

Locating the Emerging Design Identity of Students Through Visual and Textual Reflection

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Abstract

Reflective activities have the potential to encourage students to develop critical skills and awareness of mental models. In this study, I address the emerging identity of early design students as they externalize their evolving conceptions of design through visual and textual reflection. Forty-three students in an introductory human-computer interaction (HCI) course completed weekly textual reflections on a course blog, and completed visual reflections at the conclusion of each of three projects. The weekly blog reflections were intended to document their experience as a developing designer, while the visual reflections represented their personal conception of design within HCI—their rendering of the “whole game”. Through this process of reflection, students externalized their transformation as designers, including an awareness of the pedagogical, social, and cultural factors shaping them, and a growing sense of their personal and professional design identity. Through interviews and additional analysis of eight of these students, a disjuncture was found between conceptions of design in visual and textual reflections, with visual reflections forming a professional, generic design identity, and textual reflections more congruent with the student’s personal identity. Issues relating to lack of representational skill and how these forms of reflection externalize a student’s evolving design philosophy are addressed.

Keywords

Reflection; Sketching; Designerly Identity; Design pedagogy; Human-Computer Interaction (HCI)

Reflection and reflective practice have been at the centre of understanding how design education encourages professional action since Donald Schön wrote his classic text describing the interactions between Petra and Quist (1983). While this form of verbal dialogue in the studio between a professor and student, the social milieu of the studio at large (Webster, 2008), and informal interactions between students (Gray, 2013a; 2013b) encourage the development of these metacognitive abilities, less attention has traditionally been paid to formal modes of reflection. In this work, I describe the use of textual and visual reflection as tools to externalize the emerging design identity of early design students, as they move from *doing* to *becoming* (Carspecken & Cordeiro, 1995) a designer.

Review of Literature

While little research has been done to represent the shifting identity of students within design education, there is relevant work surrounding how designers build their own sense of identity in relation to their personal design philosophy, form representational skill to use sketching as a communicative act of reasoning, and externalize their tacit assumptions about design through reflection.

Reflection in Education

Rogers (2001) recognizes the substantial role reflection can play in developing critical skills and awareness in a higher education context, making the claim: “[p]erhaps no other concept offers higher education as much potential for engendering lasting and effective change in the lives of students as that of reflection” (p. 55). While Schön (1983,1987) modeled reflection primarily through verbal interaction in a desk crit, other forms of reflection might encourage other forms of evaluation to occur, moving the locus of interaction out of the classroom into a more regular, self-initiated act. Some research within traditional design education suggests using reflection as a way of articulating tacit knowledge (Ellmers, Bennett, & Brown, 2009) and revealing connections between difficult concepts (Ockerse, 2012). Within emergent design fields such as human-computer interaction (HCI), reflection has also been used in a more formal way to document changes in conceptions of design over time (Siegel & Stolterman, 2008), and more recently, to frame the role of visual reflection in externalizing a student’s mental model of design within a specific disciplinary framing (Gray & Siegel, 2013).

Design Philosophy

In relation to developing an understanding of one’s own identity, reflection allows a student to gain awareness of what they are *doing* and how they project their future as a process of *becoming* (Carspecken & Cordeiro, 1995). Within design, Nelson and Stolterman (2012) address this process in similar terms, using the concept of one’s individual *design philosophy* as one of the ways in which this *becoming* process might be explored. It is through this lens of the developing design student—as they understand their own design philosophy and how that philosophy is enacted through their evolving identity—that reflection might play a role in formalizing and externalizing conceptions of design over time.

Sketching as Design Reasoning

Sketching has long been regarded as a core skill designers should possess, with implications for formal representation of concepts, as well as in communicating design arguments to clients or other designers (Do & Gross, 1996; Verstijnen, et al., 1998). While students in traditional design disciplines are often taught to sketch or draw as part of their curriculum, this level of pedagogical concern is not always encouraged to the same degree in emergent design disciplines such as HCI. Sketching as a way of communicating is acknowledged in this field (Buxton, 2007), but many students entering this field do not have adequate representational skill in this area.

