Design Pedagogy in Practice:

Barriers to Learning and Evaluation in the Design Studio

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Abstract

The role of design pedagogy in the studio is evaluated, noting potential or perceived barriers to student learning and evaluation through a broad literature review drawn from a variety of design disciplines. Barriers relating to environmental factors, social interaction issues, formative cognitive development, and evaluation are considered, including pedagogical justification and areas of potential impact to the evolution of design skill. The design studio is evaluated both in the traditional residential sense, as well as evolving digital or virtual design studio (VDS) models of instruction. Implications for future research and practice are discussed.

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Design as a recognized discipline and method of inquiry has increased in scope and breadth, and the focus of design pedagogy has shifted to recognize and adapt to digital methodologies and react to barriers in traditional design learning. Design pedagogy—and by indirect extension, the studio design approach—has a long history, spanning from the early methods utilized at the École des Beaux-Arts in the late 19th century (Kuhn, 2001) to the present day. While these traditional studio methods have adapted over time through the differentiation of design disciplines and pragmatic applications of technology (Findeli, 1990), the core blending of functional and structural elements in a problem solving orientation (Kuhn, 2001) have been consistent across a wide variety of design disciplines. Even as these design teaching methods have approached a consistent pedagogy, a large portion of the structure of the design studio has been inherited from previous generations of design learning, and is passed from instructor to student with little thought of the logical or practical bases for the design pedagogy being applied (Brandt et al., 2008; need more citations), or the implication of theories or models for the practice of design (Smith & Boling, 2009). This attitude of teaching as you have been taught has been relatively successful for design instructors in general, but a number of barriers to learning in this way have been addressed in the design literature, spanning multiple design disciplines, which this literature review will attempt to summarize.

Methodology

This review draws from a number of the traditionally labeled “design” disciplines, including: Graphic Design, Museum Studies, Architecture, Interior Design, Instructional Design, Computer Science, and Human-Computer Interaction. Due to the breadth of the sources

compiled for this review, a wide variety of searches were initiated on Google Scholar, JSTOR, and ERIC including core search terms of "design pedagogy," "design learning strategies," and "design pedagogy evaluation," with additional clarifying terms such as "higher education" or "graduate" to refine results further. Selection criteria focused on applicability to higher education, reference to design education as opposed to primarily design practitioner-centered discussion, and direct applicability to design pedagogy, seen as separate from research design and methods. Additional sources were selected based on citations in materials found through these search engines, allowing the identification of seminal sources shared by multiple authors.

Definitions

Design is a notoriously difficult concept or practice to define. While the distinct definition of what design is comprised of is not at the core of this review, a general definition of what comprises the traditional design field may be helpful in self-limiting the scope of the literature referenced, including potential routes of applicability. Stolterman (2011) defines design as "the activity we humans engage in when we are not satisfied with our reality and we decide to intentionally change it," and this definition will be used to ground this review in the most general conception of design as an activity and discipline (para. 6). Design disciplines in their normative pedagogical forms are generally seen as bound by the methodology and praxis of the design studio (Cross, 2007; Schön, 1983), which is comprised of an informal learning environment shaped by exploration and peer and instructor critique, with little direct instruction. The design studio is also typically structured on the premise of design thinking, whereby individuals—all of whom have the innate potential for design ability (Cross, 2007) —learn to think and act in a context of design judgment and situational appropriateness to develop and defend solutions, rather than using a predefined structure or linear process (Boling & Smith, 2010; Breslin &

Buchanan, 2008; Teal, 2010; Shaffer, 2003). Schön (1987) presents this design studio as a location where projects are individually or collaboratively executed, where projects are normally selected based on their applicability and conformance to the actual practice of that design discipline. The design studio, and its intrinsically related design pedagogy are treated together in this review, with the design studio acting as the primary outlet of the generally accepted norms of an overarching design pedagogy, a feature that Shulman (2005) terms a "signature pedagogy." Although design pedagogies exist that do not rely on the studio model as a primary driver, these approaches are not seen as normative within design education as a whole (Brandt, et al., 2008).

