INVITED ARTICLE

A Shifting Practice Paradigm Meets a Persistent Curriculum Paradigm

Meredith Davis

College of Design, North Carolina State University, Raleigh, NC, USA (mjdavis[at]ncsu.edu)

Abstract: There is little debate that the demands of professional design practice and design research today are significantly different from the 20th century when modern graphic and industrial design programs first entered liberal arts colleges and universities. Currently, there is much academic discourse regarding the new outcomes for which today's designers are accountable under an ongoing shift in the nature of professional practice. However, design cannot fully address a new practice paradigm if design educators do not also rethink a persistent curriculum paradigm from the industrial era. This article argues that new course outlines alone are insufficient in overcoming the implicit messages about design practice delivered through the historical structure and pedagogy of college and university design programs.

Keywords: colleges and universities; design curriculum; design education; design history

1. Introduction

Educational psychologist and reformer Lee Shulman said, "If you want to understand a profession, study its nurseries" (2005, p. 52, paraphrasing Erik Erikson).

There is little debate that the demands of professional design practice and design research today are significantly different from the 20th century when modern graphic and industrial design programs first entered liberal arts colleges and universities. There is no shortage of current academic discourse regarding the new outcomes for which today's designers are now accountable. However, design cannot fully address a new *practice paradigm* if design educators do not also rethink a persistent *curriculum*

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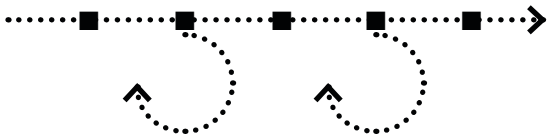

Figure 1. Simple causal chain with action taken at a few leverage points.

paradigm from the industrial era. The following discussion argues that new course outlines alone are insufficient in overcoming the implicit messages about design practice delivered through the historical structure and pedagogy of college and university design programs.

2. A Little History

A confluence of forces in the early decades of the 20th century shaped the academic environment for the modern professions of graphic and industrial design. Industry scaled up production to meet the demands of a growing consumer culture. Higher education continued its professionalization of college curricula. And modernism offered a strategy for addressing the problems created by industrialization, urbanization, and globalization with design as an agent of change.

The Second Industrial Revolution set the agenda for design practice. A "design problem" mirrored the assembly line: a linear causal chain that converted capital, raw materials, energy, and labor into consumer messages, products, and spaces (Figure 1). Designers took action at a few leverage points to resolve some perceived misfit between the form of physical artifacts and their production or use. An emphasis on appearance and craft explored the expressive potential of new modern materials. The industrial goal was optimization: efficiency in producing almost-perfect, consumer-facing editions that were sometimes separated by years. Management applied a top-down waterfall process of decision-making, approving work in stages and passing it to the next group of experts. Designers saw the consumer experience as "universal" and made intuitive decisions they considered to be in the best interest of the people who used what they made.

The turn of the century also saw a continuing professionalization of higher education that shifted college and university curriculum purposes from students' mental and moral development to solving the practical problems of modern life. Fields previously located in freestanding professional schools — business, law, and medicine, for example — moved the preparation of future practitioners to liberal arts colleges and universities. Some fields made this transition in steps, starting with informal apprenticeships and later developing professional curricula, often at the graduate level (Goldin & Katz, 1999). Faculty became *academic professionals* who also serve the research functions of

their disciplines and institutions. Consistent with the operations approach deployed by industry, professional design, engineering, and management curricula entered these academic institutions under separate administrative units, which would later present curricular and research challenges in the overlapping work of the information age.

Throughout the 20th century, a number of these new university disciplines systematically studied problem-solving curriculum and pedagogy. Harvard University had a longstanding interest in case studies under which students framed the problem at hand, assumed decision-making roles, and justified the rationality of their decisions (Schmidt, 2012). Applied at the *end* of the curriculum, the case-study approach asserted that practical insights came only *after* students acquired disciplinary knowledge. Contrasting investigations at McMaster University in Ontario, Canada, argued for students acquiring necessary knowledge *across* the course of working on applied problems. Although McMaster research showed that medical students and practicing physicians were equally good at reasoning, practitioners' diagnoses were simply better. Mastering a reasoning *process* ultimately mattered less than mastering *concepts* (Burrows & Tamblyn, 1980). Maastricht University in the Netherlands studied problems as a function of *context.* A problem was viewed as a set of phenomena or events that "could be described in terms of their underlying principles, processes, laws, or mechanisms" (Schmidt, 1983, p. 28). The student's task was not action but mental models or theories that explained phenomena. In all of these examples, students collaborated in actively framing problems.