In parallel with the formal use of sketching in design education, there have also been efforts from outside design education to find ways to externalize mental models of complex systems or processes. Perkins (2010) uses the concept of “playing the whole game” to formalize an individual’s understanding of a system or process in a more holistic way, and this method has been used in a previous study (Gray & Siegel, 2013) to encourage visual exploration of a student’s conception or model of the discipline of HCI.

Purpose of Research

This study addresses the turbulent period as an early design student is initiated into new patterns of thinking within the context of an emergent design discipline. While previous work in this area has relied only on textual reflection (Siegel & Stolterman, 2008) or visual reflection (Gray & Siegel, 2013) as a way of ascertaining tacit beliefs about design, this work extends this line of inquiry regarding reflection to more accurately identify the evolving design student. In this paper, I describe the actions of design students in an introductory HCI course as they reflect in textual and visual form and externalize their conceptions of design.

Method

This study was framed by a formal artifact analysis of blog postings and reflection sketches, which led to a multiple case study design of a selection of the total cases (Yin, 2009).

Participants

The participants for this study were first year graduate students in a Human-Computer Interaction (HCI) program that emphasized a design approach. All students were enrolled in a required early design experience course, in which they were required to complete reflection in various forms during the one-semester course.

Forty-three students were enrolled in this early design course during the Fall 2012 semester, including strong representation of females (n=17) and international students (n=16). Additionally, three of the students had taken the course previously as an undergraduate student. The 43 participants were reduced to eight, with care taken to maintain a balance of international representation, gender, educational background, and overall academic progress in the course. The eight cases (summarized in Table 1) included three international students and two females.

Data Collection

Blog Posts

Students were required to post on a course blog (Figure 1) about their experiences as a developing designer. In addition to a space for students to reflect, the professor and mentors also used the blog to reflect, share resources, and answer questions about projects. The professor included the following prompt in the syllabus describing these reflections:

Write a reflection this week [...] and every week thereafter! You are expected to write at least one weekly reflection. A reflection describes your feelings and thoughts. Again, just be yourself. These are not published essays. Treat them like casual comments, as if you were writing an email to a friend or colleague.

In all, students made 513 posts on the blog with 909 comments. As noted in the prompt above, students were required to post at least one reflection post each week. Ethics approval was obtained for analysis of all reflection materials, and efforts were taken to protect the identity of participants through assigned pseudonyms.

