Personal and Pedagogical Factors That Shape Design Thinking

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Abstract

A wide range of design literature discusses the role of the studio and its related pedagogy in the development of design thinking. Scholars in a variety of design disciplines pose a number of potential factors that affect this development process, but a full understanding of these factors, especially as experienced from the student perspective is lacking. I examined the experience of six first-year graduate design students in an intensive design course through three semi-structured interviews over the course of their first semester of instruction. The constant comparative method was used to analyse the factors that shaped their design thinking. Factors identified in the literature were confirmed, and additional factors relating to group work, culture shock, critique, individual versus group identity, and the design influence of people and curriculum are identified and reported.

Keywords: design pedagogy; art and design education; design studio; identity; cultural identity; human-computer interaction

Personal and Pedagogical Factors That Shape Design Thinking

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 factors encountered in traditional design learning. While studio design pedagogies have adapted over time through the differentiation of design disciplines (Findeli 1990), the blending of functional and structural elements in a problem solving orientation are consistent across a wide variety of design disciplines (Kuhn 2001; Brandt, et al. 2008). While a core design pedagogy has been widely implemented, the process of moving a student toward mastery, changing the way they think about design (Siegel & Stolterman 2008; Cross 2011), is not well understood. In this study, I evaluated the experiences of first-year design students to understand factors that shaped their design thinking.

Definitions

Design disciplines 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, peer and instructor critique, and little direct instruction. The design studio is typically structured on the premise of design thinking, whereby individuals 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; Brandt, et al. 2008; Breslin & Buchanan 2008; Teal 2010; Shaffer 2003). Design thinking, as originally proposed by Cross (1982) includes four important features: it is constructive in nature, it addresses ill-defined problems, it is solution-focused, and is dominated by problem solving.

Schön (1987) presents the 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 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.'

Review of Literature

A literature review was conducted to establish potential factors that may shape a student's development of design thinking. The identified literature includes the application of the studio pedagogy in a variety of design disciplines. From this literature, candidate themes of factors that are informed by design pedagogy were identified, and these themes form the tentative outline of factors that follows.

Environmental Factors

For many new studio programs, the lack of dedicated space is problematic (Blevis, et al. 2004; Reimer & Douglas 2003). It is suggested that a mix of public spaces and defined private work areas meets the needs of the design studio most efficiently, providing common areas for critique and peer interaction, while allowing students to work in a consistent, self-defined space (Wang 2010; Reimer & Douglas 2003).

Design students on the graduate and undergraduate levels unfamiliar with the environment of a design studio may be uncomfortable due to the lack of apparent structure or traditional classroom practice (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 (examples include: Boling & Smith 2010; Siegel & Stolterman 2008).

A design student unfamiliar to the design studio is 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; Lee & Breitenberg 2010) and rapid prototyping (Akalin & Sezal 2009; Dutton 1987), which may require a range of specialized tools. 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).

Social Factors

Social issues within the studio may include discomfort when working with peers or openly receiving feedback, or the creation of protective mental structures or design processes (Ochsner 2000) that limit the progression of that student. The core social activity of the studio is the critique process—both giving and receiving— surrounding the design production process (Blevis 2010). The introduction of the group dynamic 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.

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 often serve a pedagogical purpose, spurring new thinking in studio participants (Logan 2008).

Designers must be willing to accept regular critique in the design studio environment (Pringle 2009; Danvers 2003). The designer can interact with the instructor to justify their actions by telling and showing (Demirba & Demirkan 2003; Schön 1983), but evaluation can sometimes result 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 stages of pre-emergent thinking and designerly thinking.

Formative Factors

Formative factors describe how an entry-level designer tends to think about the design discipline, or how the student would describe or explain their relationship to or knowledge of design.

The goal of the design studio is to produce students who 'think' like someone in that design field (Cross 2011; Ledewitz 1985; Oxman 1999). Mapping the progress of an individual student to this general norm is less clearly defined, 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 threshold in terms of how they think about and practice design.