Pedagogical Barriers in Design Pedagogy

Overview of Barriers

The pedagogy of the design studio may seem unstructured from a traditional educational standpoint, which, as Schön (1987) notes is ontologically structured on "technical rationality" (p. 8). But the role of design pedagogy is not oriented primarily toward research or theory, but rather to the application of these traditional educational constructs as they inform the development of practitioner-oriented skills—the utilization of existing knowledge to extend knowledge into new domains (Schön, 1987). Because much of traditional education is structured based on these traditional norms, rather than the application of these skills in a practitioner role, the primary barrier of the design pedagogy is one of unfamiliarity and lack of comfort in extending and synthesizing existing knowledge to solve new problems (Dorst, 2006; Ledewitz, 1985). Many of the barriers to design pedagogy noted in the literature stem from this inability or unwillingness to think in a "designerly" way, seen as separate and distinct from the knowledge-gathering approach on which much of traditional academia is based.

Additional barriers in the design studio naturally result from the unique environmental, social, formative, and evaluative contexts inherent in this methodology. Environmental barriers include such issues as the distinction of private and public space, the lack of a traditional classroom setting, and the potential of unfamiliar tools or classroom norms. Social norms can also create issues of comfort, particularly in the critique-oriented culture of the design studio; students must be willing to openly discuss strengths and weaknesses of their classmates' work, and receive feedback in a similar manner. Formative barriers occur in tandem with social concerns, but relate to the individual's progress in developing personal design knowledge, thinking, and sense of personal process. Evaluation is inextricably connected with the other three categories of barriers, but also stands alone as a centerpiece of the normative design pedagogy (Schön, 1988). The studio is based on a non-traditional evaluation structure, which is strongly weighted toward public—as contrasted with private—critique and feedback. This evaluation is accomplished through small group, or desk "crits," but is also commonly adapted to a larger setting through public critiques formed by the entire class or cohort (Reimer & Douglas, 2003). Evaluation may also be seen as a combination of these formal critique sessions in tandem with self-reflection techniques, or informal peer feedback or support, sometimes accomplished through peer mentoring.

Environmental Barriers

Private and public space. The traditional classroom is, by its very nature, a transient space, occupied for a traditional class period, but generally unused outside of that defined context. A design space, by contrast is generally available for student use on an ongoing basis, with an architecture that encourages a combination of public and private space. For many new studio programs, the lack of defined studio space is problematic, resulting in the lack of the

desired studio culture, which this shared, persistent space denotes (Blevis, Rogers, Siegel, Hazlewood, & Stephano, 2004; Reimer & Douglas, 2003). In particular, the lack of private space results in limited opportunities for students to remake a space as their own, which may translate to a lack of comfort working in that space (Lester, FitzGerald, & Stone, 1997). This issue is potentially multiplied when only public spaces are available, even if they are persistent in nature, due to the malleability of location within the space that can result. It is suggested that a mix of public spaces and defined private work areas meets the needs of the design studio most succinctly, providing common areas for critique and peer interaction, while also allowing students to work in a consistent, self-defined space (Wang, 2010; Reimer & Douglas, 2003).

Contrast to traditional classroom space. While the metaphor of the design space is a comfortable and efficient working model for experienced design students, introductory design students on the graduate and undergraduate levels unfamiliar with the environment that the design studio denotes may be uncomfortable due to the lack of apparent structure or adherence to traditional classroom norms (Burdhardt & Hacker, 2004; Demirba & Demirkan, 2003; Ochsner, 2000). This contrast is especially problematic for graduate students entering a design discipline from a field outside the traditional design experience, for instance, students entering a graduate program in Human-Computer Interaction from an undergraduate background in Computer Science (Boling & Smith, 2010; Siegel & Stolterman, 2008). The positioning of the professor in this classroom space may also be unfamiliar, as the design professor is primarily concerned with indirect instruction (Reimer and Douglas, 2003), accomplished through informal desk crits rather than a traditional lecture stance.