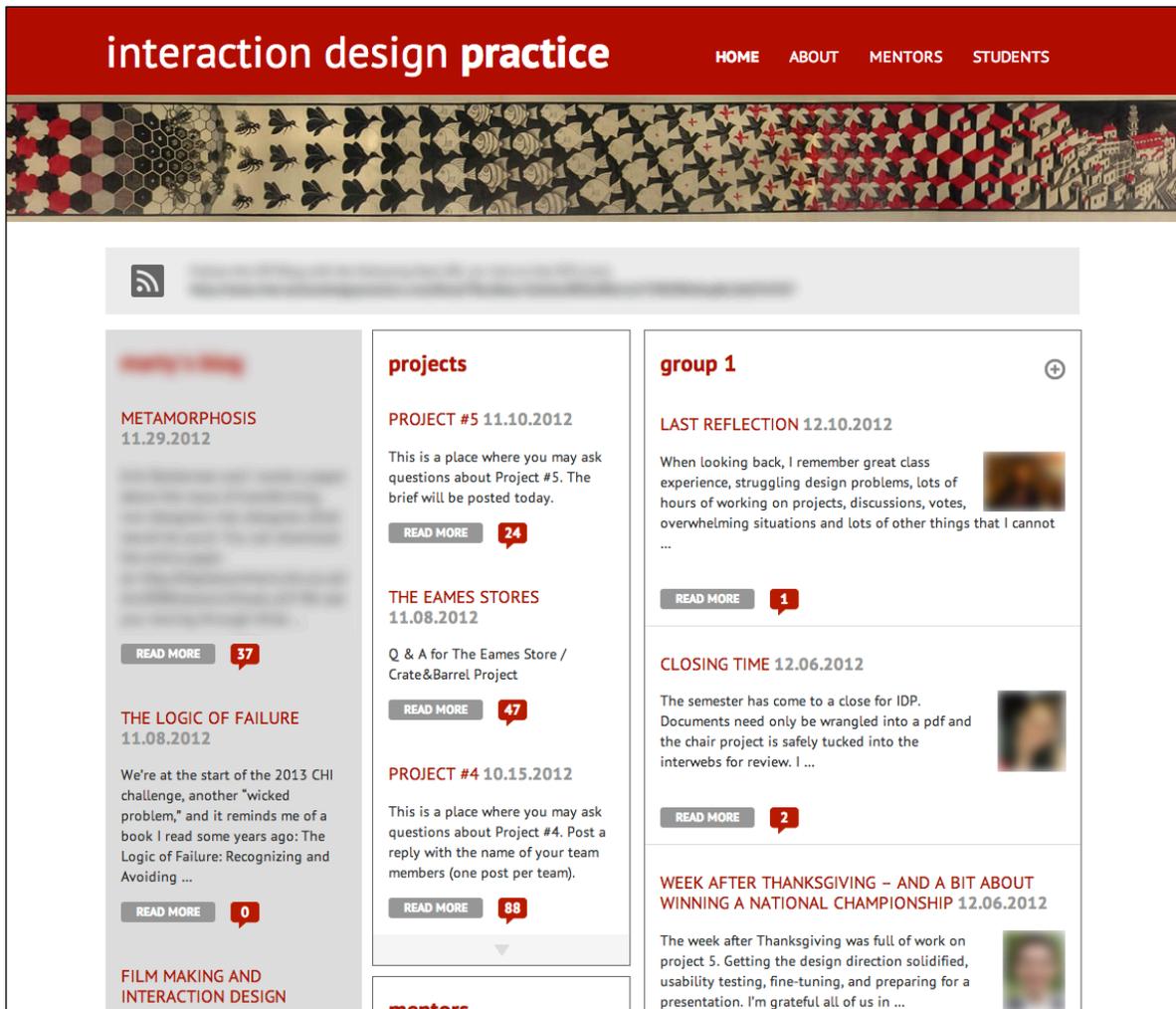


Figure 1. Course blog, with sections for the professor (left), projects and mentors (center), and students by group (right).

Whole Game Sketches

Students were required to submit a sketch summarizing their understanding of the “whole game”—a holistic understanding of HCI and design as expressed by each student—at the conclusion of each project in the course, with three out of five projects represented in this study. The following prompt was provided to students:

I want you to submit a paper sketch of your current understanding of the whole game of HCI Design.

Important: this will not be graded other than you will lose credit if you do not submit this sketch. Do not consult any online or book resources. Your drawing is likely to be somewhat “primitive.” It will be interesting to see how your drawing evolves over time.

In total, 105 sketches were turned in for the first three projects. The first sketch was completed collaboratively with a partner, while the subsequent sketches were completed individually.

Interviews

Based on factors identified above, eight cases (Table 1) were selected from the 43 total cases for further data collection and analysis. All sketches and blog posts for these students were subjected to a close reading, and key themes and issues discussed each week were summarized. The reflection sketches were associated with the blog to contextualize the creation of the sketch in relation to the textual reflection. Comparisons were made between these reflections to identify ideas presented in only one of the reflection mediums, and overall development noted in both forms of reflection during the semester.

Name	Country of Origin	Educational Background	Sketches (by project)	Posts	Comments
Thomas	United States	Philosophy	3	9	17
Jack	United States	Journalism	1,2	11	56
Naveen	India	Engineering	1,2,3	6	12
Isabella	Mexico	Computer Science	1,2,3	17	29
Parker	United States	Computer Science	1,2,3	10	7
Mei-Xing	China	Telecommunications	1,3	16	46
Adrian	United States	Education	2,3	15	28
Zachary	United States	Political Science	1,3	17	27

Table 1. Summary of eight participants by demographic characteristics, available sketches, and blog activity. (*Participants were assigned a pseudonym.*)

After close reading and preliminary analysis, these students were interviewed for 30-45 minutes at the start of the next academic semester. This interview included a discussion of their sketches over time, feelings about reflection in both forms, and explanation of differences between the two modes of reflection.