Designers use numerous mental constructs and frameworks to structure their design process (Notess & Blevis 2004; Boling & Smith 2010). The studio process reinforces the creation of design knowledge (Yilmaz, Seifert, & Gonzalez 2010), which ultimately forms a 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 result in linearization or simplification (Lewis 2005; Mawson 2003; Smith & Boling 2009; Teal 2010).

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).

Designers address 'wicked' problems that have no direct solutions, where standard methodologies cannot be applied in a formulaic sense (Cross 2001, 2007). 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 is key in the development of designerly thinking as it relates to problem solving (Siegel & Stolterman 2008).

Evaluative Factors

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).

Public critique and feedback. Public feedback is the core of the design studio experience, including 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). This public critique process is crucial to the development of design thinking (Blevis 2010), and Walliss & Greig (2009) and Danvers (2003) conclude that 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.

Self-reflection. Wang & Ilhan (2009) note the importance of understanding how creative processes and their outputs relate to one another, even though each of these elements—design artefact, 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 element 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).

Peer and mentor support. Peer feedback and mentoring 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.

Synthesis of Factors

While each of these emergent categories of factors are helpful in understanding the features of a design studio, the core of the design studio is the evolving design student. As Siegel & 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,' (100) not a collection of strategies or procedures that are only tangentially related.

Purpose of Study

Graduate students with little or no design background who matriculate into a design discipline offer a unique viewpoint. These students often bring additional lived and educational experience from outside design education. The literature suggests a wide range of factors that may influence this development process, but is inconclusive as to what factors shape the individual designer during their educational experience. Research questions from the larger study are included here, although this manuscript focuses exclusively on the first question.

Research Questions

1. What factors appear to affect the ability of first year design students in their development of designerly thinking in a one semester introductory HCI design course?
2. How do student conceptions of design and individual design process during a one-semester introductory HCI design course reveal the development of their design thinking.

Method

This is a qualitative study, drawing on critical theory. The experiences of individual participants as reported from their vantage point is necessary to elicit responses for which the participants have tacit awareness (Carspecken, 1996). Longitudinally constructed interviews allow participants to reflect on their experiences over a semester, creating a sufficient source of data to triangulate their experiences and document changes in behaviour or thought process.

Setting

The study was conducted at a large Midwestern USA university, focusing on students in a graduate design program in the School of Informatics. The Human-Computer Interaction design (HCI/d) Master's program trains students for careers in interaction and user experience

design. A majority of students come from a non-design background, including students with undergraduate degrees in the liberal arts. HCI/d students take courses including: intensive design practice, exploration of methods and theory, and a design capstone project at the end of the second year.

The Researcher

The researcher conducting this study completed undergraduate and graduate coursework in graphic design, HCI/d, and instructional design, and worked as a student mentor for first-year students in a foundational design course during the period of data collection. This mentoring included regular contact with students and student work, access to collaborative design meetings in which the students completed required projects, and participation in two out of three classes that were required of first-year students. Although no explicit field notes were taken during these experiences, regular collaboration with students allowed the researcher a high degree of familiarity with student experiences and project work from which to base interview questions.

Participants

The participants in this study included six students from the HCI/d program (See Table 1). Participants were solicited through email, using a departmental list-serv established for first-year students in the HCI/d program. All responding participants were recruited into the study.

[TABLE I]

Data Collection

A series of three interviews were conducted with student participants. These interviews were placed at approximately the ninth, 12th, and 16th weeks of the first semester. Each interview followed a semi-structured format over approximately one hour, and was audio recorded to allow

for transcription and further analysis. Stimulated recall from previous interviews was used to allow for member checking of interview data and provide opportunities for reflection on past reported or observed experiences by the participant.

Analysis

Data collected from student interviews were analysed using the constant comparative method. Each interview was divided into utterances that represented a complete thought or idea. The utterances were then assigned to one or more themes that appeared to be consistent with the data (Glaser & Strauss 1999). The final themes were informed by, but not limited to, the themes addressed in the literature review. A coding scheme was constructed from these themes during the process of analysing multiple interviews, and the final coding scheme was applied across all student interviews (see Table 2). Codes were applied non-exclusively.

[TABLE II]

Findings & Discussion

During the analysis of student interview transcripts, several categories of factors were found to be consistent with the data. Some of these categories were confirmatory of themes addressed above, but other emergent themes were absent or underrepresented in the literature. All of the themes identified in the literature review were found in the interview data.