Unfamiliar tools and norms. A design student uninitiated to the design studio is also frustrated by the difference in tools with which to express themselves (Mawson, 2003; Ochsner,

2000). In place of notes and textbooks, a design studio is most frequently oriented towards sketching (Buxton, 2007; Do & Gross, 1996; Lee & Breitenberg, 2010) and rapid prototyping (Akalin & Sezal, 2009; Dutton, 1987), which may require a wide range of tools and media depending on the target environment or specific design profession. Any combination of these tools, which eventually allow for thoughts to be quickly captured for quick iteration (Lee & Breitenberg, 2010; Mawson, 2003), require mastery in isolation prior to being useful in the ideation process (Norman, 1998). The norms of working with tools in isolation or in a collaborative context may also be unfamiliar to the introductory design student: collaborative work may be difficult for a student that has previously completed work on a largely directed basis (Cross, 2007; Ledewitz, 1985; Schön, 1987). Schön (1988) also notes that students may discard or ignore material that is not seen to be immediately relevant or helpful. In many design fields, a tension between the ways of knowing and executing critical research also colors the role of design within the larger academic context (Boling & Smith, 2012; Schön, 1988).

Complexity of technological tools. While the physical design studio introduces a large number of physical tools that may create feelings of unfamiliarity or lack of immediate comfort, the online or digital studio experience creates additional layers of required technological competence (Marx, 2000; Oxman, 2008; Gross & Do, 1999). Kvan (2001) and Oxman (2008) relate the coming technological divide due to the rapidly increasing level of baseline technological competence to perform basic design tasks in the digital architecture studio, with Marx (2000) concluding that the technological competencies must be separated from the design-specific competencies to maximize the effectiveness of the studio experience, regarding tool-level competency as secondary. Won (2001) also describes the bias that technology-based tools can exert on the design process, resulting in greater visual fidelity, but self-limiting expression

due to the relative strengths and weaknesses of these tools. Oxman (2008) also notes the digital divide that is created by the use of digital tools for visual discovery as compared to sketching as a method of design thinking.

Social Barriers

Social issues within the design studio may appear at the introductory level, as a function of discomfort when working with peers or openly receiving feedback, or social issues might reactivate in developing or intermediate design students who have created mental structures or design processes—some of which may be protective in nature (Ochsner, 2000) —that are self-limiting the designerly progression of that student. These social issues may present as a difficulty in interacting with other design students in a productive way, or by nurturing other design students but stunting individual development as a result of this mentoring process. The core social activity of the studio, however, is the critique process—both in the giving and receiving of critique—which generally takes place in the context of design production (Blevis, 2010). Within the general work processes of the studio, the introduction of the group dynamic also often requires collaborative group work and a willingness to break rules in an organized sense to encourage innovation (Gregory, 2003; Wylant, 2008), which requires additional social interaction in an organized, consensus-oriented way. Also critical in the development of social skills in orientation to the design space is the development and sustainment of a design culture, which reflects the goals and structures of the design process itself (Nelson & Stolterman, 2000; Blevis, Rogers, Siegel, Hazlewood, & Stephano, 2004)

Willingness to give critique. In traditional educational settings, critique is often reserved for the professor or instructor, and this power is rarely given to an individual student within the classroom environment. The design studio is founded upon a culture of open critique (Wang,

2010), both between peers and professors, encouraging reflection and learning (Pringle, 2009). Designers can construct their own design knowledge through the act of critique and self-reflection about the design processes of their colleagues (Lewis, 2005; Soufi & Edmonds, 1996). As a corollary to the process of accepting critique, questions asked during a formal or informal critique may add dimension to the creative process, spurring innovative thinking in all studio participants (Logan, 2008).

Willingness to receive critique. Designers must be willing to accept regular critique in the design studio environment, as an outgrowth of the experiential journey to becoming a practitioner (Pringle, 2009; Danvers, 2003). Accepting this critique is a social barrier for some students, especially when the designer interacts with the instructor to justify their actions—through a synthesis of verbal and visual components—of telling and showing (Demirba & Demirkan, 2003; Schön, 1983), or the critical process of evaluation results in misconceptions about design principles (Oxman, 1999). In particular, Siegel and Stolterman (2008) note that an unwillingness to accept critique in a constructive way can result in a difficult transition between their stages of pre-emergent thinking and designerly thinking. The process that exists between these two states is by nature indeterminant, but the designer can be seen as creating patterns of thinking as they relate to specific design concepts (Danvers, 2003; Oxman, 1999). Expanding or breaking down these patterns through the process of critique is important to creating validated, flexible patterns that can be applied to new problems in the future (Danvers, 2003).