Similarly, industrialists founded independent professional schools to meet demands for a modern design workforce. Unlike other professions, however, the field continued to support these freestanding, single-discipline schools as a pathway to practice, even as liberal arts colleges and universities added graphic and industrial design study to their fine arts curricula. Dual curricular offerings continue today, and depending on the country, they determine the requirements, duration of study, and whether undergraduate students earn a diploma or bachelor's degree.

In both institutional contexts, design duplicated its trade-oriented training model, with the Bauhaus having an outsized influence in furthering a vocational approach. The school referred to students as *apprentices* and *journeymen*, a reflection of the centuries-old guilds and ateliers that socialized young men in craft-based trades. Learning by doing under the tutelage of a *master* involved little theory; *problems* resided in the application of perceptual phenomena and the nature of materials. Although the Bauhaus intent was to align design study with higher education interest in practical education and the industrial goals of its sponsors, relatively few Bauhaus products were commercially produced in their own time. In the school's move from Weimar to the industrial town of Dessau, director Walter Gropius had to insist that work in the joinery studio respond

to a list of consumer preferences (for example, an angled back in chair design; Droste, 2006). Laszlo Moholy-Nagy lost funding for the New Bauhaus in Chicago following negative reviews of student work, including a *Time* article calling it "an exhibition of bewildering nameless objects" (Sisson, 2019). And by the time Ludwig Mies van der Rohe established an architecture program at Armour Institute in Chicago, the curriculum no longer required applied building experiences. Critic Tony Fry described the output of the Bauhaus as mostly "published representations of industrial work…unproducible under mass manufacturing and lacking consumer appeal" (Fry, 1999, p. 158).

Despite little evidence that the Bauhaus truly served the problem-solving needs of industry, the modernist curriculum model became the dominant approach to design education by the middle of the century. It spread through the immigration of Bauhaus faculty and applications at a few high-profile institutions. The curriculum was easy to replicate and could be taught by existing fine arts faculty. The preliminary course also offered a unified arts approach and simple language of form — the "elements and principles of design" — which K-12 art educators found appropriate for pre-college art education. For much of the 20th century, "design" was synonymous with "abstraction," rather than a profession, for many secondary students.

Graduates of 20th-century college design programs also contributed to the worldwide proliferation of a modern design monoculture that replaced indigenous forms and practices. Under an economic and technological global hierarchy, there were centers of innovation, places that served centers of innovation, and places perceived as having little hope of overcoming their historical and local conditions (Florida, 2005). Modern design concealed such differences under a singular, rational expression of social progress. This presumption of universality encouraged institutions to reproduce modern design curricula, even under culturally and economically diverse circumstances. Embracing modernism would later result in 21st century concern for issues of design colonization.

Maintaining and perpetuating a mostly vocational training model in two types of institutions — single-discipline professional schools and multi-purpose colleges and universities — likely delayed the evolution of design in areas normally characteristic of professions but not trades. The scholarly study of design methods did not emerge until the 1960s.* A comprehensive history of graphic design was not published until 1983 and followed an art historical canon with few references to parallel developments in commerce, management, technology, and non-Western cultures (Meggs, 1983). Graphic and industrial design often remain *subdisciplines* of art in many institutions, while new design offerings and research develop in other non-art units (in user experi-

* The Conference on Design Methods took place in September 1962 at the Department of Aeronautics, Imperial College in London, UK.

ence, service design, data visualization, and transition design, for example). Unlike other fields, many master's programs in design still require independent study aimed at personal growth in the fine arts tradition, not explicit instruction in a consensus-built body of knowledge preliminary to more advanced work in the field.

In particular, the development of a design research culture lagged far behind other fields, even as the 20th century professionalization of higher education prompted the development of the modern *research university*. Doctoral study in design was not available until the 1990s and there is still considerable debate regarding the differences between practice-based and research-based PhDs, as well as the appropriateness of graduation submissions (artifacts versus dissertations) as "knowledge" (Davis et al., 2023b). The standards applied to design faculty scholarship often vary widely from those used by the institution to evaluate faculty work in other disciplines, subsequently denying designers access to some types of research funding and partnerships.

This history would shape a longstanding approach to design curricula and pedagogy that persists today, despite the formidable challenges of the Information Revolution.

3. Paradigm and Pedagogy

Historian Thomas Kuhn wrote about paradigm shifts in his 1962 book, *The Structure of Scientific Revolutions.* He defined a paradigm as the established theories that a field agrees address the most acute problems of the time. Kuhn (1962) characterized these theories as having been sufficiently novel at one time to pull advocates away from competing perspectives and become the basis of fact (p. 24). The paradigm offers fundamental principles and standards that guide ongoing practice and succeeds by continually revealing a family resemblance among the problems to which it is applied (pp. 10, 46). It is a filter that determines what is and what is not a problem in the field.