The additional emergent themes seem to reflect the quantity—both in depth and time—of thick data collected from a specific design program, and the collection of data from a student-centric viewpoint. Some of these themes may represent a richer interpretation of an existing theme, such as the individual tensions that were identified around the process of critique, while others are contingent upon the specific application of design pedagogy applied in this HCI/d

program. For instance, the assumption of group work in the required primary design course that first year students framed not only the act of working in a group and fostering productive relationships, but also had ramifications on the development of a personal v. group identity, and issues of communication that result when working with non-native speakers or individuals with an unfamiliar educational background.

Group Work

In this specific design program, group work is highly valued, both as a way of fostering professional and personal relationships, and as preparation for work in a professional design team. Many students shared a lack of familiarity with group work, or had negative past experiences, but as the semester progressed, group work seemed to become more familiar. Others developed an identity separate to their team experience.

Importance of an informal/personal relationship. Project teams were initially assigned in the primary design course, and few students had established relationships prior to beginning the program. Starting in week seven, students were allowed to pick their own group members, and at this point, most students had the opportunity to work with a number of other students. As the semester progressed, the importance of establishing personal relationships with teammates as a path to effective group work emerged. Zhen noted that her teammates interacted in a variety of settings, '...not only meetings and just when we meet in hallways or yeah, we will talk and we will go to bar and talk more than others. Just makes me feel we are more intimate than others, and just feeling makes me feel good, and makes me feel easier to discuss and critique.' (R3). Similarly, Jessica's team often met at a local bar, and she found that 'informal meetings are sort of the way to go and uh (.) well whenever we can, whenever it's appropriate' (R3). It appeared

that establishing personal relationships between group members allowed for more honest discussion during group time, and led to a more productive design process.

Hiding ideas. Several participants felt that effective group work was facilitated by withholding personal feelings and opinions to establish group consensus. Zhen noted that 'you have to hide your ideas to fulfil other's feelings' (R1), while Jiao '[tried] to keep silence instead of um throw out my emotion to others' because she 'wasn't in the mood to talk about the conflicts or struggling things' (R3). Other individuals seemed to 'shut down' when they disagreed, with Jessica recounting that she 'shut[s] down in groups whenever the conversation [...] starts to wander into a land I disagree with' (R3). From another perspective, Jonathan observed: 'everybody has a great mind, great ideas, it's just—they feel suffocated and they can't show that.' (R2).

Conflict. The potential for conflict in a group situation was addressed as an almost inevitable feature of group work, as an outcome of expressing conflicting design opinions. These conflicts ranged from the mundane, ('We ended up arguing left and right about the way everything would look [...] it's funny...it's cliché to talk about where like a button should go', Jonathan.R1). to complete stalemate ('[she] propose a vote and then uh like [they] divided to two groups and no one can convince each other and [she] think that the other's idea is traditional and boring.', Xia.R1). Zhen's group engaged in conflict over ideas, as she describes: 'Sometimes, I know I'm right, but when I insist on it—we just got a fight. I really couldn't convince them. I don't know why...' (R1). Jiao experienced conflict as lack of comfort: '...we didn't actually have a fight with each other, uh, I just feel so uncomfortable in the meeting.' (R2).

Culture shock

This program included a diverse group of students in gender, background, and country of origin. This academic year, almost half of the incoming cohort was comprised of non-native speakers—the highest level in the program's history. While numerous resources are available for international students, the transition to life in the USA was difficult for many students, including the three participants from China—none of whom had been to the USA previously. During the semester, the ability of students to readily communicate in a team setting improved, but this additional barrier often created added stress. Although all of the study participants worked in teams with native and non-native speakers, only the three non-native speakers reported difficulties communicating and adapting to new personalities.

