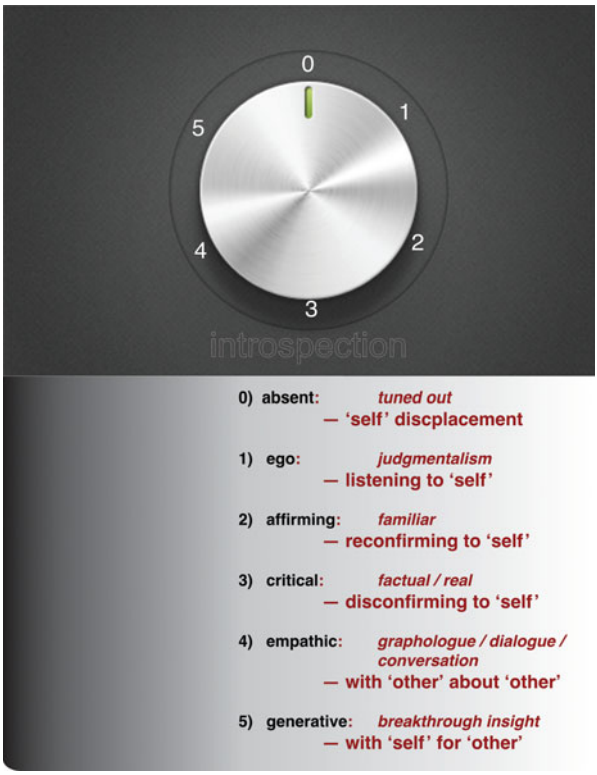

Fig. 1 Quantum listening

Like design, systemics is a term used as both a noun and a verb. Systemic thinking is not merely a concept in the abstract. It is something that is real to this moment of your time. Its concrete reality can be made apparent by paying close attention to your reading this chapter. Reading this chapter is a systemic process, since you as the reader are interacting with ideas encoded on these pages through lenses and filters that arbitrate how the ideas will be mediated as they enter your awareness. You are tuned into incoming ideas at any specific time through a selected level of minded attention (see Fig. 1).

A *systemic schema* (an organizational pattern, model, or conceptual framework) of levels of attention can be characterized as a "quantum listening" instrument – a channel selector controlling which "open-channel" will be used to take in the ideas and images presented. The character and evaluation of the communication experience and instrumental value of the exchange is as dependent on the channel selected as the content of the ideas or concepts themselves, and therefore the outcome is not objective – thus the label "quantum" is used. Something as common as the act of reading this chapter consists of a systemic interrelationship being in place, in context, in the moment, with the author and you as participants in a shared communication system.

Design Context

Designing and designers are too often immersed in a design context that is taken-for-granted with little self-awareness. Is it possible for a fish to step out of water to ascertain the nature of wetness? Is it possible for designers to step out of their design entrainment – in which they are incorporated and swept along – in order to understand the contextual framework and basic nature of designing? If there is any desire to create well-formed designs for design education or to improve design praxis, the answer to this last question needs to be explored in greater depth and breadth.

As immersive contexts and mysterious elements, water and design have a significant point in common: they both continue to be actively used in everyday life despite being ineffable. Even though scientists tell us that very little is known about the true nature of water, we continue to put it to productive use. Even though among scholars, experts, and practitioners of design there is little agreement on what the activity of designing actually is, within its fluid design context, we continue to engage in designing, use designed things, talk about designing things, and teach others how to design things.

Despite not understanding or agreeing on what sort of surround designers are entrained in, we believe we have good enough access to an instrumental understanding to forge ahead with practice and education. That is to say, we have had a good enough understanding of designing for various practices of design to become normative. However, we continue to press the case for more insight into the nature of designing within a complex reality and to confront the challenge of *epistemic freedom* (Protzen & Harris, 2010). Epistemic freedom asserts that approaches to inquiry, and the purposes of inquiry, are not given – they are selected from an open list.

Design Cultures

Parallel to the need for a greater understanding of the immersive milieu that designing is always contained in is the necessity to proactively create integrative *social system crucibles* from social, cultural, intellectual, and political interests. Such crucibles are formed to hold, protect, and champion design activity. These design containers – *design cultures* – are essential to the health and viability of active *cultures of design* – the people who engage in designing. That means that systemic design education cannot just be focused on academic programs and professional development, but must be focused on forming and maintaining inclusive, design-compatible social systems as well.

Why should we learn to become designers? What are the aspirational reasons behind why we are drawn to design? There are many such reasons, both profound and pedestrian. One response is that we design because that is what defines us as being human. It is who we are. We are motivated, even driven, to improve our lives and to transcend our inherited limits in natural and cultural conditions – our

birthright. We want to become more than what we come into the world as, and who we have been influenced to become socially or culturally. We want to extend our reach and amplify our powers as *prosthetic gods* (Freud, 2010). We design for many of the following reasons:

- To feel significant and be useful
- To be intensional and intentional
- To participate in the never-ending genesis
- To steer human evolution
- To be a design agent and serve others
- To create reality
- To create value
- To enact aesthetics, ethics, and reason
- To aim and steer for desirable outcomes
- To answer a calling from necessity
- To create order
- To relate, link, and connect diversity
- To make meaning
- To gain enlightenment
- To exercise prudence and act wisely
- To make up for natural limitations
- To be altruistic and empathic
- To thrive as a *lame god*
- To serve *prosthetic gods*
- To create products and services
- To expand human capacity
- To improve the human condition
- To realize potential

Even though we do not have all the wisdom we need to become perfect designers, we believe we can become adequate designers. We are *lame gods*, in that our full, god-like potential is counterbalanced by our human limitations and liabilities (Nelson & Stolterman, 2012). For better or worse we create adequate, imperfectly designed additions and changes to evolving realities – our own and others.

The world and our perception of the world have changed dramatically. Old ways of dealing with changes or creating changes no longer seem to work. The acronym VUCA, which stands for volatile, uncertain, complex, and ambiguous, is used by governmental agencies, including the military and business organizations, to remind them of what their work environments feel like nowadays. Their traditional, normative way of dealing with the real world no longer seems to work satisfactorily for them. As a consequence, the questions that arise are: what can be understood, what is predictable, and what is controllable in a VUCA environment?

Because reasonable answers to these questions are not easily accessed using tried-and-true approaches to inquiry and action, there is a certain sense of fearfulness concerning the responsibilities and accountabilities of being change agents. There is

a fear of risk, a fear of change, a fear of the new, a fear of not knowing enough, a fear of causing unintended consequences and a fear of problems or challenges not yet articulated. They live a reactionary existence consisting of habitually stepping back from, or away from, undesirable situations rather than stepping toward things desired. The consequences of that habituated behavior create serious challenges for any hope of progress or improvement in the human condition. But here systemic design offers hope.

Design Narratives

Although design is as omnipresent in the lives of humans as water is for fish, the seminal question is how does one, metaphorically speaking, "give form to water" – to designing – so that it can be described, explained, and confidently practiced? Some historic narratives that describe and explain design distinguish different sets of fundamental postulates in play:

- Design as crafting or making
  - *Homo faber* – "man (sic) the creator"
  - Technology and artifacts – augmenting prosthetic gods
  - Craftsmanship
  - Processes of production
- Design as art – aesthetic judgment
  - Composing
  - Representing
  - Evoking emotions
- Design as visual communication
  - Informing
  - Persuading
- Design as problem solving
  - Thought as a precursor to decision making
  - Reaction to the undesirable
  - Problem finding – locating a trigger for change
- Design as intentional change
  - *Homo sapiens* ("wise man" (sic), i.e., prudent action)
  - Forming, transforming, reforming
  - Purpose driven
  - Relating, linking, connecting
- Design as intensional change
  - Cybernetic course control
  - Way finding, navigating processes
  - Determining direction and setting course
- Design as an engine of created evolution
  - Creating evolving reality
  - Fulfilling human destiny/expressing human agency

Distinct narratives describing and explaining the nature of design can be found in a variety of contemporary discourses. At least four narratives are being used nowadays to frame and name design activities:

1. An aesthetic narrative (the beautiful) as applied to arts and crafts
2. A rational narrative (the true and the real) as applied to science, engineering, technology
3. A mercantile narrative (products and services) – the economic activity that fuels buying and selling
4. An advanced or systemic design narrative (wise action and prudent judgment) – the activity of creating holistic assemblies and complex socio-technical systems.

Aesthetic

The first narrative of design is a form of applied art that focuses on the aesthetics of designed artifacts or experiences. Creativity is a seminal dimension of design in this case. Style – most often visual – is central to how design in this approach is defined and is often associated with specific individuals or schools of design.

Rational

The second narrative of design as a form of applied science and technology is closely allied to engineering and computer science as well as to the social sciences, psychology, and other forms of "soft" science. Terms like efficiency and effectiveness dominate discussions in this narrative tradition. This form of design is grounded in forms of inquiry that describe and explain the world in terms of what is true and what is real logically and rationally. The Design Methods Movement arising in the 1960s (Alexander, 1964; Upitas, 2008; Vardouli, 1967) was an attempt to scientize design and break it free from the aesthetic, intuitive traditions found in the arts and crafts design traditions. The scientific method and the language of science are idealized standards in this approach to design. Design research, design theories, and design methods are developed within this narrative.

Mercantile

The third narrative of design derives from a mercantile determination of design as creating products and services at the heart of economic behavior. In this case, design is a "push" because consumables are first created, and then consumers are persuaded of their value and encouraged to purchase them. Innovation is the fundamental defining quality of design in this case – as opposed to mere creativity. The fundamental strategy is to move new products or services into people's lives – the definition of innovation. The term creativity is often used as a stand-in for the term innovation when in fact innovation is a follow-on to creativity – making the new or novel a part of peoples' lives – the whole point of this approach to design. Design is promoted by governmental or business organizations as an engine of "the" economy – the national economies of countries and the private economies of corporations. This is because innovation is expected to create wealth, which is not necessarily the expectation of mere creativity – the basis for the starving artist image.

Systemic Design

The fourth type of narrative, explaining design activity in complex environs, has emerged concomitantly with new systemic worldviews. It is formulated from the systemic paradigms evolving since mid-twentieth century and is focused on such ideas as integrative thinking and systems thinking. In place of reductive analysis and linear dynamics, which are representative of the mechanistic worldview dominating the previous two centuries, integration and interrelationships are today becoming more dominant in our approach to understanding how to intervene proactively in the real world.

Design, as a profession, is constrained. Professions of any kind, including design professions, are characterized by having codes of practice, standards of practice, and a commitment in part to social service. For example, in the case of architecture in the United States, potential practitioners are required to undergo years of extensive training and education and to pass rigorous, government-sponsored examinations in order to become licensed to practice as an architect. As a professional, an architect enters into legal contracts with clients who form a part of a larger design cohort. Architects are obligated to serve their clients' wishes as well as meet societal demands and professional standards. As a licensed practitioner, an architect is confronted with formal rules, regulations, codes, policies, and other legal instruments that define the professional architect's responsibilities and accountabilities in the State in which she or he practices.

Not all domains of design practice, which are labeled as design by common practice or who self-identify as such, are considered to be professions. However, some well-established domains of practice are highly regarded because of the high standards of instrumental and applied knowledge that are required and expected from them, such as in software design or interaction design.

Third Culture of Inquiry: Design

C. P. Snow, in his famous Rede Lecture at the University of Cambridge in 1959 (Snow, (2001) [1959]), presented the sciences and the humanities as two distinct and separate cultures of inquiry that were so different, there was little or no chance that adherents would find any common ground between them. However, cases have been made that common ground can be found in design defined as either an intersection point or midpoint between Snow's two cultures (Fig. 2).

If the question "what approach to inquiry and action would be best in the face of the growing challenges in today's world?" is asked, an answer that ought to be considered is that it should be a systemic approach to design – not design in the historic sense, but design in the sense of what is a better fit for nowadays – a *third culture of inquiry*. There is a need for a more robust systemic approach to change in a world of increasing complexity and contradictions. There is a need for a more apposite approach for creating desirable new artifacts – artifacts that are treated as elements in existing systems or are systems themselves. But what would such a new approach to design look like ideally, ethically, and pragmatically?

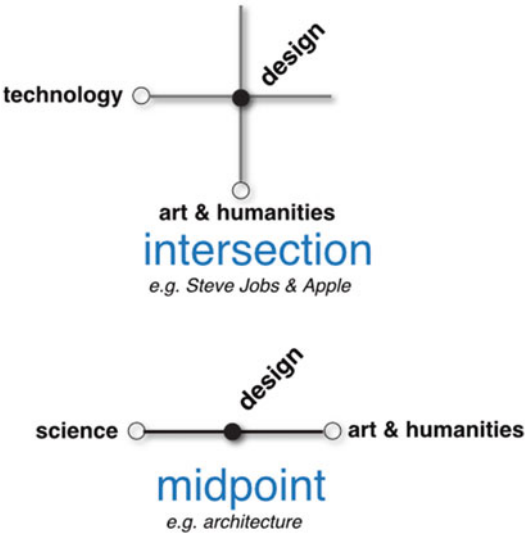

Fig. 2 Design as common ground between the sciences and the arts

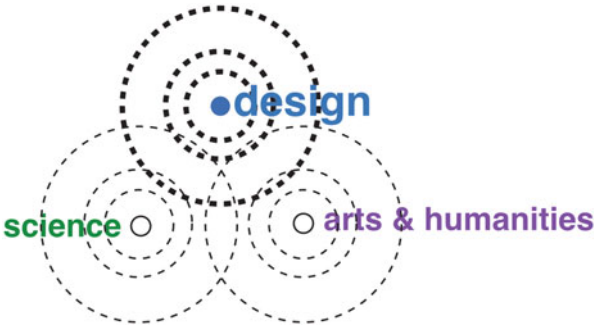

Fig. 3 Design: a distinct third culture of inquiry

Design, as a third culture of inquiry, is both a wider and deeper approach than the normative design approaches inherited from simpler times (Nelson & Stolterman, 2012). It is inclusive of seminal attributes of the sciences, the arts, and humanities, yet remains distinct from them (see Fig. 3). Design, as a third culture of inquiry, is based on postulates, assertions, and beliefs in the same way that the sciences and the humanities are based on their own sets of postulates, assertions, and beliefs. This approach to design asserts that design is one of the earliest, even first, forms of human inquiry. It also asserts that this type of inquiry is unique in that it is inquiry for action – not just description and explanation. In this chapter, this approach is expanded, framed, and named systemic design.