A shift occurs when anomalies illustrate the inadequacies of existing theories to account for new problems. Kuhn observed that the field first responds by relaxing or stretching threshold criteria to make problems appear to fit the established paradigm. For example, practitioners extended design thinking — a step-by-step approach first developed for the design of human-centered artifacts — to problems ranging from business to government and K-12 education. In other cases, advocates of the established paradigm argue that aberrant problems are the domain of other fields. Advances in the data economy, for instance, raise such issues regarding where professional responsibilities for the design of sociotechnical systems reside. And there is ongoing debate regarding whether designers or ethnographers should lead user-centered research in companies.

As anomalies increase, however, they erode the standards of the existing paradigm and require a new language, concepts, and procedures (p. 55). Kuhn classified the remaining work of the field as *puzzle solving*, which simply adds diversity to an inventory of successful applications under problems already known to have solutions (p. 36). He described the new paradigm as calling for a *revolution* in disciplinary knowledge, not an *evolution* of revisionary adjustments or additions to the scope of an existing paradigm.

There is little disagreement that design practice is in the midst of an ongoing paradigm shift that began with computing in the middle of the 20th century and expanded under more recent design responsibilities for environmental and social outcomes. Artificial intelligence also presents new challenges for which many designers are unprepared. At the same time, however, the curriculum paradigm and signature pedagogy that underpin professional design education owe more to industrial-era design practice than to the work of this century.

Stanford education professor Elliot Eisner defined a curriculum paradigm as a theory of learning that determines:

- The consistent purpose of study for which the curriculum is designed;
- The kinds of knowledge the program values;
- What it means for learning and how to assess it; and
- The roles faculty and students play in the learning process (Eisner, 1985).

While design faculty discuss new content intended to make college curricula more relevant to current practice, there is less evidence that they seek consensus for a corresponding theory of learning. Curriculum development today typically involves new subject matter packaged as course outlines. Because the political environment and glacial approval processes of higher education make it easier to invent or change courses than to invent or change curriculum, design faculty often add this new content to an existing program of study — a *curriculum by accrual* approach — rather than rethink the paradigmatic principles and practices on which the traditional curriculum is based.

The *surface structure* of design's persistent signature pedagogy — educator Lee Shulman's (2005) term for the operational aspects of instruction — reflects its industrial-era intent (Figure 2). Beginning undergraduate studies typically isolate perceptual principles and material exploration, consistent with the historical role of design as appearance and craft. The curriculum usually defines upper-level courses by medium or artifact, congruent with specializations in fine arts and the industrial mass production of tangible messages, products, and spaces. All students solve a faculty-defined problem and compare solutions in the industrial spirit of top-down, waterfall management and optimization (finding the "best" answer to a singular challenge). Students work individually and intuitively, offloading consideration for technical feasibility and economic