Ability to communicate. The need to communicate fluently and accurately was reported frequently by all three non-native participants. Jiao expressed that 'it's really hard for us to communicate—really communicate...' (R2), while Xia recounted that '...most of the time is American talk to another American and they—both of them talk really fast [laughs]. So, sometimes it's even hard for us to catch up their uh speaking' (R2). Communication of abstract concepts in a non-native language was often a barrier as well ('What really embarrass me is like when I try to express uh abstract ideas I can't speak it clearly, I have to explain again and again and again', Zhen.R1), with the delay sometimes causing the group to shift before they really understood the concept. The speed of communication was a reported issue ('...we cannot talk as fast as American...', Jiao.R2), as was the inability to effectively speak and think at the same time ('... sometimes I keep quiet not because I get lost, but because I'm thinking...', Xia.R2). Language issues persisted in groups with non-native speakers that did not share the same first language, as Jiao reported: 'I think the biggest problem—one is our communication skills since

we got three internationals in our team, it's really hard for us to understand each other. Sometimes, I will say we spend more than 50% of our time to catch up with each other, and make sure everyone on the same page.' (R3).

Personality. The adaptation of individual personality in a new setting also seemed to be an issue. Zhen reflected that 'when [she] was in China, [she was] the kind of person [that] like to talk' (R1), while Jiao felt 'kind of lost in America' (R3). While there were some positive feelings associated with the shift ('Since I come here, I come I feel more free and I can do what I want.', Jiao.R1), the frustration sometimes led to isolation and frustration ('I feel really upset and really frustrated and I don't even want to talk to any Americans.', Jiao.R3). Zhen also experienced a difference in culture in a group setting, expressing: 'I think Americans are used to speak up and uh—to—to voice for themself and the Chinese are used to compromise.' (R2).

Identity

Several individuals reported feelings about self, personality, preferences, and changes resulting from individual and group work in the design program. It seemed to be typical that an individual's identity within the context of the program grew in tandem with their design expertise. In particular, there seemed to be a shift from individual to group, influenced by the large role of group work in the program. However, some participants viewed themselves as separate from the group and expressed the need to develop as an individual.

Individual to group orientation. Many students came into this design program with little experience as a designer or as a member of a design team. The role of group work seemed to be valued once enrolled, as Xia reflects: 'I didn't expect that teamwork is very important before I come here.' (R3). However, group work often included distribution of tasks based on individual competencies ('...sometimes we will sketch by ourselves and when we come back to

discuss it...', Xia.R1; '... beforehand I think I want to hide my design before it is…presented, but now I think it's better to discuss the design with others as early as possible', Xia.R3), or students experienced group work as a barrier to deep thinking about a problem ('...when people are trying to define their ideas [...] it's hard to open the communication, but after we separate and think more deeply about it.', Xia.R1). The progression from individual to group work was couched in preparedness for industry ('...the way I see like our group projects right now, um I think that that's more akin to like what happens in industry...', Jessica.R2), but the role of the individual was still seen as important but difficult to grasp ('I don't know how to like give like an individual focus [to projects]...', Jessica.R2).

Individual v. group. While the transition from individual to group work was largely seen as positive and reflective of work in industry, one participant seemed to see herself as an individual designer, distinct from group work. Jessica commented '...it's sort of dawning on me that like there is myself as an individual designer and then like how I play in a group' (R2), identifying these unfulfilled needs as an individual as important for group work ('whenever I have more time to focus on [myself], I'll be able to contribute to groups more...', Jessica.R3). This concept of knowing oneself as a designer seemed to figure into an overall of design pedagogy, with Jessica noting: 'if somebody gives me a design challenge, I want to know myself a little bit better than I know myself right now...' (R3).

Critique

While critique was located prominently in the literature, both as a social and evaluative factor, the experience of critique was often diminished due to perceived pedagogical value. Most students had little experience engaging in critique, so the transition to accepting critique—rather than defending their design—was a dominant theme. Also important was giving critique, and the

seeming inability of some participants to provide critique if they were unable to communicate flaws or provide a solution. These tensions regarding critique seemed to mark student insecurity around the role of critique as a tool to improve design.