Designs are often described as things that are concrete and real in the same way that systems are spoken of as real objects. However, design as a verb is a stance, an approach to inquiry and action – a way of seeing, thinking, and doing. Design, based in part but not wholly on systemic logic, is separate and distinct from other meta-schemas of inquiry such as the sciences, the arts, the humanities, or religions. It is a

meta-schema that not only predates the other cultures of inquiry, but is the source of their genesis as well (Nelson & Stolterman, 2012).

This nascent design narrative is forming with greater and greater focused attention and energy because of concerns about the growing consequences of human behavior that have caused environmental damage, or for concerns such as sustainability and social justice. But beyond these issues, there is a growing interest in how humans can better fulfill their potential as global agents of change by becoming more reflective, careful, and responsible for what is, can, should, and ought to be done. In this case, design is a process of determining what would be ideal and what ought to be made real. Systemic design serves human interests and desires in ways that are accountable and empathic to those who are affected by the consequences of human agency. This form of design is inclusive of the other traditional narratives, but transcends their built-in limitations for dealing with the unintended consequences of unsystemic design behavior. This new design narrative – systemic design – provides the necessary breadth and depth for successfully creating desired and beneficial realities.

This new worldview accepts that the real world is volatile, uncertain, complex, and ambiguous. Reality is no longer considered to be merely mechanistic, simple, reductive, and purely objective. For example, dramatic and unpredictable incidents such as nuclear meltdowns have made routine *technical expertise* insufficient for understanding and interacting with real-world events.

Change is no longer considered to be simply a matter of chance or necessity. A third form of change – change by intention – has led to an opening for other forms of expertise, including *design expertise*. Proactive approaches to change are challenging the reactive stances to change – the problem-solving norm. We are also once again reminded that an "is" cannot prescribe an "ought" – as asserted by David Hume, the eighteenth century Scottish philosopher. Also, "is" cannot prescribe an "ideal" or "desired" purpose or outcome. Without a bridge between description and explanation (good science) and desirable outcomes (good design), strategies such as "coercion by fact" (Gr. *Sachzwang*) (Protzen & Harris, 2010) step in to justify taking action to create intentional change.

Systemics: The Logics of Design

There is a commonly expressed fear among scientists and other rational agents that design is too nihilistic – too relativistic. Design is dismissed as merely expressions of intuition, fashion, or "whatever" and not objective, rational inquiry. This fear has raised many barriers between scientific thinkers and design practitioners. It has confused design educators and students alike. However, systemics provides dimensions of critical reasoning to designing that many had assumed were missing but were not.

Systemic designers pay attention to environments, contexts, and the provenance of any design activity, while paying full attention – *notitia* – to the particulars and people of the moment. In systemic designing, systems and design are not only interrelated, they are inseparable. Systemic designing is an integral compound; it

is not an aggregated assembly of approaches. Systemic design as an emergent whole is not merely the summation of two interrelated strategies of inquiry. Rather, it is the integration of theory and action – wisdom. It is an integration of knowledge and skill that enables prudent action – wise action – to transpire. This is the original definition of *sophia* – from philosophy (philo (love) + sophia (wisdom)) – as the *wise hand*. It is a holistic synthesis of cultures of inquiry that is designed to both discern and create ultimate particulars while acknowledging particulars, generalities, and universalities. Systemic designing strives to be rational, beautiful, just, and good while remaining practical.

Systemics, as an array of logics used in designing, supports a way of designing that is better suited for application in real-world contexts of complexity and uncertainty. Systemics is a set of systems-related (Francois, 1999) concepts forming the logics of design:

- Systems
- General systems theories
- Systems thinking
- Systems research
- Systems approach
- Systems engineering
- Systems science/sciences
- Systems dynamics
- Systems modeling and simulation
- Cybernetics
- Complexity and chaos theories
- Living systems

Designing defines and creates relationships and links and connects things producing compositions, networks, and assemblies while systemics describes and explains compositions, networks, and assemblies in terms of their relationships, links, and connections. The two approaches are synergistic. Because of the growing scholarship and practical application of systems thinking, systems science, and related systems approaches since the Second World War, there are growing opportunities for the beneficial integration of systemics with design scholarship and practice.

Strategies for Systemic Design

There are two important, introductory systemic strategies for establishing a systemic design approach. The first is to look *in-between* events or objects to see what systemic relationships, links, or connections are in place and what qualities or synergies emerge as a consequence. Design Systemics defines the logics of the relationships, links, or connections in-between things and events. They make up the ordering and organizing systems that unify experiences and artifacts. For

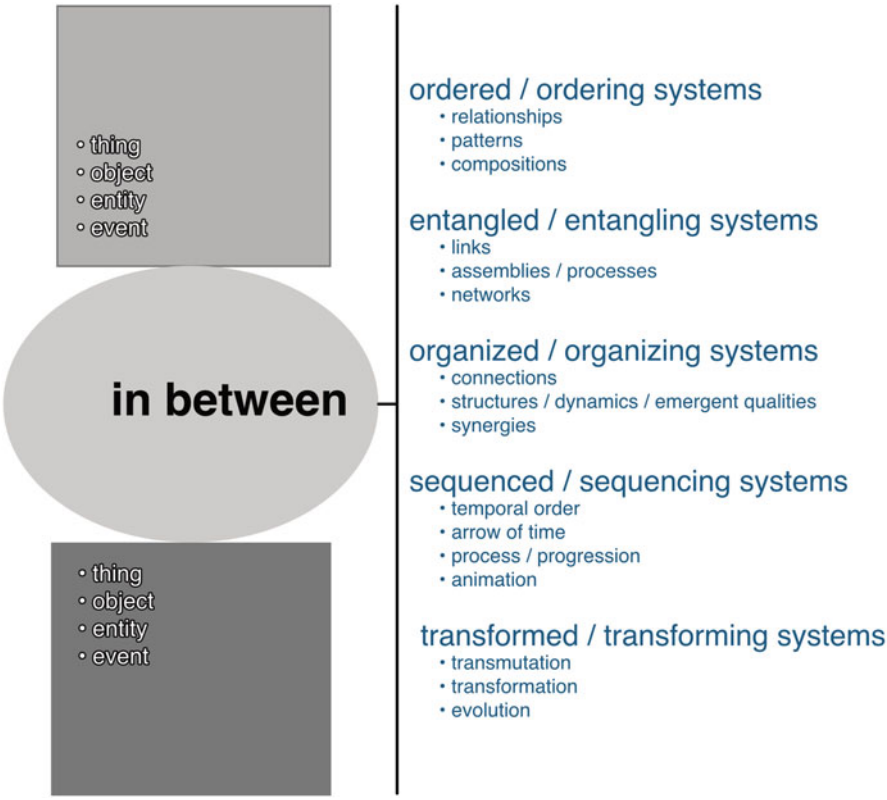

Fig. 4 Examples of systemic "in-between"

example, the in-between space can be filled with protocols forming emergent human interrelationships. Or, the in-between space can be filled with different systemic ordering systems (see Fig. 4). The challenge is to become adept at looking between things rather than just at things or into things.

The second introductory strategy involves joining events or objects through *conjunctions* ("and"). Rather than focusing on distinctions or differences between things, systemics looks at things in conjunction with one another. As mentioned above, the Greek root word sophia refers to the conjunction of thinking and doing rather than just abstract thinking on its own. Systemic conjunctions can even be inclusive of paradoxes, such as conjoining simplicity and complexity. For example, rather than labeling someone as either introvert or extrovert, systemics allows that it is possible to be *both* – describing and explaining how that can be the case. Therefore, design learning is systemic because it is based on conjunctive inquiry that results in *compositions and assemblies* rather than *categories and taxonomies*.

Systemic learning focuses on the nature and behavior of real systems. This is an important point in relationship to design learning, because whatever is designed is always a system or a part of a system embedded in a larger context. In addition, the

designer is always part of the system as it is being designed. Designing involves designers, design teams, and design cohorts, which are each a social system related to or embedded in other social systems.

From a systemic design approach, the system being designed, its context, and its environment receive synchronistic attention. For example, the systemic design of design education involves creating a design culture that understands and fully supports designers and understands design pedagogy or andragogy. Educational systems created to develop design expertise will not succeed unless they contribute to the emergence of a culture of design in return – a social cohort where the presence and actions of designers are recognized and embraced as the norm.

Everything is interconnected to a greater or lesser degree, which is the reason for the complexities found in reality. The KISS acronym (keep it simple stupid), an adage popular with pragmatic thinkers, is a misdirection. There are ways to see and interact with complex realities that are not reductive or simplistic approaches. The present geologic age, or epoch, has been designated as the *anthropocene* – the age of human influence. This is because there are no longer any natural systems that do not show the influence or effect of human activity. These influences are the results of unintended consequences as well intentional actions and are the reasons for growing concerns. These effects have contributed to a sense of anxiety in widespread sectors of the general population in relationship to human activity or agency. The vulnerability of natural systems to human influence raises the challenge of how to secure desired, prudent change rather than accidental change.

Should this new epoch be reframed as an *age-of-design*? A systemic design approach enables design to be considered as a viable option for dealing with improving the human condition in an age of interconnections and large-scale consequences. Preparing for professional praxis in an age-of-design means designers must accept greater responsibility and accountability for intentional human action. It means that they must demonstrate the necessary degree of courage to be intentional in the absence of any guarantors for right or good action. It means that it will be necessary to develop the design character required for claiming design agency – the right to create change in someone else's life.

There is a growing interest in design's potential for dealing with what people characterize as overwhelming complex problems or *wicked problems* (Rittel, 1972). An example of a tame problem-solving approach is *design thinking* (Brown, 2008) – a formulaic approach to creating and innovating new products and services. This approach was first formalized as a creative problem-solving process (CPS) by Alex Osborn (1953) in the middle of the twentieth century and continues to grow in popularity. However, this is just a wave and not the water. Assuming that design is problem-based puts change agents in reactive, fearful approaches rather than courageous, proactive stances. Design from a systemic approach is both *courageous* and *proactive*.

In addition to problem solving design, there are other kinds of design approaches, which play out in separate immersive domains of education and practice. Each is accepted as the standard or norm in their own communities of practice. Even as these

normative forms of design practice continue to evolve, unanswered questions remain. The world is changing, becoming more volatile, uncertain, unexplainable, chaotic, and ambiguous as mentioned earlier. Changes by chance or necessity compete with attempts to achieve desirable outcomes while avoiding undesirable consequences. A systemic schema of the diverse approaches to designing and their interrelationships can be profitably represented using a metaphor.

Portals to Designing: An Airport Departure Gate Metaphor

To structure a narrative about what designing is now and has been in the recent past, we turn to a metaphor of an airport and its departure gates as portals to design domains. Doing this allows us to expansively differentiate design strategies and their concomitant immersive contexts or domains of design. In this schema, each departure gate conceptually frames a particular stance and approach to designing – the *buy-in* as it were. This approach is not based on historical timelines of design movements or styles as is typical of narratives about design. This account shows the diversity of approaches to design that are in place and in practice today.