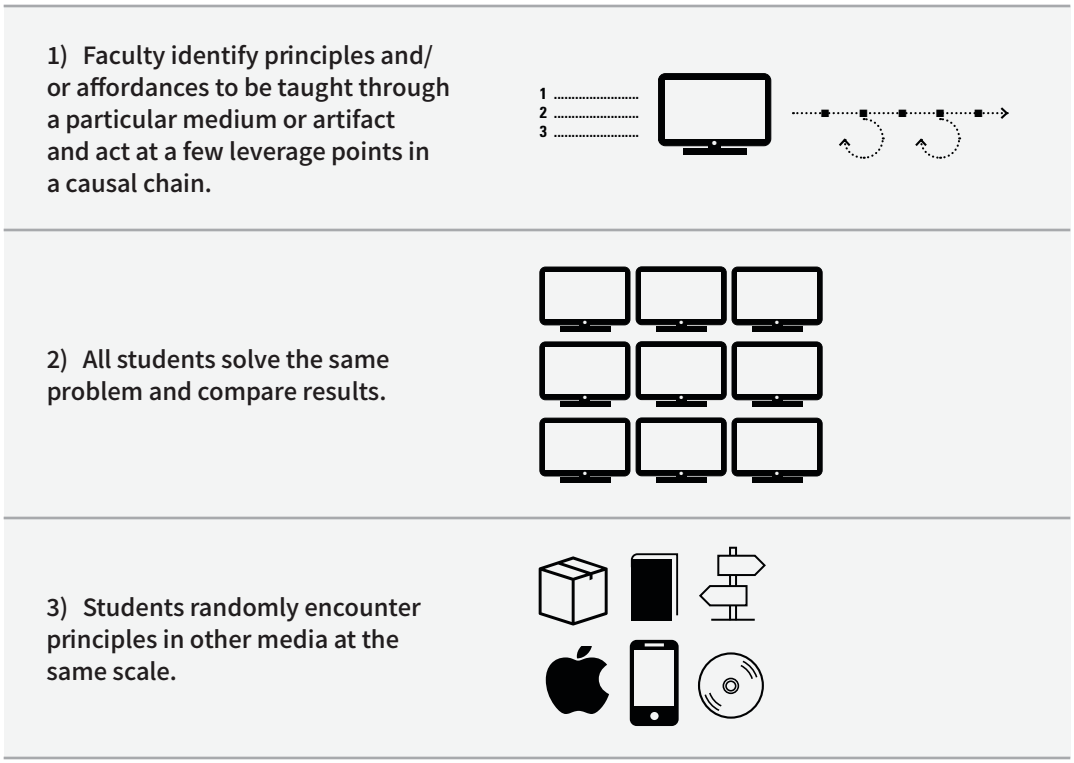

Figure 2. The surface structure of 20th century design pedagogy.

viability to other imagined experts. They spend most of their studio and critique time in refining quickly-narrowed, "almost perfect" solutions that mirror industrial editions. Project research precedes but rarely follows execution and every new assignment begins from scratch.

Further, there are industrial-era implications in what Shulman (2005) described as the *deep* and *implicit structures* of pedagogy and Philip Wesley Jackson (1968) labeled as the *hidden curriculum* — that is, in the unspoken assumptions regarding how an approach to teaching design imparts knowledge and instills in novices the beliefs, values, and attitudes of scholarship and practice in the field.

The traditional curriculum paradigm of design education views complexity primarily as the number of elements, objects, or features to be designed. Typography instruction, for example, progresses from the letter to the word, page, and document. It is more likely that an advanced problem will be the design of a magazine than a system for readers to annotate editorial content. Consistent with industrial-era practice, design students create or adjust the qualities of these elements for short-term outcomes in simple causal chains — *form follows function*. Critiques usually reward solutions that meet observable or known problem constraints, rather than offer alternate conceptions of the situation or that speculate on uncertain or emergent conditions. The design

response to anticipated breakdowns is to redirect people back to an ideal path, rather than to reconsider the conception of the problem under their situated action when design does not perform as expected.

Under a modernist tradition, beginning perceptual studies suggest that the human experience of form is rational and universal and that phenomena studied in isolation will produce similar effects when used in combination and under the influences of context and audience. These early exercises also imply that the design process begins by sketching or the hands-on manipulation of materials in preparation for later courses typically defined by medium or artifact. Accordingly, upper-level projects often foreground particular affordances of the designated medium — solutions in search of relevant problems, rather than problems in search of appropriate media. For example, students in web classes design websites, not service ecologies. Any pattern-finding among problem types usually occurs randomly across the curriculum and individual faculty project authorship.

There is also a curricular implication that problems can be solved under design expertise alone and that designers need not understand the modes of inquiry in other disciplines. Institutions within and outside the European Higher Education Area (EHEA) — the 49 countries under the Bologna agreements developed for cross-national curricular compatibility — differ from other places in the requirements for study outside of design. General education requirements in most North American bachelor's programs, for example, ensure that bachelor's graduates have read and written in a discipline other than their major. These courses, however, are usually *proximate* rather than *integral to* design study, unless the curriculum "double-counts" general education electives as requirements in the design major. Schools in the EHEA have no such requirements at either the undergraduate (diploma or honors bachelor's) or master's levels. As a result, EHEA students advance to practice and doctoral study without preparation beyond studio-based curricula.

4. The Fit of Design Education with Contemporary Practice

If the rhetoric of college websites is accurate, most professional undergraduate design programs intend to educate entry-level designers for practice in their respective areas of specialization. Elliot Eisner (1985) referred to this as a *social adaptation* curriculum paradigm, which "identifies the most salient manpower needs of society and responds to those priorities by preparing students to get ahead under existing workforce conditions" (p. 74). Yet, a paradigm shift in the nature of practice raises questions regarding the match between a 20th century curriculum paradigm and current and emerging positions in design practice. Some even question whether the established types of design practice for which these curricula were designed are still viable.

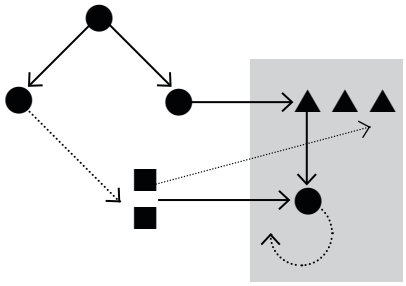

Figure 3. Today's design problems reside in the interactions among complex systems.