Defend or accept? Early on in the design program, it was unclear how to accept critique from other students or professors. The tension quickly developed between adequately defending your design and design process, and accepting critique as formative evaluation to improve the design. The instinct to defend a design seemed to stem from the public nature of the critique ('... because it's not a casual conversations or...maybe it's harder for me to accept this critique.', Zhen.R2), or the role of the individual designer's judgement ('... of course you have your opinion about it [...] But, I will defend what I've designed and I will have an opinion about it.', Jonathan.R2). This defence gradually gave way to acceptance over the course of the semester, with Zhen reflecting that 'I am feel more comfortable to take those critique, but still I feel embarrassed...' (R3) and 'I'm trying to stop trying to defend it...' (R2).

Reticence to give critique. Another common reaction to critique was the unwillingness or inability to give critique to other students. Jessica seemed less willing to contribute to formal classroom critique, since she didn't feel comfortable with public speaking (R2), noting 'I guess somebody else in the class is going to do [critique], and I already don't think I'm the most articulate person, so I'm going to let somebody else pick up.' (R3). Zhen shared that 'At first I feel embarrassed' when critiquing other student work. Another common misunderstanding of critique was the role of critique as primarily a medium for sharing solutions. Xia observed 'sometimes I just think, oh maybe there's something wrong with the work, but I can't [...] find the reason that...' (R2), concluding that '...if I just raise a problems, I didn't give the solution, that mean I didn't help.' (R2).

Design Influence

Numerous factors were reported as directly or indirectly influencing the design process of participants. Many factors related to the environment of the shared studio, or described the 'the program' as influencing them as designers. Apart from the environment, most participants acknowledged the role of people as the most important factor in their development as a designer over the course of the semester. Three primary, but related factors were emphasized: second year students, professors and mentors, and the synergy of coursework. Each of these factors were mentioned numerous times by all participants.

2nd Years' work as precedent or benchmark. Every participant mentioned the importance of seeing work by more advanced students as beneficial in developing their own sense of process, and as a benchmark for their future work. Early in the semester, Zhen noted the potential benefit of working with 2nd years to learn more about the design process, both in how they design ('...I think I can learn more how [2nd years] design.', R1), and how they work address design problems ('I think maybe it's a better way for us learn [...] to learn how [2nd years] deal with different problems.', R1). The 2nd year work highlighted a gap between cohorts in terms of capability ('...seeing what the second years are doing [...] that's kind of highlighted what is lacking between first year and second year work.', Greg.R1) and presentation ('...all second years seem very articulate. They can speak in front of a group...', Jessica.R3). The role of 2nd year work as an exemplar or precedent also appeared to be potentially beneficial, as Jonathan reflects: '...I think it would be nice if it were actually put in front of you what an exemplar for submission looks like. What it—what it takes, right.' (R2).

Professor and peer mentor. The positive value of mentorship is well established in the literature, and this benefit was also clear in this design program. Mentorship was not always seen

as helpful by participants, however, with the stated purpose of mentoring (to guide, not lead) by the professor coming in opposition to the desire for more direct assistance by students. Student mentors were assigned for each project in IDP, and the professor was available for additional consultation. Greg noted that their mentor 'was trying not to be too strong, you know, like say do this.' (R1), while Zhen was frustrated by the lack of specific feedback, stating: 'Because [the mentor] don't want us to follow his advice, so he just give some general guideline, but I don't think it is helpful.' (R1). Mentors also served a role in critiquing projects, with some students finding mentor critique beneficial ('I think having the second years around is tremendously helpful, because in general, you can just grab anyone and be like, hey, what do you think of this?', Greg.R1), and others citing conflicting advice ('Just sort of totally different sides when it comes to mentor critique. So, we take it with a grain of salt. Almost all of it. At least I do.', Jonathan.R1). By the end of the semester, participants were generally more accepting, with Zhen reflecting: '...our mentor, helped us lot. And helped us trying to keep narrow down and to move forward.' (R3).

The input from the professor, in particular the professor for IDP (Interaction Design Practice), was seen as valuable by all of the study participants. The expertise and critique of that professor was seen as different in quality, as compared to student mentors. The professor intervened in groups where he noticed difficulties arising, helping them use appropriate design methods ('...when [the professor] join in, we start he will get us to use the post notes to brainstorm and then to talk about this problems and to make a decision on it so we can move on to the next topics to expand it...to explore it.', Zhen.R1; '[The professor] had an intervention with us, like look guys, you guys are doing it wrong.', Jonathan.R2) or talk them through interpersonal conflicts ('I feel I don't know how to improve it.