Identities in the digital space. While identities are easily and naturally formed in the physical design studio space, identities within the digital design studio, or as some authors refer to it, the virtual design studio (VDS), are inherently more malleable and thus more prone to issues of trust and connectedness (Cheng, 1998; Maher & Simoff, 2000). While convenience of

digital participation in the design process has overrun the face-to-face collaboration and critique possible in the physical design studio (Kvan, 2001), Cheng (1998) notes that this lack of physical proximity creates additional barriers due to lack of body language, lack of immediate feedback (especially in asynchronous communication), and ambiguity in relation to targeting feedback to specific aspects of a physical design. While identities can create confusion in the online space, there may also be value in being more aware of their online peer's activities, tracking multiple modalities of interaction, potentially facilitating additional communication (Adler, Eisenstein, Oltmans, Guttentag, & Davis, 2004; Maher and Simoff, 2000).

Formative Barriers

Formative barriers are, perhaps, the most elusive, as much debate still exists on how designerly thinking is measured, and what stages exist between entry-level and practitioner-level design competencies. A large body of literature exists on the definition and formation of creativity, often within the design process (Crilly, 2010; Lewis, 2005), but this thread of analysis is outside the scope of this literature review. More generically, however, barriers are seen by many to exist in how an entry-level designer tends to think about the design discipline, or, in a meta-cognitive sense, how the student would describe or explain their relationship to or knowledge of design.

Personal design knowledge. The goal of the design studio is to produce students who "think" like someone in that design field. In the architectural studio, the goal is to produce a student that thinks like a practitioner in the specified design discipline (Ledewitz, 1985; Oxman, 1999). Mapping the progress of an individual student to this general norm, however, is less clearly defined, not even to a successful design student or practitioner (Yilmaz, Seifert, & Gozalez, 2010). Ledewitz (1985) notes that, "despite the fact we do not define [design] precisely,

we can easily distinguish those students who have learned to 'think architecturally' from those who have not." (p. 3) Siegel (2008) defines this transformation as a "metamorphosis" whereby students pass through a number of barriers in terms of how they think about and practice design. Overcoming, or penetrating these barriers, indicates the general transformation of a designer from a pre-emergent state to that of a designerly thinker and practitioner. Sachs (1999) also identifies the importance of recognizing "stuckness" in the studio, encouraging students to identify the source of their design barrier in a causative sense, discovering potential barriers in design practice, thinking, or interpersonal conflicts; upon overcoming or recognizing these incidents, design knowledge can be strengthened or created (Ledewitz, 1985). Meanwhile, Heylighen, Cavallin, and Bianchin (2009) reiterate the value of recognizing on a personal level the fundamental aspect of change related to the design education process, noting that "designers are concerned not only with what is, but with what should be." (p. 98). Change also represents openness to new ideas, and flexibility within existing design knowledge to incorporate new experiences and information (Danvers, 2003).

Personal process. The development of a personal process is also seen as an important aspect of developing designerly thinking. While design is difficult to define in isolation, it may be due to the multiplicity of mental processes and frameworks that designers use to structure their personal design process (Notess & Blevis, 2004; Boling & Smith, 2010). In particular, the studio process can be seen as reinforcing the development of personal design knowledge (Yilmaz, Seifert, & Gonzalez, 2010), which ultimately forms a personal problem solving strategy, or design process (Akalin & Sezal, 2009; Fincher, 1999) that they internalize and adjust over time (Pringle, 2009). Devoid of this process, the design student is left to externalized representations of design process (Blevis & Siegel, 2005), many of which overly linearize or

simplify the design process (Lewis, 2005; Mawson, 2003; Smith and Boling, 2009; Teal, 2010). The role of experience, both external and internal, is also important in developing a personal process; Strickfaden and Heylighen (2010) note the role of the professor and student in discussing experience to build design knowledge, both through precedent and theory.