The US Bureau of Labor Statistics projects employment in ten-year increments using 29 data points and large sample sizes. The 2019–2029 projections (pre-Covid) show decline in traditional design practices. In particular, the Bureau predicts a combined loss of 14,500 positions in art direction, print and online publishing, and graphic design (brand identity and print collateral) by 2029 (US Bureau of Labor Statistics, 2020). There are more than 2,000 college-level programs in the United States that teach this content at some level. The Bureau expects the much smaller practices of industrial and interior design to lose 1,500 and 3,800 positions, respectively. By contrast, creative work in web and software design will gain 330,400 new positions in the same time period. Based on international input regarding the need for new design competencies, it is likely that the overall trend represented by these American statistics can be found elsewhere.*

The differences between the paradigms that underpin 20th and 21st century practices relate to more than obvious technical competencies suggested by the Bureau's data. The following are less obvious competencies proposed here as representative of the ongoing paradigm shift (Davis & Dubberly, 2023).

- **Changes in employment reflect a shift from designing discrete artifacts to designing systems and services in complex causal networks.** The Information Revolution changed the things designers make, the processes through which they make them, and what they mean in culture. Access often replaces ownership. Even when design solutions call for physical artifacts, they are usually nested within larger ecologies (Figure 3). Understanding and designing the processes through which complex systems transform some form of input into output requires models of how they work, visual stories about actors/elements, their internal behavior and external interactions, and likely effects under dynamic conditions.

* In 2021, The Future of Design Education initiative received survey responses from 700 design faculty and practitioners internationally on how design education should change to meet the current demands of practice. This work is discussed in Davis and Dubberly (2023).

- **Systems interact dynamically over time and have consequences beyond immediate use.** Complexity is defined not only by the number of elements and their interdependent relationships, but also by their variety, volatility, and velocity of change. Stewart Brand, author of *The Clock of the Long Now* (1999), described functional layers of a healthy society: Fashion > Commerce > Infrastructure > Governance > Culture > Nature. The historical locus of design activity was the consumer-facing, fast-changing *Fashion* layer, which Brand described as "free to act as irresponsibly as society could bear" (Brand, 2018). However, action at this layer has causes and effects in other layers of society that change at different rates. For example, Americans toss 100–120 million cellphones into groundwater-polluting landfills each year (Repowered, n.d.). While designing reusable parts helps the environmental effort, changing this cultural behavior likely requires consumer right-to-repair policies and company triple-bottom-line metrics for measuring success. The design task is not only to imagine preferred conditions but also to understand how change happens.

- **Complex problems are not solved forever.** *Problem-solving* is an industrial-era concept that presumes ultimate resolution of some source of friction. Under the Industrial Revolution, society extended this concept to social conditions. However, in causal networks — rather than industrial causal chains — design action produces both intentional and unintentional effects elsewhere in the network and over time. The first task is to distinguish between root causes and symptoms — the level of generality — and then to decide the best level at which to act for positive results. Time, resources, expertise, and the likelihood of meaningful change aid in deciding where to intervene. And anticipating an "if-then" conditional sequence of actions may constitute a long-term design strategy when action is necessarily at a lower level. In this sense, "addressing the question at hand" or "improving the current situation" may better describe the work of contemporary design and research than "problem solving." And this problem framing is an essential 21st century design skill that is rarely taught in today's college classrooms. By the time students reach capstone courses, their inclination is to define independent projects as things they want to make rather than conditions they want to change.

- **Complex problem spaces can be framed in different ways.** Theorist Herb Simon argued for the term "problem spaces" rather than "problems" to better reflect initial ambiguity or variability regarding the boundaries of problematic situations. The intent of design today is to bring forth *new ways of being in the world* — to make conditions more sustainable, equitable, or just — not simply to make more things as it was in the industrial era. Therefore, the conceptualization of a problem space for design is subjective and political — more equitable than

what, in what ways, and for whom? Theorists Horst Rittel and Melvin Webber (1973) described design as paradoxical, grounded on one hand by infinite "makeability" and the unlimited potential of the future, and on the other hand by emotional engagement aimed at overcoming unequal social consequences. The understanding of a situation develops gradually and through argument. It requires a variety of stakeholders to advocate for different worldviews, not merely to test the usability of solutions.

- **Design considers the unknown future as well as the known present.** Philosopher Henri Bergson (1946) wrote that the *contingent future* (when something happens due to an external force) and the *optimization future* (when something planned comes to pass) treat the future as something that exists and merely needs to be revealed. He argued for the importance of the *novel future* — the emergent conditions that are unknowable today. Riel Miller, the head of foresight at UNESCO, warned that an unknowable future cannot be grasped simply through the search for a probable future through the logical extrapolation of current trends: "The challenge today is to incorporate 'unknowability' into the way we anticipate and engage in ongoing processes of discovery and invention in the present" (Miller, 2013).