The departure gate metaphor does not speak to the nature of any particular design journey, but only to the nature of the assertions and assumptions – the buy-ins – embedded in each contextual portal through which we pass on our way to a particular design adventure. The departure gates included in this metaphoric schema are an inclusive list, not an exclusive list. The list comprises:

- Connecting and arrival gates
  - Design's ecosystems – context and environment
  - Design's provenance – history and inheritance
- Gates used by the "frequent fliers"
  - Art design
  - Craft design
  - Engineering and technology design
  - Scientized design
  - Problematized design
  - Transaction design
- Gates for emerging new routes
  - Deep design
  - Wide design
  - Systemic design

Design Ecosystems and Provenance

The *connecting and arrival gates* in the airport schema (see Fig. 5) are exemplary of an *open system* structure with connections and open links to outside influences, including antecedents, environmental, and contextual effects. This includes design's provenance – design inquiry being one of the first traditions of inquiry used by our ancient ancestors. Another example of an open-system attribute that is revealed by using an airport metaphor is the presence of an *arrival concourse* where key

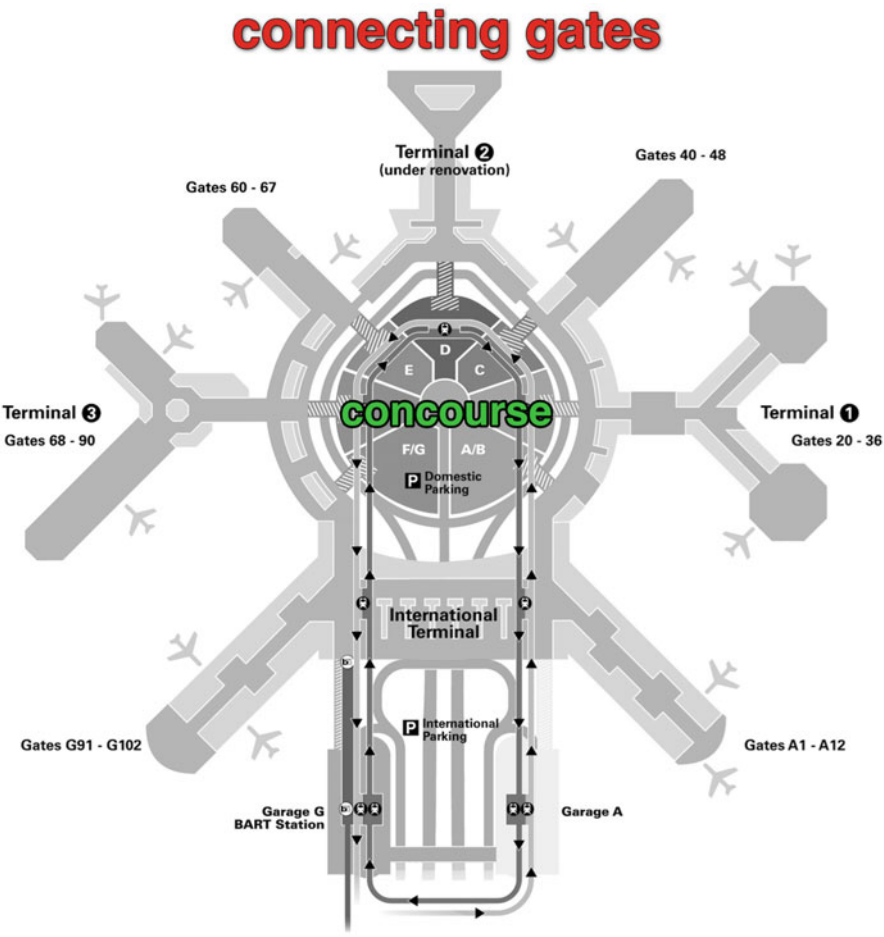

Fig. 5 Open systems links: connecting gates and concourse

triggering questions are answered. Questions such as: "What inspiration or aspiration initiated the desire for taking a design journey in the first place?" "Who are the travel agents (hint: teachers and mentors, etc.) that assist in the preplanning stage of the journey?" "Who guides travelers through the many travel options that an airport facilitates, and what should be packed in the carry-on luggage as necessary baggage and what should be checked?"

Normative Design: Six Systemic Design Portals

The departure gates that represent the normative categories of design – those used by "frequent fliers" – are well established (see Fig. 6). The first gate – *design as art* – opens up to functional art and is heavily biased toward aesthetic consideration. The second gate – *craft design* – is heavily biased toward an appreciation for, and expression of, materials and skill. It provides access to the world of hand-making

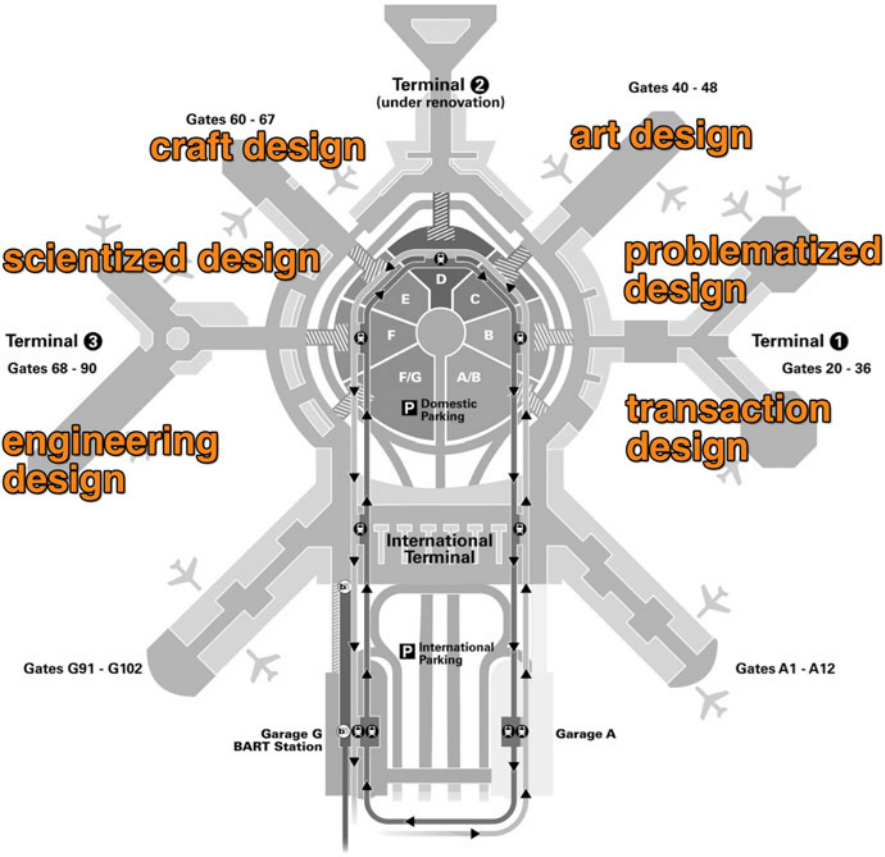

Fig. 6 Departure gates – frequent fliers

and crafting as well as quality production. The third gate – *engineering design* – opens onto activities creating efficiency and effectiveness in functional assemblies and technologies. The fourth gate – *scientized design* – opens up to an array of different fields of applied science with research and critical thinking the preferred form of inquiry (Simon, 1982). This gateway to design is singularly objective and rational.

The fifth gate for "frequent fliers" – *problematized design* – opens up to a place where design is triggered by, and guided by, problem statements. Problem solving is the primary process of inquiry – reactive and rationalistic. One of the concerns with this portal is that there is a problem with problems (Ackoff, 1974; Ackoff, Magidson, & Addison, 2006; Rittel, 1972; Simon, 1973). However the problem-focused approach, despite substantive concerns, remains popular and appealing.

The sixth gate – *transaction design* – opens onto economic undertakings such as the design of products, experiences, and services. All to be sold to consumers or customers in a market economy. One of the exemplars of this approach to design is the well-known and successful Apple hi-tech product line and its guiding design

spirit, Steve Jobs. This approach to design is very much grounded in the free market traditions of the West, where people are free to choose what to purchase usually under a heavy influence from the seller. Its agency of self-interest – acting to produce a particular result in someone else's life without a contract to do so – resides in the processes of rhetoric and persuasion with the admonition of course of "buyer beware." Many businesses in the business of creating or designing products and services will use various means for pretesting consumers' tastes and preferences as a hedge or aid in selling, but the process is still one of a *persuaded transaction*. As Steve Jobs said:

> It's really hard to design products by focus groups. A lot of times, people don't know what they want until you show it to them. – *BusinessWeek*, May 25, 1998

In noneconomic settings, this approach is used to bring change to social systems in the guise of a leader championing a cause for the greater good by someone who knows what the greater good is. The hero, or leader, persuades people to buy into his or her vision for their own benefit. For example, in the case of an academic program, students are sold an educational package that they are told is, or will be, beneficial for them.

The educational programs, which prepare students to choose to pass through particular departure gates, are matched to the buy-ins each gate requires for passage. Some educational programs in design have long, well-developed histories, while others are essentially brand new. Many programs are under constant critique with occasional redesigns, but seldom any transformations. The types of expertise developed in each type of program vary widely.

Systemic Design, Deep Design, and Wide Design: New Departure Gates

Outside the normative domains of the frequent fliers, new departure gates have begun to emerge that exemplify more compatible strategies for standing up to the challenges and growing expectations of people in an ever more complex, dynamic world. These new options reflect a wider stance and a deeper approach to design. For example, change here is asserted to be a result of intention rather than reaction – the response to change caused by chance or necessity. Here design courage mediates between the epistemic freedom to do anything and the need for prudent or wise judgments to be made concerning appropriate actions taken in the creation of the real world.

There are three new departure gates that have begun to emerge (see Fig. 7). Of particular interest for the purpose of this chapter is the new systemic design portal. The other two new portals, *wide design* and *deep design*, will be explored in greater detail at another time. Systemic design is based on contractual relationships among a cohort of stakeholders, including clients, who work together to recreate a reality in their favor. These relationships can be definitive or implied, and are by necessity ethical and professional.

In this context, designers work on behalf of others who have granted them design agency. Systemic design agents serve the interests of others rather than just their own

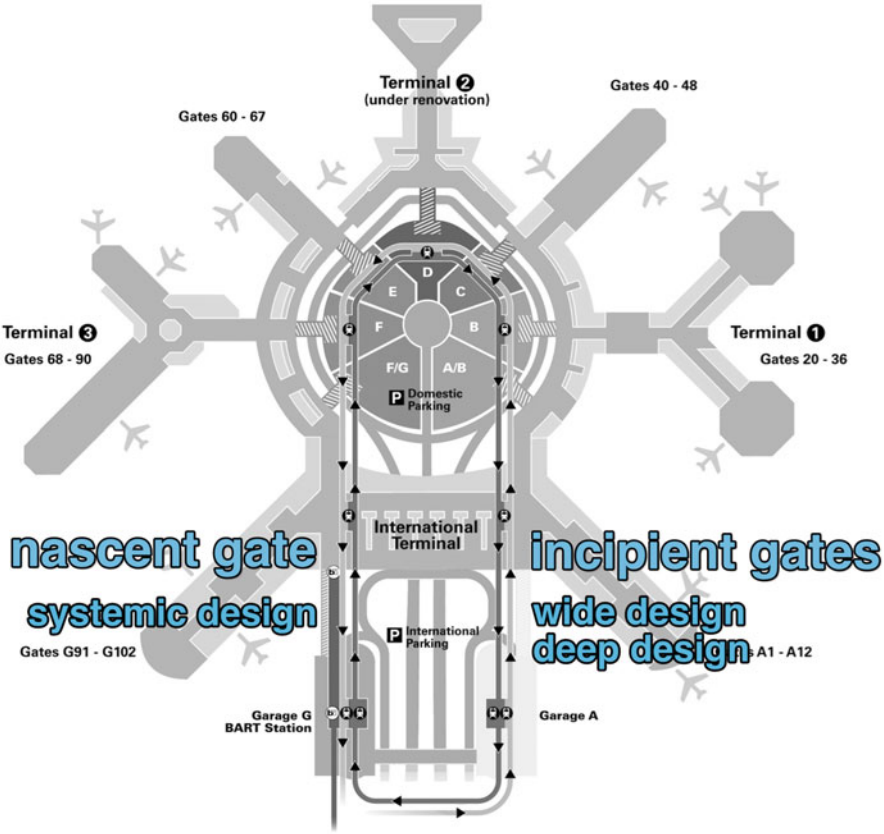

Fig. 7 New departure gates

self-interests, as can be the case (legitimately) for artists and scientists. Design contracts – formal and informal – are service contracts. They are not contracts to fix or help others. They do not treat others as helpless or broken (Remen, 1996). They serve others as equals with equal standing with a fair exchange of value. This is a fundamental requirement for any authentic systemic design contract.

Centering Design

Systemic design is not an open-ended creative process, nor is it constrictively narrow. Its focus is on establishing clarity, congruence, and direction. For example, the focus for systemic designing can be on making distinctions among multiple approaches for *centering* attention. Centering reveals the first intentions of any particular approach to designing for example. The centering process identifies design agency by identifying who the design is "for" and "by" and the interrelationships

"among" the design cohort. The centering of design action reveals the assumptions and initial conditions that are in place at the beginning of a particular design process.