Synergy of coursework. The alignment of coursework during the first semester of this design program appeared to be quite important in the overall conception of design and design process by students. The course Visual Literacy (VL) was being offered for the first time, alongside IDP and Foundations of HCI. IDP offered a primary design experience, with group projects and an emphasis on practice. Foundations was primarily a reading class, which used the structure of 'three waves' of HCI to talk about divisions of HCI research from business application to multi-user systems to hedonic qualities of interaction. VL focused on developing design judgement and the ability to critique and understand visual materials. The sharing of information between courses was clear, with participants noting value for future design work ('Jeff's class give me the—a holistic view of HCI. And—I don't think it's helps my design process directly, but maybe I feel like it will help me a lot in the future.', Zhen.R2), immediate value for research ('...before I— read this paper [in Foundations], I not think about search ubiquitous computing.', Zhen.R2), and explanation of features of the design pedagogy ('...emotion from my—myself can also influence what—what I am doing. Like it's a circle things, like when Jeff is talking about um emotions should be a priori to reason, I feel like the same way.', Jiao.R3). The contrast of individual and group assignments between VL and IDP was also important, both in feelings of success ('I feel—a lot more in control of the products for Eli's class.', Jessica.R1), and the ability to apply visual knowledge to presentations ('I know, you can see the changes in our presentation', Zhen.R2; '[VL] has brought me a lot of value in um (.) thinking critically about the choices I make in the PowerPoint presentation...', Jonathan.R3).

Limitations of Study

In this study, I have investigated the factors that were found to influence design thinking from a student perspective in a specific instantiation of design pedagogy. As such, none of these

results should be seen as directly transferable or generalizable to other design programs, disciplines, or even future iterations of this specific program. However, themes that have been identified in this analysis of a specific design program may provide further direction for future research and study.

Because of the qualitative nature of this research study, the specific implementation of design pedagogy becomes an important feature for analysis. While the literature generally speaks of pedagogical features in concrete, transferable form, a specific design pedagogy context is intensely situated, drawing from a wide range of non-replicable features, including: coursework and professors, composition of the cohort, state of research and practice in the field, availability of precedent in the mass market, and issues specific to the studio and/or learning environment. As such, no single design pedagogy instance is completely replicable, which underscores the importance of investigating these features and their role in the learning process.

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 specific terms is critical to the on-going effectiveness of the studio.

In this study, I have outlined a series of factors that were found to influence students in a specific implementation of design pedagogy, including the role of group work in shaping a wide range of pedagogical features, the implications of culture shock in diverse educational settings, the importance of building a personal and group identity within the context of design, the social

pressures of critique, and the wide range of design influence created by the alignment of curriculum, professors, and mentors/peers. Each of these aspects of learning within a design pedagogy context represents a potential area for research and further study. As design as a signature pedagogy is implemented into additional disciplines, it is important to view the studio in a holistic way, and by extension, understand the design learning environment as a 'coherent system of activity' (Shaffer 2007, 100). Without knowledge both of the complete system and the factors within the system that cause this signature pedagogy to function, we risk misunderstanding the reasons for past success of this learning structure in the rush to incorporate elements of this pedagogy in new disciplines.

References

Akalin, A., & Sezal, I. (2009). The importance of conceptual and concrete modelling in architectural design education. *International Journal of Art & Design Education*, Vol. 28, No. 1, pp., 14-24.

Blevis, E. (2010). Design challenge based learning (DCBL) and sustainable pedagogical practice. *Interactions*, Vol. 17, No. 3, pp. 64-69.

Blevis, E., & Siegel, M. (2005). The explanation for design explanations. In *11th international conference on human-computer interaction: interaction design education and research: current and future trends.*

Blevis, E., Rogers, Y., Siegel, M., Hazlewood, W., & Stephano, A. (2004). Integrating HCI and design: HCI/d at IUB, a design education case story. In Zimmerman, J., Evenson, S., Baumann, K., & Purgathofer, P. *Workshop on the relationship between design and HCI. ACM CHI 2004 conference on human factors and computing systems.* Vienna, Austria.