- **Design solutions today arise from cross-functional teams and under increasingly agile processes.** Design, technical feasibility, and economic viability develop simultaneously and collaboratively, not in expert-driven sequences as they did in the past (Davis & Dubberly, 2023, p. 103). Research shows that when teams develop a conception of the problem collaboratively, they make the most creative use of their cross-functionality (Weingart et al., 2010). Designers learn from iterative releases, embedded feedback, and ongoing monitoring and research. Contemporary design is generational and updatable. It is characterized by good-enough-for-now versions, not the almost-perfect, one-off editions of the industrial era.

- **Data is the new design medium.** The significance of dematerialization is not about virtual-versus-physical, screen-versus-paper representations. And as "material," data is more than the numerical source for visual translations in an Edward Tufte, information design sense. For example, software developed in the College of Design at North Carolina State University overlays a viewshed map of the scenic Blue Ridge Parkway (what can be seen from various elevations in the mountains) with a map of uncultivatable land and plots of private ownership (Fels et al., 1995). The results are areas of land that if donated to the Nature Conservancy give owners tax advantages from property that can never be developed, support the eco-tourism industry, and protect nature in perpetuity.

The designers had to create maps and screen interfaces, but the real design work was converting data (in a values-driven computer stack) to stewardship.

- **Design shares control.** Platform design offsets the cost and time of upfront development for third parties who use them to create applications. Systems are customizable and yield control of form and content to users. Design methods are co-creative and engage stakeholders from the earliest stages of the design process.

Maintaining a social adaptation curriculum paradigm developed for the industrial era does little to address these changed expectations of design professionals under an ongoing shift in the practice paradigm that began with the Information Revolution. For example, if framing the situation is an essential 21st century skill, the faculty authorship of problems designed to foreground media affordances does little to advance students' development of problem framing skills for an environment of growing uncertainty. Further, such skills must be taught, not left to chance in a capstone course preceded by semesters defined by the things students make.

To some extent, the lag in design education's responses to changes in practice may account for the rapid rise of alternative credential and corporate bootcamp programs. Most of the students in these programs already hold college degrees and enroll for a change of career or upskilling (Davis et al., 2023a, p. 125), the latter suggesting that previous design study may not have prepared them fully for changing with practice. However, research shows that students who pursue short-term programs for technical training typically do not advance in their positions. Further, research shows that unless employers have multiple experiences with individual education providers, companies usually do not trust the evaluation strategies of alternative credential programs beyond a first-level screening of job applicants (Davis et al., 2023a, p. 132).

Alternative credential programs teach particular job tasks, not the systemic relationships that characterize professions and professional degree study (Bernstein, 2000, p. 59). Designer Jon Kolko (n.d.) described the patterning that defines professional behavior. *Patterning in the problem* is the actions a designer takes — doing, reflecting, and making adjustments. Kolko argued that designers do not acquire this expertise through random trial-and-error, but through repeated experiences with similar problems and contexts. *Patterning around the problem* is the "political, organizational, logistic, and cultural context of design." Design experts call up these patterns in ways that seem effortless, but novice designers need enough experiences to build what Kolko called "muscle memory" or recognition that "I've seen something like this before." He argued that developing these patterns requires the "slow learning" that is not possible under the short duration and singular projects of alternative credential study (Kolko, n.d.).

Eisner described two other curriculum paradigms worth mentioning in regard to college design programs today:

- The aim of a *personal relevance curriculum paradigm* is the individual student's growth. Meaning arises from the student's native abilities and personal choices of what to study in a resource-rich environment (Eisner, 1985). Programs admit students with visual histories and offer a range of medium-based electives in both art and design, from which students construct somewhat individual curriculum paths. Students move laterally across mostly unscaffolded courses; any prerequisites better reflect the level of student maturity or technical skills than faculty consensus regarding specific developmental knowledge or problem types. At the master's level, the preferred method of instruction is independent study with a few shared seminars on contemporary issues. Where available, doctoral study likely focuses on practice rather than evidence-based research, few methods are regularly taught to all students, and artifacts may substitute for a dissertation.

  A personal growth approach is common in design programs that share an administrative location with fine arts, and particularly where there is insufficient enrollment across art and design courses to ensure depth in specialized majors. Staff at the National Association of Schools of Art and Design, the accrediting body for college programs in the United States, anecdotally report an increase in curriculum proposals that reflect this paradigm as a response to budget cuts, loss of faculty positions, and a declining college-age student population. While some undergraduates under this approach may gain design employment, there is usually little faculty agreement or coursework regarding threshold preparation for entry-level design jobs. Published employment outcomes may better describe where a few alumni happen to work than the mission for which the curriculum is explicitly designed.