Unlike traditional *material design* that focuses on objects and experiences – such as design thinking that focuses on users, consumers, or customers – systemic design focuses on diverse, more complex varieties of approaches for centering design purpose. For example, in addition to *user* or *customer-centered design*, the centering process of systemic designing involves focusing on the *capacitation* (development of intellectual and instrumental abilities) of individuals, social systems, and whole (living) systems. Approaches to centering include:

- Object centered – thing
- "Human centered" – user, consumer
- "Human" centered – design of a life
- "Human-centered" – social systems
- Life centered – whole systems

Systemic Design Postulates and Assertions

Basically, postulates form the fundamental belief system upon which designers depend for firm footing in a constantly shifting reality. Their judgment calls stand on affirmed *design postulates* and *design assertions* as well as the real *particulars* or *ultimate particulars* of any design project. Postulates and assertions are different in kind from assumptions and habits of mind. The former reflects awareness while the latter typically does not. Postulates and assertions are essential for good design but require constant assessment. Being *design-minded* includes being aware of the postulates and assertions in place at the start of any design enterprise. Affirmed design postulates may include:

- Design creates reality and steers evolution
- Design will is free will
- Design inquiry embraces epistemic freedom
- Design bridges "is" to "ought" and "desired"
- Design is a service agency relationship
- Design is the first tradition and third culture of inquiry
- Systemics are the logics of design
- Designing is synthetic, integrative, and holistic
- Design inquiry is inquiry for action
- Design scholarship is the unification of knowledge
- Design inquiry is an integration of thinking and action
- Design is humanistic, rational, ethical, and aesthetic
- Character counts in design
- Designing is a social system behavior

Designing supported by a set of postulates – given or prescribed – is grounded in a belief system that continues to evolve. Such postulates are similar in purpose to the

fundamental pallets of all other basic, foundational cultures of inquiry. By taking an analytic approach, it is possible to uncover the active postulates underpinning historic design behavior. Taking a design approach to postulation, it is possible to decide what postulates should or ought to be put into place to support desirable design behavior. The desirable postulates that are not yet in place can be proposed as new additions to existing design pallets. Future design stances, individually or collectively, can adopt the new proposals if desired. Three categories of postulates comprising pallets include:

- That which is taken for granted or accepted as a fundamental belief
- That which is observed to be successfully used in practice – accretions
- That which is desired to be put into practice – aspired to

Emerging assertions are layered onto the foundational postulates, both of which are revealed through the praxis of designers in action. Assertions translate postulates into reasons for taking stances and approaches to action in designing. For example: "Why is systemic design relevant to the complex challenges of contemporary life?" Four assertions are made. First, because designed artifacts, regardless of design approach, are parts of systems or systems themselves. Second, designed changes are made to the dynamic behavior of systems and systemic elements. Third, designers are members of social systems and are themselves living systems. Fourth and finally, all things are interconnected systemically in some way to lesser or greater degrees. These assertions make the case that systemic design is *apposite* (appropriate, suitable, fitting) for today's complex and dynamic challenges. These systemic assertions support other assertions:

- The world is becoming more complexly interlinked, resulting in increased global consequences for delimited actions.
- There is a need for newer, more fully developed forms of expertise and competencies in order to meet surging complex organizational challenges and entangling public, governmental, and professional expectations.
- There are no panaceas for dealing with unpredictable, complex changes. Every design challenge in response is unique and systemic.
- The emerging expectations for organizational leadership require new perspectives and approaches.
- Businesses, nonprofits, governmental agencies, institutions, civil society, and communities are influencing and influenced by one another, redefining the boundaries of professional roles and responsibilities.
- Organizational designers are professionally and ethically responsible for defining strategies to create desired states of human affairs within complex environments in the face of unpredictable changes of increasing complexity.

Design assertions determine how design inquiry relates to other strategies of inquiry, such as the relationship between designing and *futuring* – a popular basis for planning:

- The future is not predetermined.
- The future does not just happen.
- Design action is not based on prediction.
- Design action is not reaction.
- The future starts now.
- The future can be designed.

Systemic Design Causes: The Logics of Design

The simple first step when taking a systems approach of looking "in-between" reveals what existing interactions need to be preserved and protected or where desired interactions are absent. Where absent, designing is the act of putting such desired relationships, links, or connections into place – in-between essential elements, parts, or components.

Designing is the process of manifesting – making something real – intention through the use of *causes* (forces) that are the shaping influences of reality. Design causes are the means for enacting or enabling design agency. Design-related causes are inclusive of:

Self-cause – intension
- Desires or desiderata
- Inspiration

Action cause – intention
- Goals
- Targets
- Objectives
- Ideals

Design cause – Aristotle expanded
- Material
- Instrumental
- Formal
- Final
- Particular
- Aim/direction

Designers cause changes to occur in the real world. Becoming a designer means learning how designers go about causing desirable realities to come into existence. Becoming a designer means learning how to translate this understanding into actions.

A full exploration of the nature of different types of design causes is not possible within the limits of this chapter. However, an introduction to the basic underlying concept can be made by looking at Aristotle's notion of fundamental causes expanded into a more comprehensive schema of design causes. Aristotle's schema presents four types of causes that are the basis for the appearances and behaviors

of material phenomena. For example, in architecture or engineering, a structural column's appearance and function can be explained in a straightforward manner. This can be done using each of Aristotle's four types of cause: (1) the *material* the column is made from, (2) the *means* or methods used to form the column, (3) the visual and functional *form* given to the column, and (4) the *purpose* served by the column. Taken together they explain its unique appearance in any particular setting.

In a more complex world, that includes human intention, designs emerge that are invisible as well as visible, abstract as well as concrete, living as well as technologic. Simple material causes cannot describe or explain such a reality on their own. The list of causes needs to expand to include design-related types of cause. The design schema below (see Fig. 8) shows the additional two types of cause (*aims*, *particulars*) that relate directly to agency and contextual complexity. It also shows the mediating factors (*limits and containers*, *imagination*, *phronesis*, *techne*, *elements*, *and hypostasis*) between each of the constituent causes. These mediating factors integrate the separate causes into a comprehensive whole design process – revealing the multiple, additional transformational accountabilities to be taken on by those who want to become successful design practitioners.

Designing the Designers

Despite the fact that what designing is and does remains a mystery, it is necessary to ask: "How does one become a designer?" This question focuses attention on design learning and training – formal and informal. Related questions arise such as: "What are good design practices and how can one become better at being a good designer through learning, training, and experience?"

The various forms of design narratives or typologies are supported by, and connected to, a variety of means for preparing inexperienced novices to become designers, or experienced designers to become even better systemic designers, even *scholar-practitioners*. These approaches include both formal and informal designs of education inclusive of training, learning, and experiential learning. Conventional forms of design praxis currently in place have well-established schools and practical programs for preparing future designers for work in their distinct domains of design. Although these educational designs are occasionally critiqued and improved upon, it's not enough. Just as the light bulb is not an outcome of continuous improvement on the candle, nor is the automobile the product of continuous improvement on the horse, existing design practices and education programs cannot be improved upon enough to meet contemporary needs. Disruptive educational designs must be innovated as a response to the increasing complexity of today's world. The increased complexity of contemporary design praxis increases the demand for more relevant design education. The growing list of new opportunities for designing is beyond the limits of traditional academic design domains.

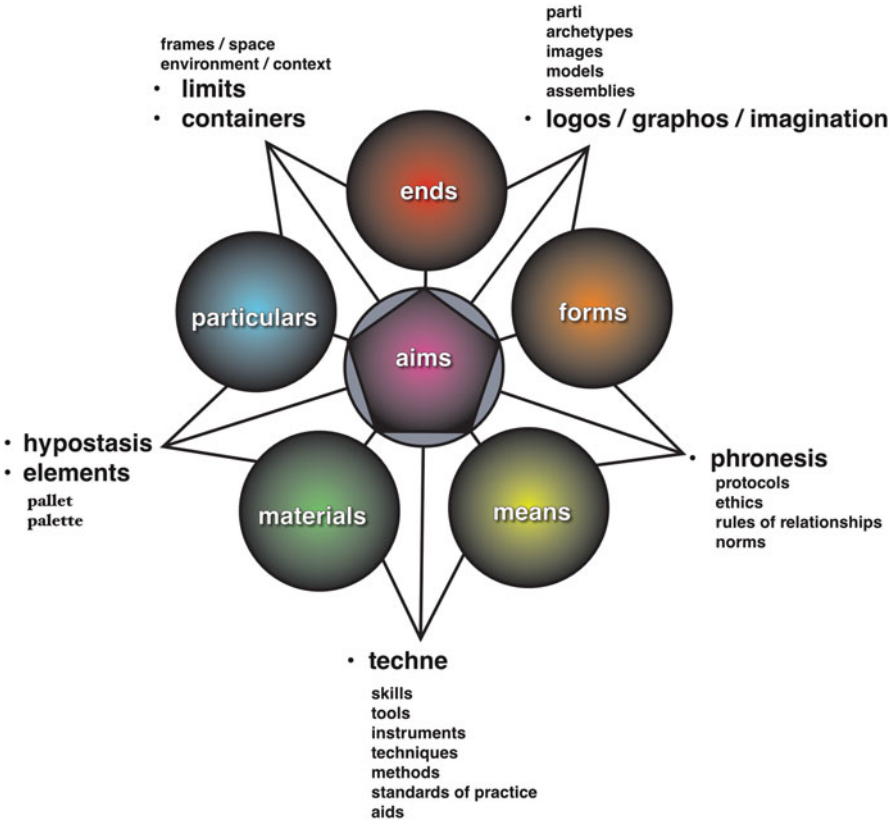

Fig. 8 Design causes and mediating factors

It is clear that a more apposite approach to designing educational systems is prudent and necessary. Through a bootstrap approach, design inquiry can be used to design educational programs in design. As with any good design process, it is important to start with well-formed questions. These questions are systemically intertwined and difficult to divide into separate threads of inquiry that stay unentangled. That said, we start with the first question: "How does one become a designer?"

Design learning is inclusive of both *abstract learning* and *experiential learning*. Too often abstract learning is posed as opposite to experiential learning in relevance and value. However, they are not opposites. They are systemically bound together. Abstract learning involves becoming aware of ideas and concepts from one's own or another's reflective contemplations. Experiential learning is *reflective learning* responding to events in the real world or in the imagination.

Experiential learning is not just doing something to observe outcomes in order to learn something about cause and effect in the real world – action research – or, more simply, to learn to stop doing what didn't work and try something else. To be most successful, experiential learning should take the form of *deep learning*.

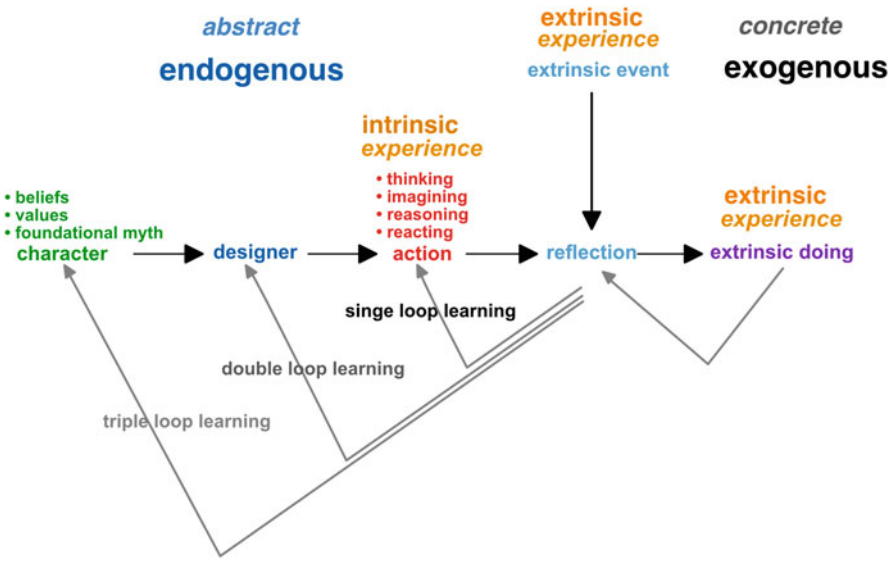

Fig. 9 The experiential (deep) learning process

Deep learning requires careful reflections on actions taken and their consequences. *Reflective learning* requires that the consequences of action be abstracted to levels of understanding that inform ever deeper levels of learning: *single loop learning*, *double loop learning*, and *triple loop learning* (see Fig. 9).

Design education, as a focused and controlled learning process, can be facilitated in both formal and informal settings. Formal learning is guided by an established curriculum and a carefully scored andragogic or pedagogic process. Experiential learning is *minded experience*. It occurs when full reflective attention is paid to particulars or events – whether occurring by intention, chance, serendipity, or happenstance. For example, case studies are a form of minded experience. They are vicarious experiences that, when reflected upon, can result in some of the same levels of experiential learning – or close proximities of – as direct experiences do.

Learning how to design the designer is the responsibility of both the learner and those who are facilitating the learner's capacitation. Design education is the process of facilitating the development of the *design mind*. There are two conditions that define a design mind – stance and approach:

Stance – grounding

- Postulates
- Degrees of freedom
- Lenses
- Filters
- Values, belief systems
- Cognitive frame

Approach – action
- Intension
- Intention
- Agency
- First intentions

The immergence of the design mind is manifested through the transformation of free will into the expression of *design will*. The design mind has at least three distinct manifestations of design will:

- Intensional mind
  – finding direction and aiming desiderata
- Intentional mind
  – fulfilling purpose by determining desired outcomes
- Mindedness
  – self-awareness, introspection

Mindedness denotes the personal responsibilities and accountabilities for self-organization and self-development as a designer and includes:

- Purpose and aspiration
- Direction and bearing
- Cognitive frame
- Notitia or awareness
- Mediative lenses and filters
- Values and beliefs
- Self-awareness and introspection
- Self-designing ability
- Systemic awareness and connections
- Character
- Capacitation

For example, *self-designing* involves developing qualities, traits, and attributes necessary to qualify and justify assuming agency in other people's lives including:

- Having presence – being fully in the moment and paying full attention
- Maintaining ethical standards – doing the right thing, for the right people, at the right time, in the right place, for the right reasons
- Showing courage – taking responsibility and being accountable for midwifing reality
- Showing character – personal excellence, honor, and integrity
- Displaying craftsmanship – skillfully creating artifacts of value

Design education's focus needs to be on individuals as members of different types of social systems. Since designers seldom, if ever, work alone, individuals need to learn how to become a contributing member of self-organizing social systems such

as functional groups, teams, design teams, and design cohorts. Learning to participate in or manage each type is crucial in the education of a designer and in the practice of design.

Systemic designers need to engage in each cooperative type of design-related social system at the right time for the right reasons in the right way. This is an essential competence to be developed through design education. Everyone in a design cohort is equal, but everyone is not the same, nor are their contributions to collective designing the same. Collaborative designing is not an expression of egalitarianism, but an expression of diversity and strength through shared participation. Shared designing results in synergies and emergent abilities greater than the aggregate.