Boling, E., & Smith, K. M. (2010). Intensive studio experience in a non-studio masters program: Student activities and thinking across levels of design. Proceedings of the Design Research Society International Conference, Montréal, Canada. Retrieved from http://www.designresearchsociety.org/docs-procs/DRS2010/PDF/015.pdf

Brandt, C., Cennamo, K., Douglas, S., McGrath, M., Reimer, Y., & Vernon, M. (2008). *(De)coding the studio method to teach the design of human-computer interaction*. Paper presented at the 24th National Conference on the Beginning Design Student, Atlanta, GA. Retrieved from http://smartech.gatech.edu/bitstream/handle/1853/29133/22-243-1-PB.pdf?sequence=2.

Breslin, M., & Buchanan, R. (2008). On the case study method of research and teaching in

design. *Design Issues*, Vol. 24, No. 1, pp. 36-40.

Buxton, Bill. *Sketching User Experiences: Getting the Design Right and the Right Design.* San Francisco: Morgan Kaufmann, 2007.

Carspecken, P. F. (1996). *Critical ethnography in educational research: A theoretical and practical guide*. New York: Routledge.

Crilly, N. (2010). The structure of design revolutions: Kuhnian paradigm shifts in creative problem solving. *Design Issues*, Vol. 26, No. 1, pp. 54-66.

Cross, N. (1982). Designerly ways of knowing. *Design Studies,* Vol. 3, No. 4, pp. 221-227.

Cross, N. (2007). *Designerly ways of knowing.* Basel, Switzerland: Birkhäuser.

Cross, N. (2011). *Design thinking: Understanding how designers think and work*. Oxford: Berg.

Danvers, J. (2003). Towards a radical pedagogy: provisional notes on learning and teaching in art & design. *International Journal of Art & Design Education*, Vol. 22, No. 1, pp. 47-57.

Demirba, O. O., & Demirkan, H. (2003). Focus on architectural design process through learning styles. *Design Studies*, Vol. 24, No. 5, pp. 437-456.

Dorst, K. (2006). Design problems and design paradoxes. *Design Issues*, *22*(3), 4-17.

Dutton, T. A. (1987). Design and studio pedagogy. *Journal of Architectural Education*, Vol. 41, No. 1, pp. 16-25.

Fincher, S. (1999). Analysis of design: an exploration of patterns and pattern languages for pedagogy. *Journal of Computers in Mathematics and Science Teaching*, Vol. 18, pp. 331-348.

Findeli, A. (1990). Moholy-Nagy's design pedagogy in Chicago (1937-46). *Design Issues*, Vol.

7, No. 1, pp. 4-19.

Glaser, B. G., & Strauss, A. L. (1999). The discovery of grounded theory: strategies for qualitative research. New York: Alpine de Gruyter.

Gregory, J. (2003). Scandinavian approaches to participatory design. *International Journal of Engineering Education*, Vol. 19, No. 1, pp. 62-74.

Kuhn, S. (2001). Learning from the architecture studio: implications for project-based pedagogy. International Journal of Engineering Education, Vol. 14, No. 4/5, pp. 349-352.

Lawson, B., & Dorst, K. (2009). *Design expertise*. Oxford: Architectural Press.

Ledewitz, S. (1985). Models of design in studio teaching. *Journal of Architectural Education*, Vol. 38, No. 2, pp. 2-8.

Lee, H. -K., & Breitenberg, M. (2010). Education in the new millennium: the case for design-based learning. *International Journal of Art & Design Education*, Vol. 29, No. 1, pp. 54-60.

Lewis, T. (2005). Creativity: a framework for the design/problem solving discourse in technology education. *Journal of Technology Education*, Vol. 17, No. 1, p. 35.

Logan, C. (2008). Metaphor and pedagogy in the design practicum. *International Journal of Technology and Design Education*, Vol. 18, No. 1, pp. 1-17.

Ludden, G. D. S., Schifferstein, H. N. J., & Hekkert, P. (2008). Surprise as a design strategy. *Design Issues*, Vol. 24, No. 2, pp. 28-38.