- The *social reconstructionist paradigm* is more recent and not concerned with graduates fitting into the current landscape of professional employment. The intent is activism that challenges the status quo; investigations of important problems that society has to address (Eisner, 1985). However, it is important to distinguish study under this paradigm from concern for social and environmental outcomes under other definitions of design practice. For example, in a 2023 research study by Köln International School of Design professor Birgit Mager found more than 80 service design programs that conduct applied projects in the public sector (Mager & Davis, 2024). 18F is a professional design office of the United States government with the sole purpose of improving citizen service experiences with federal agencies. Designers in these efforts prepare for making

change under the political and regulatory environments in which they work as employees or consultants.

Alternatively, the work of a social reconstructionist paradigm generally addresses action from outside the system it hopes to reform or replace and it makes no promises of typical design employment. Increasingly, design offices report interviewing recent graduates who "only want to do socially-oriented work," suggesting that design education may confuse students by the frequent use of "design for good" as a type of work rather than a sign of integrity in any design solution.

5. Principles and Models

Researcher Herb Simon offered a view of problem solving that could have implications for preparing today's college students for research-supported practices, as well as the generation of new knowledge. First with Allen Newell and later with Glen Lea, Simon's *problem spaces* describe the set of things the problem solver knows or postulates at a particular stage in understanding a problematic situation (Simon & Newell, 1974). There is an initial state of this knowledge, a goal state, and all states in between. The problem emerges through conjecture and inferences derivable under a premise regarding the nature of relationships in the problem space (Simon & Lea, 1974; Simon & Newell, 1974). Simon argued that this framing activity may not involve only the search of a single problem space for a solution, but also a comparison of the different knowledge sets found in multiple problem spaces for *concept attainment* or *rules discovery* (Simon & Lea, 1974, p. 115). As a practice example, Apple built its in-store service design on the model of concierge services in high-end hotels. The shared service principle is *triage.* In contrast to the supermarket service model of Best Buy — aisles of boxed products and queuing up at a cash register to pay for purchases — triage guided the physical design of the store and service components, as well as customer interactions with Apple staff.

In this sense, Simon's thesis offers insights for problem framing by undergraduates, as well as original research by more advanced students (Figure 4). Students extract principles or rules from recurring situations to inform models of *how things work.* They compare and critique propositional models of the situation and judge solutions under the conditions the model describes.

Burns and Vollemeyer (2000) emphasized the importance of models in understanding the situated tasks in Simon's search of problem spaces. Tests of these representations do not confirm a solution to a problem, but instead demonstrate the adequacy or inadequacy of the model in explaining the task, phenomena, or rules on which a future solution depends (Burns & Vollemeyer, 2000). This role is different from the

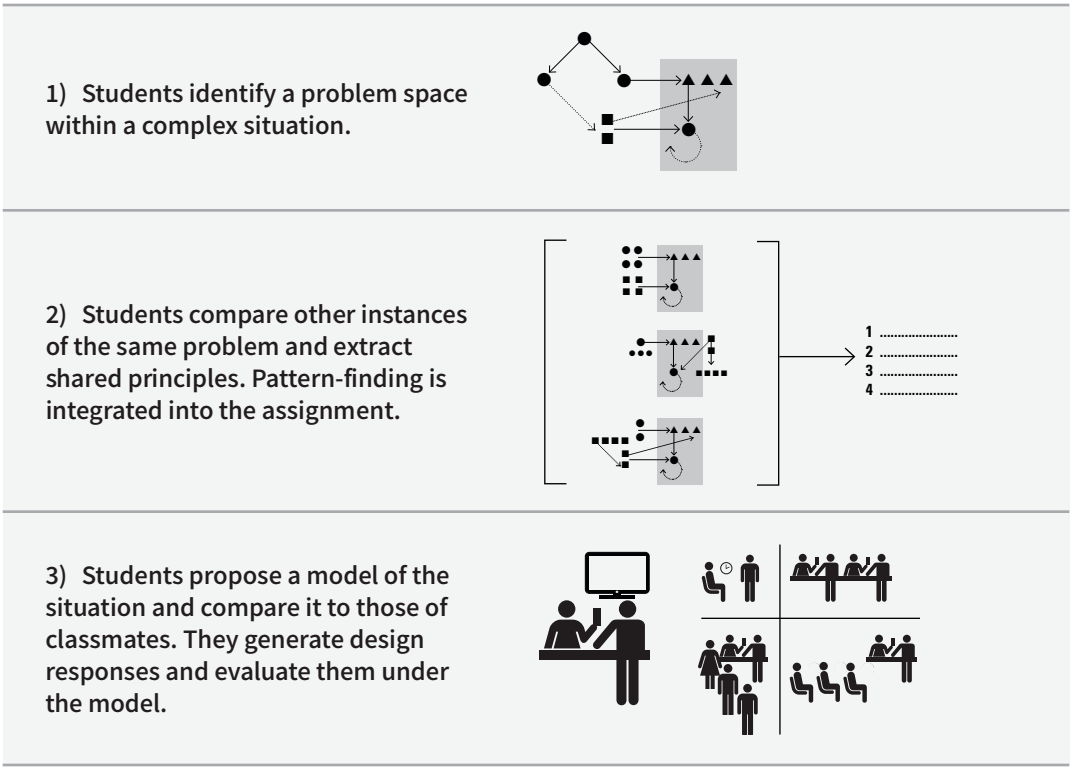

Figure 4. Problem framing through the search of multiple problem spaces for a model of "how things work."