Designing Design Learning

Designers are complex inquirers both subjectively and objectively. Their approach to inquiry is a mediation between intrinsic and extrinsic influences. A schema of the cognitive framework of a designer discloses a composition of psychological types, layers of perception, and intellectual structures with mediating filters and lenses in-between the designer and "reality" (see Figs. 10 and 11). One of the key challenges for any designer is to be able to reflect on the particulars of their own cognitive framework and to decide what they want to keep unchanged and what they want to change, modify, or dissolve. They need to be able to make modifications or changes to this framework in an ongoing basis – self redesigning.

The existential design challenge for designing design education is to use an inborn design inquiry competence – the innate design ability. This is called bootstrapping – like building an airplane while in flight. The nature of the fundamental ability to design anything, including the design of design inquiry, is one of the many mysteries associated with designing. West Churchman (1971) wrote about a select group of designed approaches to inquiry created by European philosophers in past centuries to answer the generic question: "what is true?"

- Leibnizian – fact nets
- Lockean – consensus
- Kantian – representations
- Hegelian – dialectics
- Singarian – progress
- Churchmanian – systems approach and ethics

These designs of inquiry still influence today's rational discourses, including dimensions of designing. Interestingly, Churchman did not reflect on the nature of design inquiry itself – the approach that had to be used by the selected philosophers to create their own designs of truth-seeking inquiry. Including himself.

When associated with design, inquiry is often referred to simply as "research." However, real research is just one particular form of truth-revealing inquiry. Looking

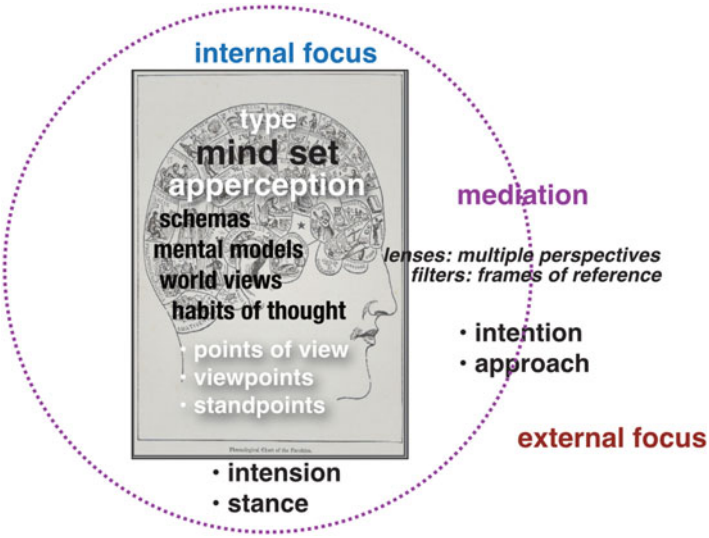

Fig. 10 Mediation in-between intrinsic and extrinsic focus of inquiry

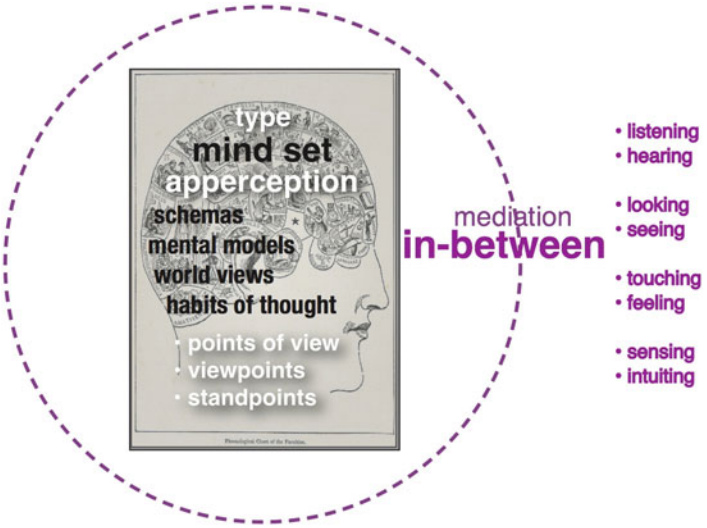

Fig. 11 Example of mediation in-between the intrinsic and extrinsic

things up on the web or in the library are activities of inquiry useful to designers, but this is not a form of scientific inquiry – research using the scientific method – which is a very controlled, rational approach to inquiry. Research is used to describe and explain things that are believed to be true. Design inquiry on the other hand is inquiry for action followed by action. Design inquiry is a compound process of

inquiry consisting of multiple types of inquiry, all of which are woven into one integrated approach to design inquiry. Questions – well-formed questions – give direction to design inquiry. Seminal well-formed design questions are:

- What is true?
- What is real?
- What would be ideal?
- What ought to be made real?

They give direction to design inquiry and are interrelated systemically rather than hierarchically. Well-formed ultimate particular (unique and singular) questions, relevant to particular design projects, further refine the design process's aim and direction. For example: "Who, in particular, is to be served by the design; who, in particular, should have agency to carry out the designing?"

Heather Banchi and Randy Bell (2008) suggest that there are four levels of inquiry-based learning in science education:

1. Conformation inquiry: Verifying concepts by following a procedure.
2. Structured inquiry: Following a procedure to find an answer.
3. Guided inquiry: Instructor provides a question, and learners pick an approach to find an answer.
4. Open inquiry: Learners ask the question, then find an answer.

Design inquiry includes this taxonomy at the lower levels of design learning where the point of inquiry is to describe and explain natural phenomena. However, description and explanation do not prescribe action nor justify action. Design inquiry also includes inquiry into what would be desirable, ethical, and prudent. It includes determining the right direction for the inquiry to take and how to follow through with skill, courage, and action – *design navigation*. Design inquiry requires more capacities than found in explanatory and descriptive forms of inquiry.

Becoming Systemic Designers: Scholarship and Praxis

Design learning continues over a lifetime – *lifelong learning*. Since design inquiry is a learning process, it can be used as a model for the pedagogical or andragogic designs used for attaining an education in design. It can be used to organize and score the pedagogical or andragogic dynamics of the learning and training processes in design education.

Design scholarship does not fit easily into the typical structures of academic institutions. It is often linked with science or art or left to its own devices as a profession. A schema for proposed new forms of scholarship developed by the Carnegie Foundation (Boyer, Moser, Ream, & Braxton, 2016) is an example of a new academic structure that could offer a place for design scholarship:

Proposed scholarship		Design scholarship
Scholarship of discovery	>	Inquiry for action
Scholarship of integration	>	Systemics
Scholarship of application	>	Service and agency
Scholarship of teaching	>	Capacitation – formal and informal

What is it that we need to learn to do to become systemic designers in an increasingly complex and volatile era? What is design, designing, and associated design education? By engaging in reverse engineering – we can make reflective observations, aided by reasonable speculation, that lead to useful theories about traditional or normative design. We can observe how the professions and disciplines affiliated with design choose to describe what they do and how they do it. We can describe and explain the designers' professional status, as it has evolved over time. We can describe and explain designing using either best approximations of what is thought to be the true nature of design or as historic stages in an ongoing, non-deterministic, evolutionary process. We can ask what people think they know or what they sense the true or real nature of design to be.

From responses to this line of questioning, the expectation is we can discern principles and invariant truths about design. We can ask people how they believe design ought to be made useful. We can ask what practical design would look like. From these lines of interrogation mixed with practical experiences (*praxis*), it will be possible to collaboratively improve the way we prepare novices to become systemic designers.

The point is that we want to improve the very nature of design itself – becoming more systemic, aesthetic, and ethical – in order to better match the challenges, expectations, and hopes of today. More importantly and interestingly, we are asking in a serious way, what should design, designing, and design education be ideally, ethically, and practically? Design may be a complex mystery like water, but unlike water, it is not strictly a natural phenomenon that can be observed and understood scientifically. Aspects of design are natural, but much more of its nature is unnatural, in that it is the consequence of human ingenuity and creativity. Design continues to evolve over time and does not have a predetermined end-state.

Systemic Design Learning Domains

The *locus* for design learning can be schematized as residing in four learning domains (see Fig. 12). These systemic design *learning domains* are interrelated to one another as distinct domains of learning demarcated along an axis going from abstraction to concreteness and another axis moving from the personal to the collective. The personal is the domain of the individual and the collective is the domain of the social system in which the individual is embedded. Systemic design education needs to be designed to take into account all four domains, providing learning or training activities that address each of them individually as well as holistically.

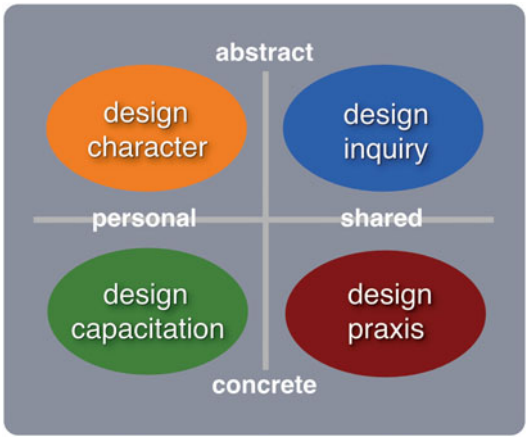

Fig. 12 Systemic design learning domains

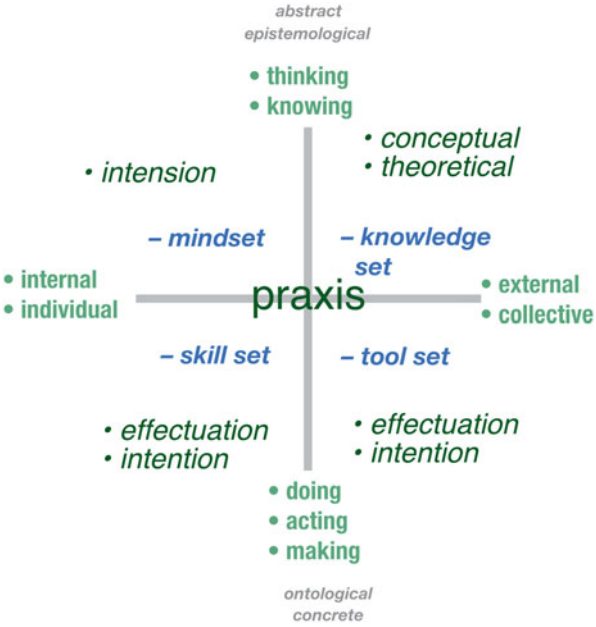

Fig. 13 Systemic design learning sets

Learning Sets

The interrelationships of systemic design *learning sets* can be shown using another quadrant schema (see Fig. 13). One axis moves between a thinking and knowing pole to a doing, acting, and making pole. The second defining axis, perpendicular to the first, moves between an internal and individual pole to an external and collective pole. The learning process begins with learners establishing each of the sets initially

and then maintaining the sets by updating and renewing the content, as well as discarding content that is no longer relevant. The ability to manage the upkeep of the sets is of singular importance in systemic designing.

The four design sets are proportionally focused on both particulars and universals:

1. Design *mindset*
   - Structures, norms, logic systems, protocols
   - Creativity crucible
   - Thinking context and environment
   - Cognitive framework
   - Frame-of-reference
   - Liquid intelligence, liquid mind
   - Stance: open mind, new mind, beginners mind
2. Design *knowledge set*
   - Knowledge (separable from knower)
   - Justified true belief
   - Education and experience
   - Data, information, knowledge, understanding, wisdom
   - Knowing-in-the-moment (inseparable from knower – judgment)
3. Design *skill set*
   - Skill acquisition ability
   - Artisanship
   - Training
   - Instrumental abilities
4. Design *tool set*
   - Enabling instruments
   - Methods
   - Processes
   - Technologies

Changing Mindset

The *ability* to change one's mindset is extremely important given its central role in design inquiry. The ability to initiate a cognitive shift in the mindset of a designer allows the designer, whether learner or practitioner, to mentally pivot when desired or needed. It becomes possible to change ones' mindset by using a form of *cognitive liquefaction*, so to speak, followed by the crystallization of a new cognitive frame. It makes it possible to execute a transformation in self. Mindset is exemplified in part by:

- Types of intelligences, learning styles, thinking styles
- High-level cognitive abilities
  - Mindedness – self-knowledge, self-reflection, self-intervention
  - Reasoning, decision-making

  - Judgment making
  - Creativity
  - Empathy
- Maturity of mind
- Cognitive frameworks
- Frames-of-reference

The time and energy spent in managing mindsets should never be undervalued. The importance of having the competence to change mindsets, either in individuals or in the collective minds of an organization or a social systems "culture," should not be underestimated. Learning how to manage and change mindsets is one of the most important and essential design abilities to be learned and practiced.

The systemic mediation of sets involves not only learning how to establish sets, renew sets, and apply sets (see Fig. 14), but also, most importantly, learning how to mediate among the sets by forming links, making connections, and defining relationships (Nelson & Stolterman, 2012) (see Fig. 15).

To be a systemic designer, it is essential to be fluent in fundamental systemic design abilities, such as:

- The ability to take a design stance – **intension**
- The ability to make sense of complexity – **schematize**
- The ability to make a holistic assessment and evaluation of design situations – **systemics**
- The ability to see and select essential elements – **systemics**
- The ability to see, protect, and repair essential relationships and connections – **sustainability**
- The ability to prepare, initiate, and carry out design action – **intention**
- The ability to create and form essential relationships and connections – **adeptness**
- The ability to (1) self-design, (2) design in support of self, and (3) design on behalf of others – **design expertise**
- The ability to create and manage project design teams and projects – **design management**

Acquiring Expertise

Systemic design pedagogy and andragogy are transformational processes, rather than processes of linear summation and aggregation (Nelson & Stolterman, 2012). The systemic design process unfolds through stages and phases that are distinct in character and type from one another. Outputs of each become inputs to the next. The content of a course or a collection of courses is not the same as a pedagogy or the process of learning. An integrated, transformational learning process leading to a designated level of expertise – for example a degree process – is not merely a curriculum.