Marx, J. (2000). A proposal for alternative methods for teaching digital design. *Automation in Construction*, Vol. 9, No. 1, pp. 19-35.

Mawson, B. (2003). Beyond 'the design process': an alternative pedagogy for technology education. *International Journal of Technology and Design Education*, Vol. 13, No. 2, pp. 117-128.

Norman, E. (1998). The nature of technology for design. *International Journal of Technology and Design Education*, Vol. 8, No. 1, pp. 67-87.

Notess, M., & Blevis, E. (2004). Integrating human-centered design methods from different disciplines: contextual design and principles. In *Proceedings of the design research society futureground 2004 conference.* Melbourne, Australia: Design Research Society.

Ochsner, J. K. (2000). Behind the mask: a psychoanalytic perspective on interaction in the design studio. Journal of Architectural Education, Vol. 53, No. 4, pp. 194-206.

Oxman, R. (1999). Educating the designerly thinker. *Design Studies*, Vol. 20, No. 2, pp. 105-122.

Oxman, R. (2008). Digital architecture as a challenge for design pedagogy: theory, knowledge, models and medium. *Design Studies*, Vol. 29, No. 2, pp. 99-120.

Pringle, E. (2009). The artist-led pedagogic process in the contemporary art gallery: developing a meaning making framework. *International Journal of Art & Design Education*, Vol. 28, No. 2, pp. 174-182.

Reimer, Y. J., & Douglas, S. A. (2003). Teaching HCI design with the studio approach. *Computer Science Education*, Vol. 13, No. 3, pp. 191-205.

Schön, D. A. (1983). *The reflective practitioner: how professionals think in action.* New York: Basic Books.

Schön, D. A. (1987). *Educating the reflective practitioner: toward a new design for teaching and*

learning in the professions. San Francisco: Jossey-Bass.

Schön, D. A. (1988). Toward a marriage of artistry & applied science in the architectural design studio. Journal of Architectural Education, Vol. 41, No. 4, pp. 4-10.

Shaffer, D. W. (2003). When Dewey met Schön: computer-Supported learning through professional practices. In *Proceedings of the world conference on educational media, hypermedia, and telecommunications.*

Shaffer, D. W. (2007). Learning in design. In *Foundations for the future in mathematics education.* (pp. 99-125). Lawrence Erlbaum.

Shulman, L. S. (2005). Pedagogies of uncertainty. *Liberal Education*, Vol. 91, No. 2, pp. 18-26.

Siegel, M. A., & Stolterman, E. (2008). Metamorphosis: transforming non-designers into designers in *Undisciplined! Proceedings of the design research society conference 2008.* (pp. 378:1-13). Sheffield, UK: Sheffield Hallam University.

Smith, K. M., & Boling, E. (2009). What do we make of design? design as a concept in educational technology. *Educational Technology*, Vol. 49, No. 4, pp. 3-17.

Soufi, B., & Edmonds, E. (1996). The cognitive basis of emergence: implications for design support. *Design Studies*, Vol. 17, No. 4, pp. 451-463.

Teal, R. (2010). Developing a (non-linear) practice of design thinking. *International Journal of Art & Design Education*, Vol. 29, No. 3, pp. 294-302.

Walliss, J., & Greig, J. (2009). Graduate design education: the case for an accretive model. *International Journal of Art & Design Education*, Vol. 28, No. 3, pp. 287-295.

Wang, D., & Ilhan, A. O. (2009). Holding creativity together: a sociological theory of the design professions. *Design Issues*, Vol. 25, No. 1, pp. 5-21.

Wang, T. (2010). A new paradigm for design studio education. *International Journal of Art & Design Education*, Vol. 29, No. 2, pp. 173-183.

Wylant, B. (2008). Design thinking and the experience of innovation. *Design Issues*, Vol. 24, No. 2, pp. 3-14.

Yilmaz, S., Seifert, C. M., & Gonzalez, R. (2010). Cognitive heuristics in design: instructional strategies to increase creativity in idea generation. *AI Edam-Artificial Intelligence for Engineering Design Analysis and Manufacturing*, Vol. 26, No. 3, pp. 335-355.