Findings

To understand the relationship of the experiences of the selected eight students, a narrative of all cases will be reported in three segments, representing the period in which each sketch used in this study was created. While there are numerous ways in which this evidence might be presented, a chronological approach has been shown to be effective in previous reports (Gray & Siegel, 2013), highlighting common challenges across multiple students in the course. Additionally, comprehensive data is not available for all participants due to lapses in participation on the blog or missing sketches, complicating a case-centric reporting of data. A representative sample of sketches and quotations from blog entries and/or the interview support a narrative that describes the evolution of design thinking of these students and their overall experience of the pedagogy. All quotations from the reflection blog are indicated by week (e.g., W1), while other non-annotated quotations are from the interview.

Sketch 1 | Weeks 1-3

The first few weeks of the semester represented a time of transition for many students in the program, most which were coming from non-design educational backgrounds. There was a wide range of experiences among the eight students in relation to reflection, with some like Jack already intimately familiar with journaling and writing as reflection, while Thomas felt this type of reflection was more forced.

Mei-Xing struggled to find herself in these early weeks, commenting that "...[I] can't be myself. Maybe I'm too nervous and anxious" (W1), asking basic questions such as "what's the nature of design?" (W3) and attempting to learn how to grow as a designer. She completed a personal sketch and collaborative sketch for the first project, which were not completely reconciled due to disagreements with the other student about what should be included. While she frequently discussed group work in her blog reflection, it was not included in her sketch because she saw this as a separation between her personal and professional life—the sketch being professional and the blog being personal. By the second semester when she was interviewed, she had begun to break down this differentiation between these modes of reflection.

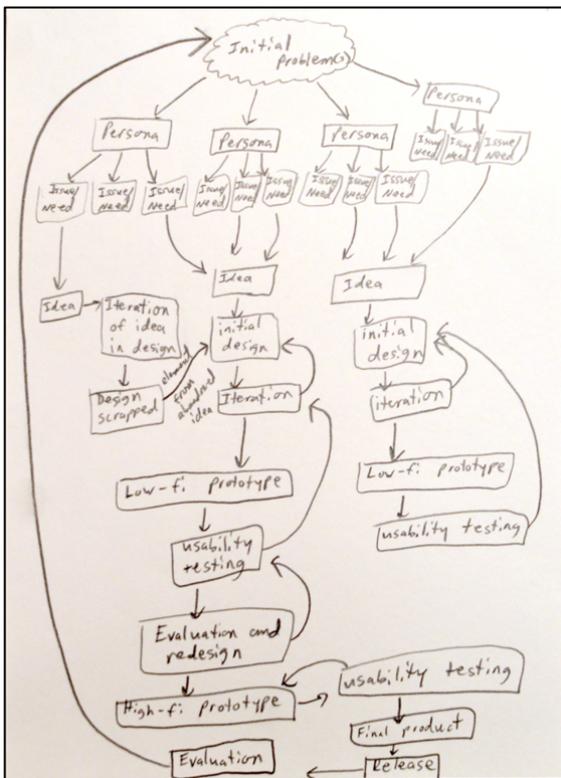


Figure 2: Zachary, P1 Sketch.

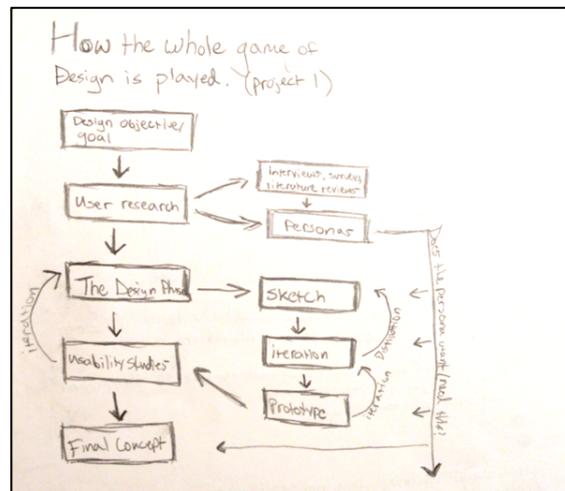


Figure 3: Jack, P1 Sketch.