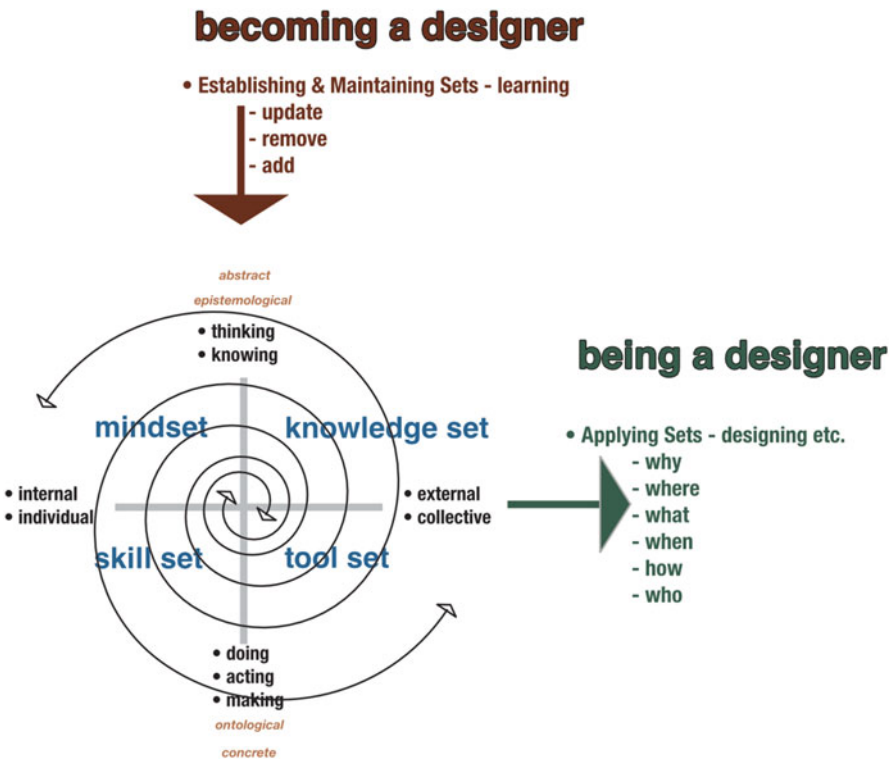

Fig. 14 Becoming and being a designer

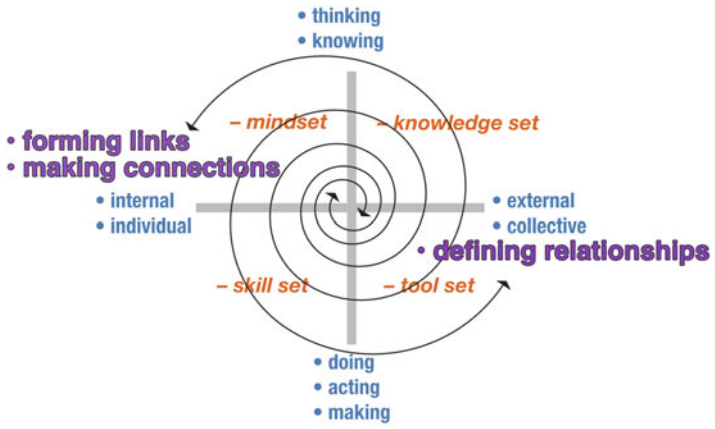

Fig. 15 Mediating sets

Fig. 16 Cooking – a transformational process

An excellent example of a transformational process is cooking (see Fig. 16). A metaphor for design education could be the process of cooking and serving – as opposed to just choosing items at a food market. The critical question is what kinds of meals get served in today's typical educational cafeteria?

A systemically designed academic process for design learning (capacitation) is an emergent, transformational production process based on approaches used in professional design practice. The particular score for any design learning process will vary according to the particulars of the situation, but the general stages and phases remain constant. For example, using the design sets as elements in a design learning process, a score for an academic design program can be transcribed as a dramatic change process (see Fig. 17). From the perspective of educators, the process of becoming a designer is a process of transformation. From the perspective of students, the same thing holds true, with the significant difference being that the student experiences the process of transformation at a personal level.

Learning styles, types of intelligence, and similar categories have been mixed into traditional subject-matter taxonomies. These are formed around educational and

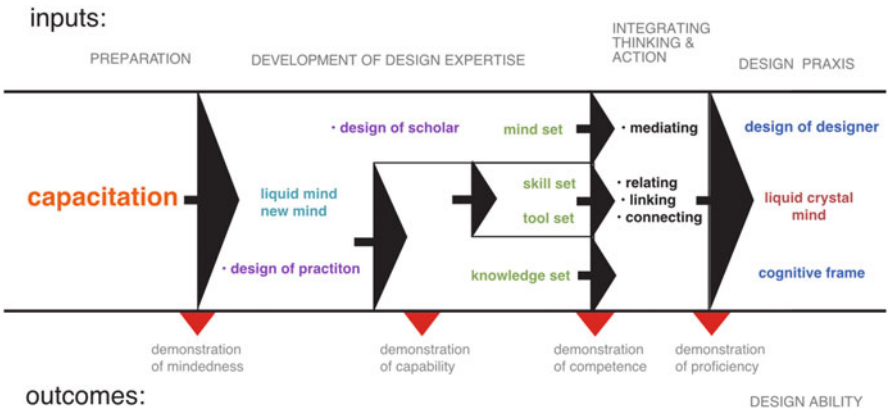

Fig. 17 A "Score" for learning to become a designer

training programs designed primarily to develop *routine experts*. However, because of the increase in the rapid pace of complex changes in all aspects of life, there is a growing need for *adaptive experts* (Bransford, 2000; Bransford et al., 2010).

Routine expertise guarantees anticipated or presumed outcomes, while adaptive expertise ideally guarantees *expected unexpected outcomes* – the ability to be creative and innovative. Adaptive experts emerge between undisciplined novelty generation and unchanging fundamentals (see Fig. 18). The mediated developmental learning path between creativity and certainty leads to the development of *adaptive expertise*. Adaptive experts make meaning in contexts of significant change and uncertainty. This is in contrast to routine experts who apply ready-made answers to pre-categorized situations with the assumption that nothing fundamental changes over time. STEM educational programs primarily produce routine experts, for example.

Academically it is easy to test for routine expertise, especially with ubiquitous machine grading. Because of the ease in grading, ease of delivery, and ease of formulating the content, routine expertise has become the default objective of a majority of educational designs. In the history of education, we see that educational professionals are well known for remaining focused on the means and methods used in the development of routine experts. The predominant assumption in this type of formal and experiential education is that science or the arts and humanities form the basis or foundation for curriculum and pedagogy. They form the intellectual platform for routine experts.

The need for different types of expertise in today's world includes but goes beyond adaptive expertise to include:

- Design expertise (systemic designers): create desired change
- Value expertise (clients, stakeholders): give direction to change
- Adaptive expertise (problem solvers): react to relentless change

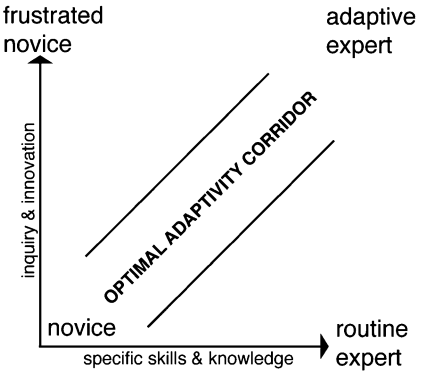

Fig. 18 Bransford's expert development model

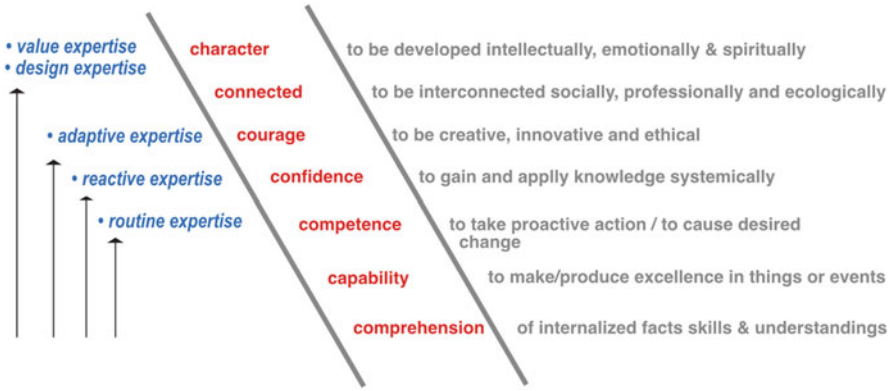

Fig. 19 Hierarchy of expertise and capacitation

- Reactive expertise (trained professionals): interact with sudden change
- Domain or subject-matter expertise (consultants): manifest evolving change
- Routine expertise (technicians): stable state – no change

The intention of systemic design education is to develop design experts who accept not only that significant change occurs, but also that significant *desired* change can be caused to occur through their agency. They believe that intentional change can be formulated and carried out, with the expectation that the outcome will be as desired with minimal undesired side effects. They understand and accept that they change or recreate reality.

A schema for design education should match the different types of expertise with specific types of capacitation in hierarchical form (see Fig. 19). The higher orders of expertise are inclusive of each of the next lower orders of expertise and capacitation.

There is an important distinction between training and learning (see Fig. 20) that is too often glossed over in discourses concerning education in general and design education in particular (Nelson & Stolterman, 2012). Both training and learning are essential to the development of design practitioners, but the purpose or outcome

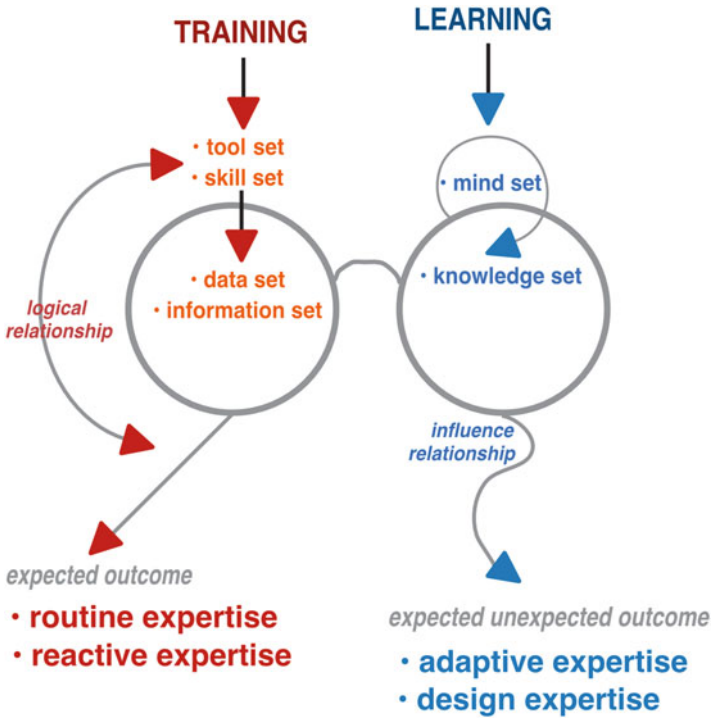

Fig. 20 Training and learning

of each is very different, plus the means for attaining each is different. Companies and governmental agencies often spend a great deal of time and resources on training. This is convenient because the ability to control for outcomes is much simpler with training than it is for learning. However systemic designing requires both.

Acquiring expertise (capacitation) can be described partially as skill development over time. A seminal example is the model for skill acquisition (see Fig. 21) developed by the Dreyfus brothers at UC Berkeley (Dreyfus & Dreyfus, 1980).

A schema for understanding systemic design capacitation, influenced by the work of Dreyfus on skill development, shows the distribution of the development of hierarchical design capacitation over time (see Fig. 22). This schema is useful in helping to understand the necessary diversity of different types of training and learning, over time, in different contexts of maturity and experience.

For example, it can be used to guide the design of design education in a variety of settings and scales (see Fig. 23).

The development of capacitation levels over time is enabled by the appropriate level of learning concomitant with the level of complexity (see Fig. 24).

As an example, the levels of capacitation can be understood through a relationship with rules (see Fig. 25).