Problem solving behaviors. Traditional problem solving strategies are targeted at well-defined problems, which are generally acknowledged to not exist in real world design problems (Breslin & Buchanan, 2008; Cross, 2007). Moving beyond the structure and strategies appropriate for a well-defined problem, a "wicked" problem has no direct solutions or standard methodologies that can be applied in a formulaic sense (Cross, 2001, 2007), although strategies can be used to push the designer in new, previously unconsidered directions (Lewis, 2005; Ludden, Schifferstein, & Hekkert, 2008). The willingness to accept the constraints indicated by these wicked problems (Dutton, 2006), along with the removal of the idea of a best solution or "right" solution as a possible outcome is key in the development of designerly thinking as it relates to problem solving (Siegel & Stolterman, 2008). Exploration is seen as a natural way of reconciling these difficult problems, utilizing design heuristics to guide the exploration of the problem space (Yilmaz, Seifert, & Gozalez, 2010) and emergent characteristics of design artifacts to guide problem solving behaviors (Soufi & Edmonds, 1996). Since problems are discussed in relation to other experiences or design issues through practice, some learnings regarding the problem solving process may not transfer directly to problems in the future, resulting in a slower, inductive approach to understanding of theory (Breslin & Buchanan, 2008).

Evaluative Barriers

Evaluation can be seen as a confluence of the previous three categories, as environmental factors, social factors, and formative cognitive functions mesh together in the basic evaluation

activities of the design studio (Schön, 1988). While aspects of evaluation can be considered to affect barriers within environmental, social, and formative functions, evaluation also includes a broad base of support and implementation of feedback in the design studio, and provides a variety of functions to support and motivate design students as they transcend various barriers in design thinking and production in the metamorphosis process.

Public critique and feedback. Public feedback is the core of the design studio experience, creating opportunities to present design concepts, respond to peer and professor critique, and iterate the design appropriately to meet defined constraints and desired outcomes (Dutton, 1987; Schön, 1988). The public critique process is crucial to the development of design thinking (Blevis, 2010), and Walliss and Greig (2009) along with Danvers (2003) conclude that the indeterminacy and the lack of clear, unbiased feedback that often results from this approach encourages designers to think introspectively and further their intellectual development by questioning and being questioned. Additionally, the metaphor of the design may be ambiguous or not communicated equally among all members of the studio, resulting in additional feedback with which to continue the design process (Coyne, Snodgrass, & Martin, 1994; Logan, 2008).

Self-reflection. Wang and Ilhan (2009) note the importance of understanding how creative processes and their outputs relate to one another, even though each of these elements—whether it be design artifact, concept, or feedback—in isolation is not predictive of the next step in the creative process. This interaction between elements generates what Cross (2007) terms "the creative leap," forming the next iteration in the design process, often without a clear link from previous design iterations (p. 65). While innovation is one of the defined causes of this "creative leap," it is also a natural outcome of the self-reflection process and the linking of feedback, experience, and design knowledge (Crilly, 2010; Dorst, 2006; Wylant, 2008). Meta-

cognition is also an important feature of the self reflection process, as it serves to synthesize existing knowledge and patterns gathered through internal and external experience (Dorst, 2006; Ledewitz, 1985; Strickfaden & Heylighen, 2010) formed in the design studio, consolidating these themes in a way that furthers the design process and encourages future exploration of the problem space (Spanbroek, 2010).

Peer and mentor support. In addition to the roles of self-reflection and public critique, peer feedback and mentoring also facilitate the overall goals of evaluation in the design studio (Schön, 1988; Oxman, 1999). Wang (2010) underscores the importance of peers and mentors being able to enter the design conversation and understand the design process and knowledge behind physical design prototypes, understanding and guiding each other through the iterative design process. This externalized communication about design process and outcomes also reinforces the goals of Schön's (1987) "reflection-in-action," propagating an active and ongoing reflection among all participants of the design studio (Wang, 2010; Schön, 1988). However, too much structure or support at varying levels of design education may result in delayed development of design thinking or the use of varying supports to supplement or replace true design thinking (Ochsner, 2000).