Zachary felt he was more “text-based at heart” and had to force himself to think in visual terms. He explained that his first sketch “felt square” (in terms of the use of boxes for representation) based on his background in information architecture and formal workflows. Like Mei-Xing, Zachary saw the different modes of reflection as discrete, unrelated activities at this point in the semester. The sketch was more of a formal “deliverable” for the class, while the blog was a more natural way to reflect. This first sketch was similar to many of his colleagues at this stage, focusing on a linear understanding of the design process, with minimal iteration and a focus on representation of design activities rather than the designer.

Jack remarked that the first sketch was what he envisioned as a “design process” based on what he thought the professor was looking for, and like others, didn’t think of this as *his* design process. Unlike some of the other students, Jack relied on journaling to reconcile his feelings: “if I don’t journal, I’m likely to explode. I need to cognitively offload...”; he explained that “I can already feel my brain beginning to rewire” (W2). While his blog reflections offered a rich insight into his evolution of thinking in the first few weeks, such as his shift in belief that “it’s not the destination, it’s the quest” (W3), his sketches still represented a largely linear process.

Thomas had taken the class before, including participating in both of these forms of reflection. Although he brought in prior experience reflecting, he noted that he has “never been good at reflection assignments” (W1/2), and early on, located a “struggle between [his] personal life and work life” (W3). He also explained that reflecting in this way “felt forced—having to reflect” and that it was more natural for him to reflect in more informal ways like Facebook or talking face-to-face; but Thomas also agreed that it was valuable “once he sat down and did it.”

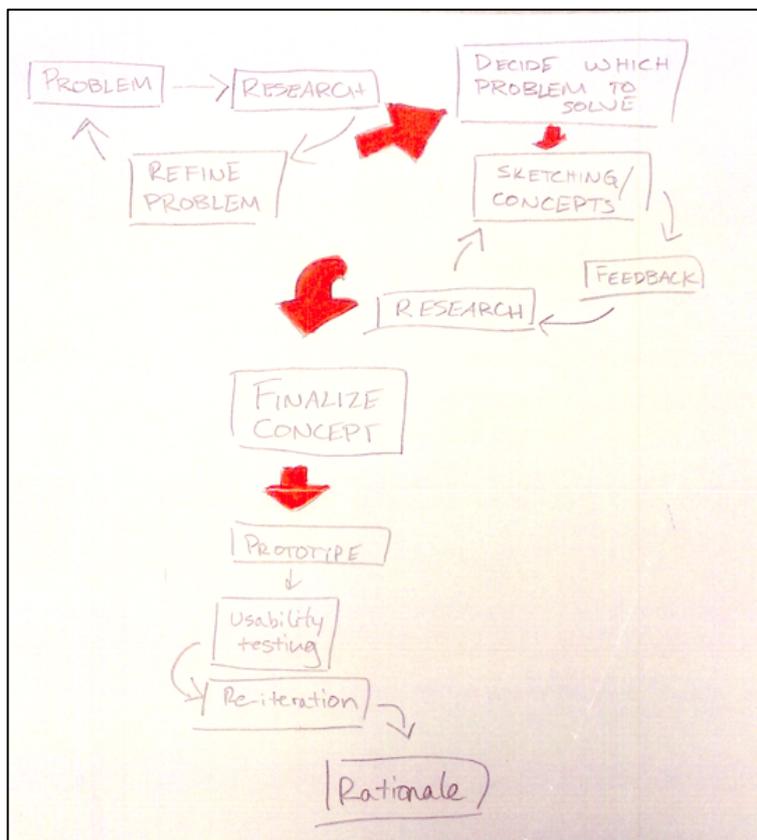


Figure 4: Naveen, P1 Sketch.

Naveen did not engage in reflection on the blog as much as others, but explained that a second year student had warned them “you have to suffer to learn new things” (W1). By Week 3, he had come to the conclusion that you “shouldn’t be attached to your design ideas,” although this theme was not represented in his sketch—a linear flowchart. Unlike many of the other students, he said it was not difficult to sketch his ideas, although given this early sketch, it is unclear whether a more sophisticated understanding of design would be equally easy for him to represent.