	Knowledge	Standard of work	Autonomy	Coping with complexity	Perception of context
1. **Novice**	Minimal, or 'textbook' knowledge without connecting it to practice	Unlikely to be satisfactory unless closely supervised	Needs close supervision or instruction	Little or no conception of dealing with complexity	Tends to see actions in isolation
2. **Beginner**	Working knowledge of key aspects of practice	Straightforward tasks likely to be completed to an acceptable standard	Able to achieve some steps using own judgement, but supervision needed for overall task	Appreciates complex situations but only able to achieve partial resolution	Sees actions as a series of steps
3. **Competent**	Good working and background knowledge of area of practice	Fit for purpose, though may lack refinement	Able to achieve most tasks using own judgement	Copes with complex situations through deliberate analysis and planning	Sees actions at least partly in terms of longer-term goals
4. **Proficient**	Depth of understanding of discipline and area of practice	Fully acceptable standard achieved routinely	Able to take full responsibility for own work (and that of others where applicable)	Deals with complex situations holistically, decision-making more confident	Sees overall 'picture' and how individual actions fit within it
5. **Expert**	Authoritative knowledge of discipline and deep tacit understanding across area of practice	Excellence achieved with relative ease	Able to take responsibility for going beyond existing standards and creating own interpretations	Holistic grasp of complex situations, moves between intuitive and analytical approaches with ease	Sees overall 'picture' and alternative approaches; vision of what may be possible

Fig. 21 Dreyfus model for skill acquisition: novice to expert

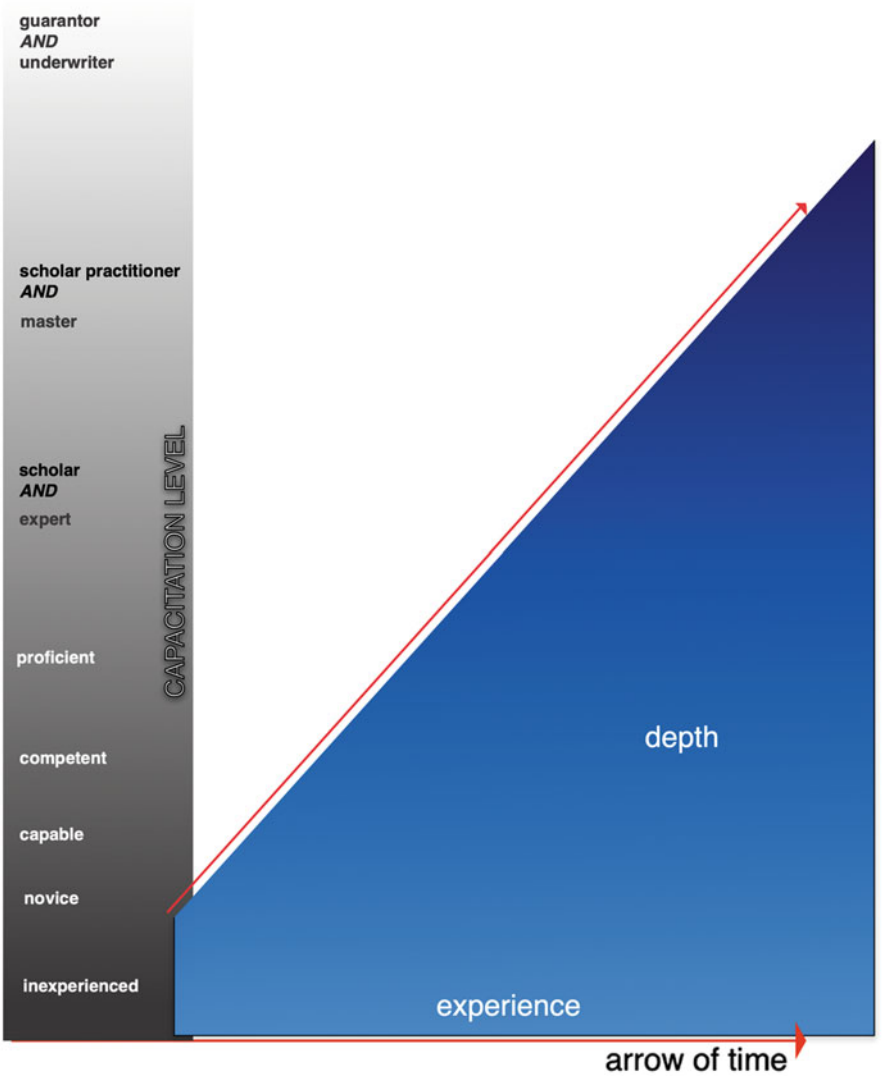

Fig. 22 Systemic design capacitation

The inability to move beyond merely following "rules" reveals a learning plateau that prevents many professionals, including but not limited to designers, from engaging in lifelong learning (see Fig. 26). For example, in military organizations and governmental organizations with strict hierarchies of control, members are discouraged from breaking or ignoring rules. There is a very strict disciplinary control system in place. But, of course, if young military officers or bureaucrats never learn when or how to break rules when necessary, nor how to create rules when needed, how can they become leaders?

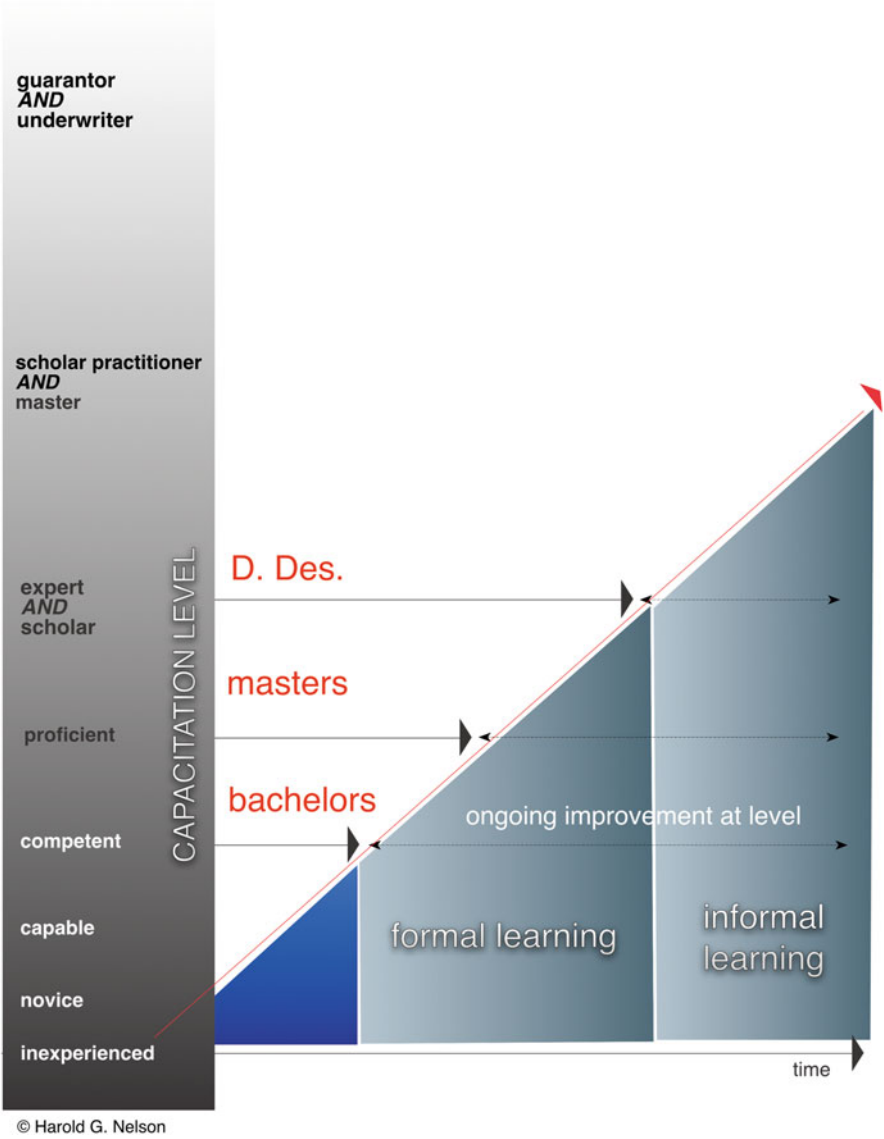

Fig. 23 Example of post-secondary levels of design capacitation

Other less command-and-controlled social systems or organizational systems have a similar challenge. Individual members are confined to gaining competence through training – competence in following rules – but not competence in learning to break and make rules or eventually, to work without rules. Systemic designing requires the ability to engage in lifelong learning and to move beyond the plateau imposed by strict systems of control.

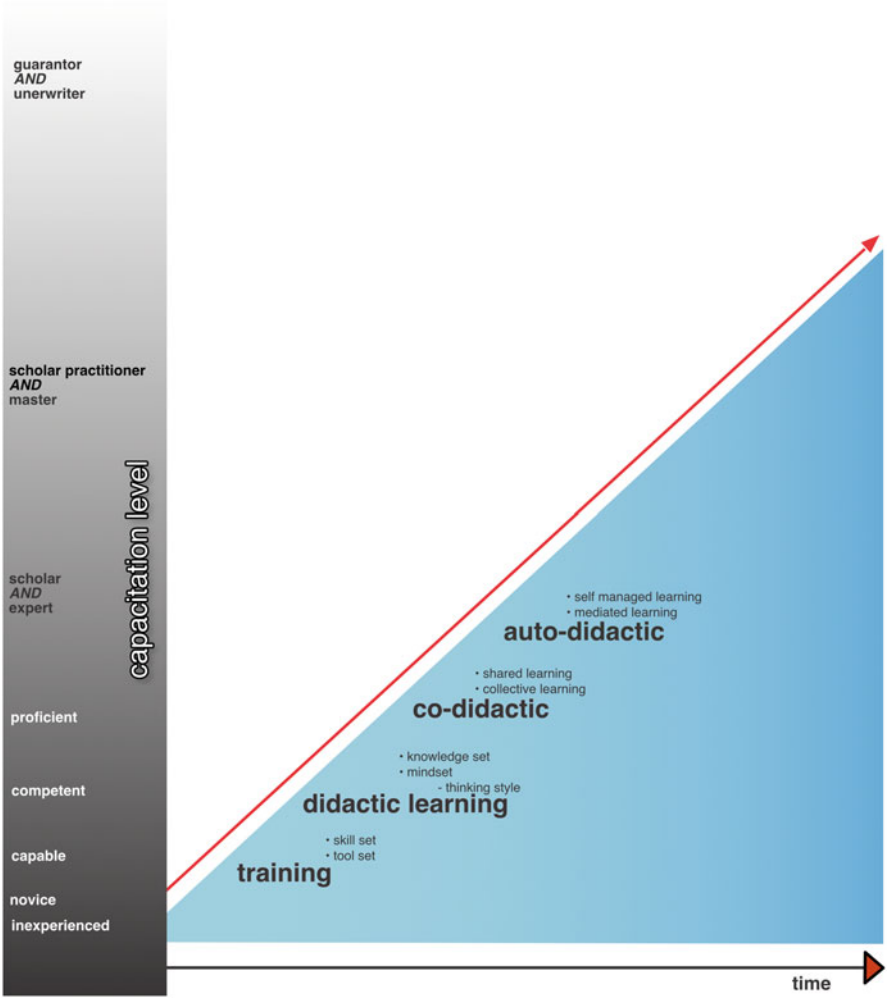

Fig. 24 Types of learning

There is much more to systemic design capacitation than just dealing with rules. Systemic design capacitation involves gaining skills and abilities that far exceed merely thinking out of the box. Systemic design learning experiences are differentiated across orders of learning (see Fig. 27).

Designing Design Education

The rising tide of interest in design increases the pressure to continue the quest to better understand design and how to best prepare ourselves and others to become

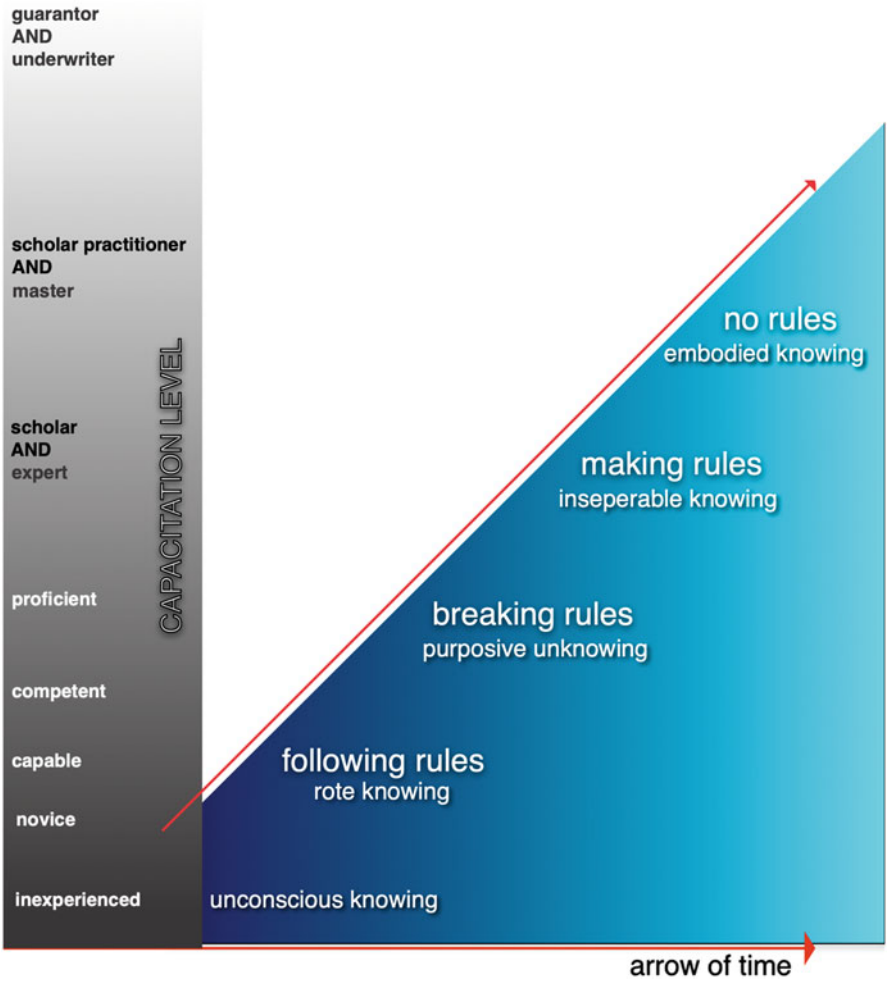

Fig. 25 Rules and capacitation levels

better designers. We actively pursue the concomitant concern for how to best design design education using design inquiry – bootstrapping our way into greater design competency using that selfsame competency in the process.