Synthesis of Barriers

While each of these main categories of barriers and associated elements, are helpful in establishing an effective design studio, the core of the design studio is the evolving design student. As Siegel and Stolterman (2008) note, this transformational process to designer from non-designer is characterized by the penetration through a variety of barriers. It is through the overcoming of these barriers that individual design knowledge and process is developed, thereby giving the individual student the intellectual tools and practical experience to think in a

designerly way. Shaffer (2007) describes an effective design learning environment as a "coherent system of activity," (p. 100) not a collection of strategies or procedures that are only tangentially related. It is through this systems-view of design pedagogy that the importance of common elements such as social interaction, evaluation, and the creation of individual design knowledge becomes evident.

Areas for Future Research

Even as a large body of research exists within the field of design pedagogy, the specific value in understanding how design students are learning in the studio and what barriers might result in that learning process are more difficult to ascertain. Siegel and Stolterman (2008) have undertaken one of the most comprehensive reviews of design barriers as applied within the field of Human-Computer Interaction, but not all of these findings are generalizable across the discipline of design. And further, a variety of social and environmental factors located in other sources, especially in terms of basic studio orientation and composition, were not indicated in this single review. To extend this body of research, two distinct directions are proposed: confirming generalized barriers to design pedagogy across all design disciplines, and locating barriers germane to specific areas of design practice, including confirmation of the work of Siegel and Stolterman (2008).

Generalizable barriers. Barriers to design pedagogy noted within this review span a variety of disciplines, but it is not clear if all disciplines share these concerns in so far as they share they design studio model of education. Emerging fields, especially those who are utilizing elements of the traditional design studio pedagogy within the larger context of Problem Based Learning (PBL), may incorporate issues of design thinking in a different context (Brandt et al., 2008), if these issues are considered at all. In addition, many educational institutions are

employing an incomplete studio model (Brandt et al., 2008), occasionally due to lack of proper resources or space, but potentially due to lack of experience as well. Future research might attempt a lower-level analysis or meta-analysis of a variety of design disciplines, in order to confirm features consistent across the design studio model as an organism or cohesive model, including those features that are critical to the success of the studio (Brandt et al., 2008) and those that are found to be merely peripheral.

Discipline-specific barriers. In addition to generalizable barriers to design pedagogy, it is clear that although a variety of design disciplines share the formation and sustainment of the studio model concept, the application of this model, and its implications for praxis vary somewhat. Due to this variance in goals, it is assumed that students may also perceive different types of barriers based on their design focus. These barriers, based on the design disciplines noted in this review, might range from formal cognitive skills such as spatial reasoning or color recognition to performance-based skills such as tool dexterity or technology-based composition. Further research into the nuances and special pedagogical needs of particular design disciplines may serve to further strengthen the overall studio pedagogy concept, while simultaneously reducing the reliance on a monolithic tradition in emerging fields where portions of the experience may be unnecessary or unhelpful.

Evaluation strategies. Evaluation is at the core of the design studio environment, centered on the desk and public crit, but little research is currently available to pinpoint the ideal functioning of this component of the studio. The execution of this complex evaluative instrument by peers and faculty is often guided by the past crit experiences of those involved, often creating a mirrored pedagogical effect, rather than a constructed, logical progression of inquiry into the subject's design thinking. Additional research into the varying forms of critique and how they

enhance or inhibit the evolution of design thinking may indicate themes of practice that enhance the overall effectiveness of the evaluation instrument, thereby affecting the pedagogical efficiency of the studio model at large.

Conclusion

The tradition of design pedagogy within the studio has evolved over the past century, adapting to changing orientations of design practice, perceived need, and logistical demands of the educational process. As the design studio model continues to be adapted and applied to emerging fields, and as the core design disciplines change in focus and breadth, an understanding of how design students are affected by the studio model in both generalizable and specific terms is critical to the ongoing effectiveness of the studio.

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