industrial view of models as facsimiles of yet-to-be produced solutions and suggests that exploring a range of cognitive artifacts — concept maps, diagrams, user journey maps, and computer simulations, for example — is essential to addressing systems-level challenges in complex causal networks.

6. Increasing Research Accountability

Among the new expectations of designers is research that informs the outcomes of design action. However, a consequence of importing trade- and art-based practices as the traditional content of university design curricula is confusion regarding the definitions and standards for contemporary design research. In response to a study by *Metropolis Magazine* (Manfra, 2005), research definitions by 1,051 design faculty and students ranged from selecting colors to rigorous studies of user behavior. And while respondents ranked *sustainability* and *culture* as the most important topics for the field to study, *systems* and *ethnography* (anthropology) were at the very bottom of their lists. It is difficult to imagine how designers can address issues of sustainability without also understanding how systems behave and interact.

The responsibility of design to achieve particular outcomes also varies among organizations, even those engaged in mostly similar work. A 2019 report by Invision entitled *The New Design Frontier* (Blanda, 2019) studied the evaluation of designers' work in 2,200 digital product companies in 77 countries. The study found that the performance criteria for which designers were accountable depended on the management structure of their organizations. For example, when designers reported to product managers or engineers, *usability* was most important in their performance evaluations. When they reported to marketing, *brand equity* and the *conversion funnel* (the user's journey from an internet search to product purchase) were the only metrics that mattered. When designers reported directly to CEOs, all metrics were important, *except* usability (Blanda, 2019). These different evaluative criteria raise questions regarding the types of research that should support designers' work.

There is also little consensus regarding where students should acquire research dispositions and skills in their design education; that is, the levels of study at which students should be *users* versus *producers* of design research and the core competencies required for each. Library retrieval often equates with "research" in studio projects. And while medicine and management, for example, draw clear distinctions between the content of a practice versus a research doctorate, there is no consensus on such issues in design. These concerns extend to design faculty research output, typically generated without the benefit of a doctoral education in a context that often equates creative tangible objects with "knowledge," rather than "information."

Although the purpose of this article is not to sort out these issues, it is accurate to say that without some effort toward agreement regarding the nature and necessity of design research, it is difficult to describe how design faculty can reinvent academic programs and the body of knowledge in rapidly changing design fields.

7. Obstacles to a 21st Century Curriculum Paradigm

It is significant that despite additional new courses or objectives that reflect the current demands of design practice, an industrial-era approach to learning and inquiry persists in most institutions. Design programs are resistant to curricular and pedagogical change due to a number of factors:

- A long-held personal identity of the solo designer as a creative maker of material things as the locus of innovation;
- Political curriculum approval processes in higher education that make it easier to change courses than to reform curriculum or establish new curricular partnerships across administratively separated disciplines of study;

- Increasing program reliance on part-time faculty, who by contract may not have curriculum development or course-to-course coordination responsibilities;
- No agreement by the field regarding the purpose or core knowledge requirements of the terminal master's degree; and
- No preparation of terminal master's and doctoral students or part-time faculty for teaching, which results in instructors who teach how they were taught.

Some of these obstacles are likely to intensify under current social and economic pressures on higher education. However, standing still is not an option. Patterns of consumerist student migration from traditional curricula are already evidence of challenges to the continuing relevance of a 20th century teaching and learning paradigm. The students who seek out design programs are not the art students of the past. They bring to inquiry lived experiences in the rapidly changing possibilities of the Information Revolution. College and university programs owe them equal concern for how design education must change.

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Author

Meredith Davis is Emerita Distinguished Alumni Professor in the College of Design at North Carolina State University, where she served as Graphic Design department head and director of the PhD in Design program. She taught at the college level for 40 years, first at Virginia Commonwealth University and then at NC State. She is an AIGA Fellow and Medalist, Holladay Medalist, and NASAD Fellow. She served as president of the American Center for Design, co-authored the NASAD design accreditation standards, and conducted more than 100 curriculum reviews and consultations. She is the author of several books, including *Teaching Design,* and numerous articles, including the AIGA Design Futures Papers. She was principal in the firm Communication Design from 1979–1989.