Being creative and talented alone does not automatically make someone a competent designer. Becoming a competent designer takes commitment, dedication, and courage. It is the difference between being a dedicated sport fan and being a member of a professional team. A colleague tells the story of when she decided to become a professional tennis player after becoming one of the top amateur players in Australia. Her coach immediately changed her training regime. After weeks of extreme physical and mental challenges she asked the coach what was going on, because the experience was not what she had expected, given her success as an

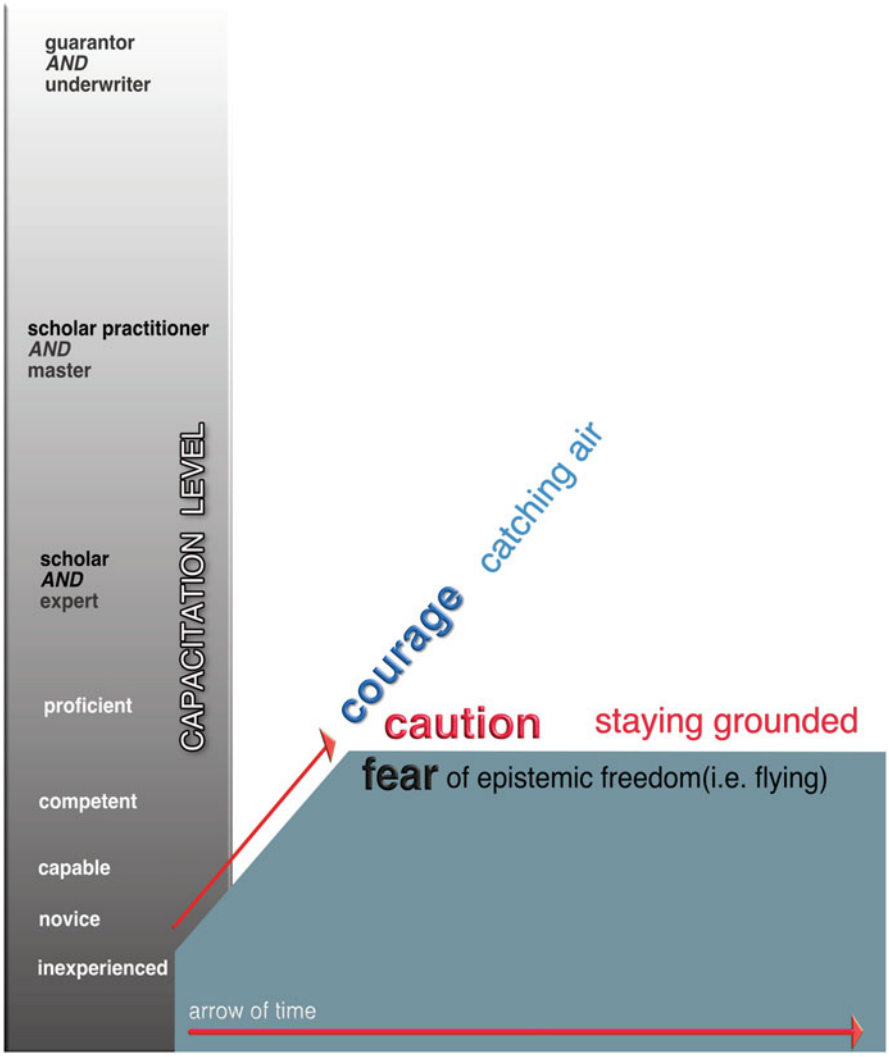

Fig. 26 Plateau between training (caution) and learning (courage)

amateur. Her coach told her: "when you chose to become a professional, you chose an entirely different level of performance. If you don't want to be a professional, then return to what you were doing before."

In today's world, there are extensive networks of training programs and workshops that promise to make people more creative and innovative problem solvers, allowing them to become "design thinkers" with a limited commitment of time and effort. A low investment for a high return has broad appeal among people in both business and government. However, to become design competent in systemic design requires an effort similar to becoming a professional in any field. Although there is

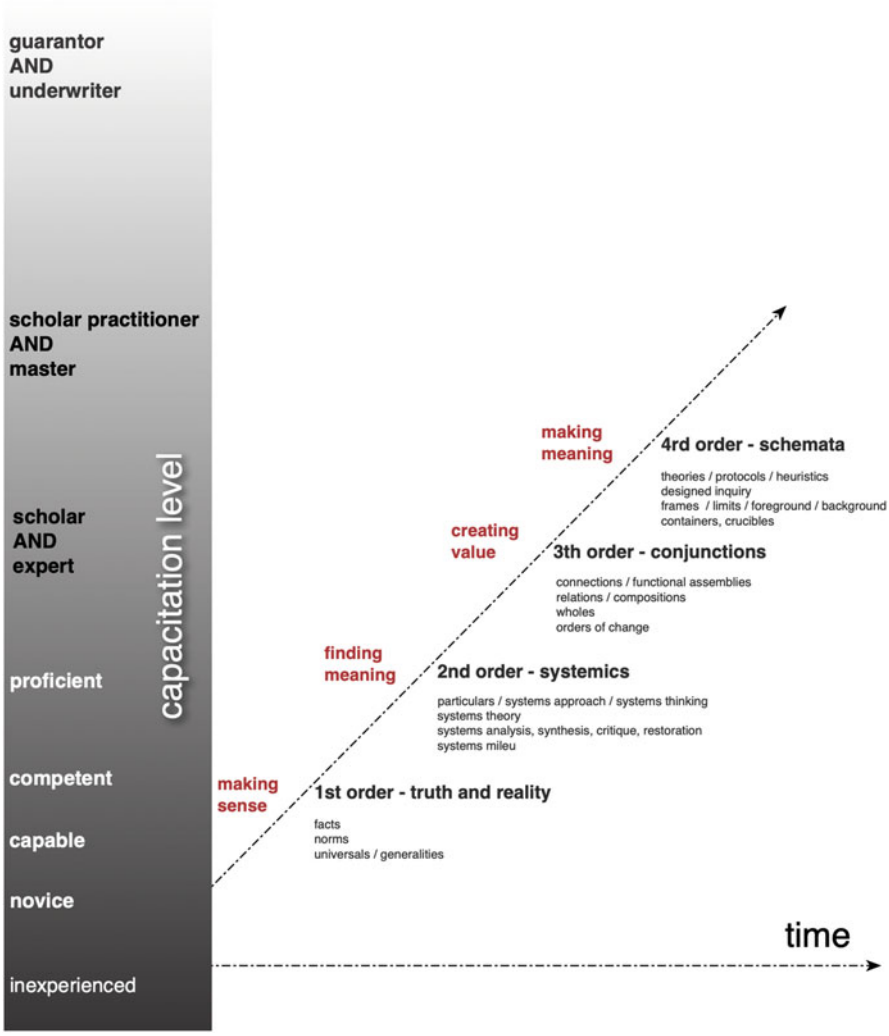

Fig. 27 Orders of learning in systemic design capacitation

nothing wrong with recreational scuba diving, a pair of swim fins, a face mask, and air tanks with a PADI (Professional Association of Diving Instructors) dive certificate does not qualify one to be a US Navy SEAL.

A systemic design education is designed to inculcate the appropriate levels of capacitation at the right time in a person's scholarly and professional developmental trajectory based on reflective experience and intellectual maturity. The assessment of design capacitation is a big challenge on both the design side of education and the assessment side. Whether designing just a single learning experience (course, studio, field study, etc.) or an entire learning sequence (grade level, degree etc.), the

challenge is to determine the learning outcomes and objectives that define the capacitation expected in the learner:

Outcomes: What needs to be known and applied to be a good designer?
Objectives: What kind of learning facilitates becoming a designer?

Educational objectives, with their concomitant strategies, are the ways, means, and methods used to support design learning.

It is essential that beginners or novices are helped to become prepared to learn. This means getting prepared to open up to new learning by transforming the novice's mind into a *new mind*, *an open mind*, *a liquid mind*, or a *beginner's mind*. This is the same kind of preparation that successful professional designers go through at the beginning of each new design project.

The process of getting prepared to learn involves becoming immersed or entrained in the appropriate cognitive "space" – the *design milieu*. A systemic design milieu forms the container and the space to hold the intensity of designing – a design culture. Immersion into a design culture depends on successful preparation and follow through, in the right direction, from where one is at the beginning.

Systemic Design Education

Basic to design education is the assumption that designing is a professionalized activity dependent on good professional judgment-making, resulting in prudent or "wise" action. That means that to become a designer, it is necessary to learn about professionalism and professional praxis. Because design inquiry is inquiry for action, a design education involves learning how to integrate inquiry and action and to be reflective in action (Schon, 1987). Design inquiry is a learning process that results in two types of outcomes:

1. Knowledge – learning, which is separable from the inquirer
2. Knowing – judgments, which are inseparable from the inquirer

The design of systemic design education requires augmenting the design brief for normative educational design. Designing design education requires a clarification of what is meant by design and education. A systemic approach to the design of design education realistically involves several distinct design projects that require holistic integration:

- Design of design strategies and tactics
- Design of design pedagogy and andragogy
- Design of design curriculum
- Design of the designer
- Design of a professional practitioner
- Design of design praxis

- Design of design inquiry for action
- Design of a design milieu

Determining *design specifications* for the design of design education involves formulating two types of specifications:

1. **Performance specifications** – intensions, aims, direction of design education
2. **Prescriptive specifications** – intentions, objectives, particulars of design education

The aim of formalized design education must be further refined through the determination of design agency and who the educational system is meant to serve: (1) those who are to be learners, (2) those who provide the resources for the educational process, (3) those who are responsible and accountable for the success of the educational process, (4) those who are in practice as designers, and (5) those who will be served in the future as clients of designers – all are members of the design education cohort. The expectations and outcomes of design education need to be measured by *scales of measure* that serve the interests of all members of the cohort.

In addition to determining design specifications, clarifying the focus of the design process is essential to establish transparency at the start. Curriculum schemas reveal the assumptions or assertions made about what intentions lie at the center or core of learning (see Fig. 28). The development of any curriculum is based on these assumptions about the nature of knowledge and how it is created and shared. Design pedagogy or andragogy assumes that design knowledge evolves and emerges through a designerly process. Curriculum based on the belief that knowledge is additive, summative, or a process of accumulating greater detail results in very different categories of curriculum from a design curriculum which is based on the assertion that the core of systemic design knowledge is *liquid* and *fluid* (Nelson & Stolterman, 2012).

"Being" a designer is different in degree only from the process of "becoming" a designer. The skills needed to learn how to learn are the same for both the novice and the professional as a lifelong learner. Being a practicing systemic designer involves

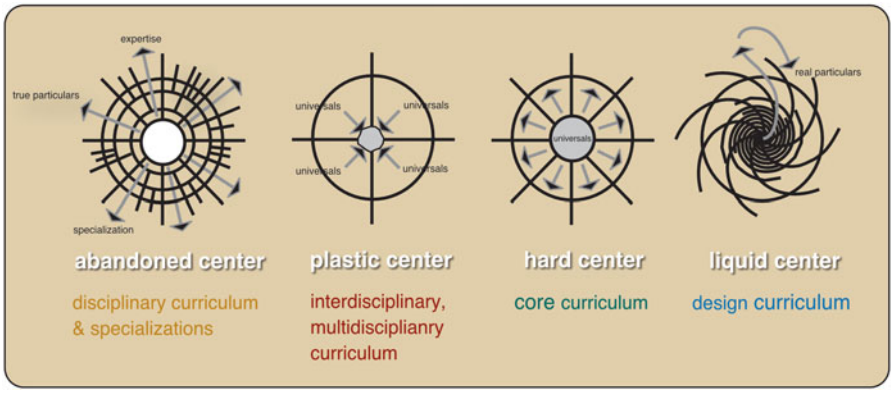

Fig. 28 Curriculum schemas

striving to become a scholar–practitioner – conjunctive: scholar *AND* practitioner – over a lifetime of designing. A scholar–practitioner unites thinking and acting into prudent wisdom. The process of becoming a systemic designer at ever higher orders of capacitation never ends.

Interestingly, being a designer starts right after the choice is made to become a designer. Systemic design education unfolds formally and informally over the span of a designer's life from novice to scholar–practitioner and beyond. Learning to become a designer involves the assistance of a cohort of guides, mentors, and inspiring sources, just as being a designer involves the work of a cohort of stakeholders, teammates, professional colleagues, and cultural champions.

Conclusion

This chapter has tried to give form to a fluid and evolving idea of design by exploring systemic design. It makes the case for why systemic design is important, what it looks like, and how novices can be prepared to become practitioners of systemic designing. We have explored the nature of design, designing, systemics – the logics of design – and historical, normative design narratives. Systemic design was introduced as a newly emergent form of design inquiry better equipped to confront the complexities of today's challenges. The chapter outlines the logics of systemic design by exploring systemic design stances, approaches, and causes. From this, the chapter evolves principles for developing – designing – systemic designers. We explored designing design learning and what it means to become systemic designers. We looked at designing the designer experience, inclusive of experiential learning – deep learning – for example. We explained how design learning domains, sets, and abilities help designers become competent professionals. Finally, we outlined several schemas to help designers acquire design expertise through new designs for formal and informal design education. The focus was on developing the systemic designer within more appropriate, more systemic design education contexts. The results are topography of principles and ideas to develop systemic designers with a capacity to create and innovate more competently and responsibly than is possible today.

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