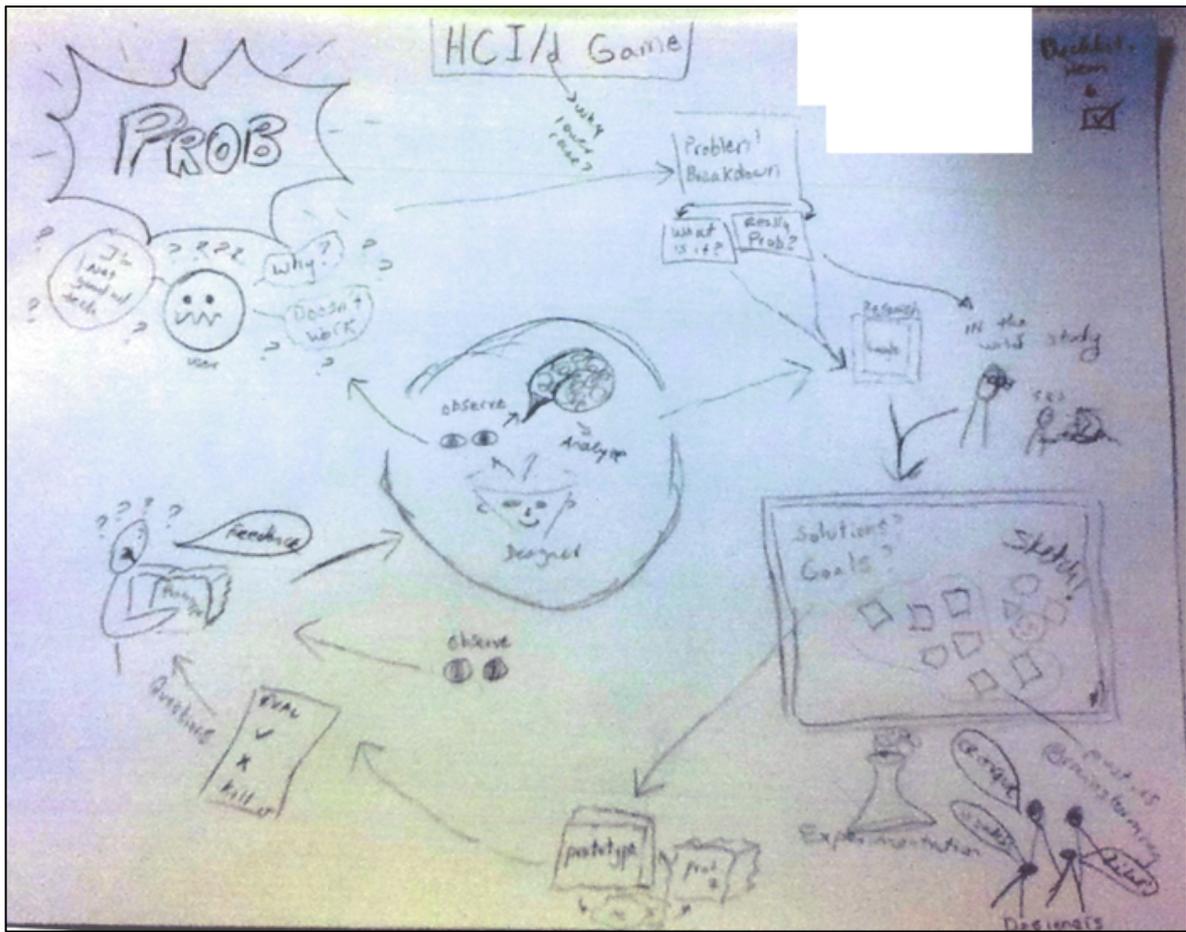


Figure 5: Isabella, P1 Sketch.

Isabella came into the program from a computer science background, but was impacted by this designery perspective, “seeing the world through ‘different eyes’ as experiences” (W1). She wrestled with working in teams and the additional complexity this adds, alongside deep questioning of “what will design mess up?” (W3). Despite this substantial textual reflection, none of these concerns are addressed in her first sketch to any significant degree. Isabella “wanted to draw boxes” for the initial sketch but branched out as she saw examples of sketchnoting from her 2nd year colleagues, resulting in one of the least linear constructions in this set of sketches.

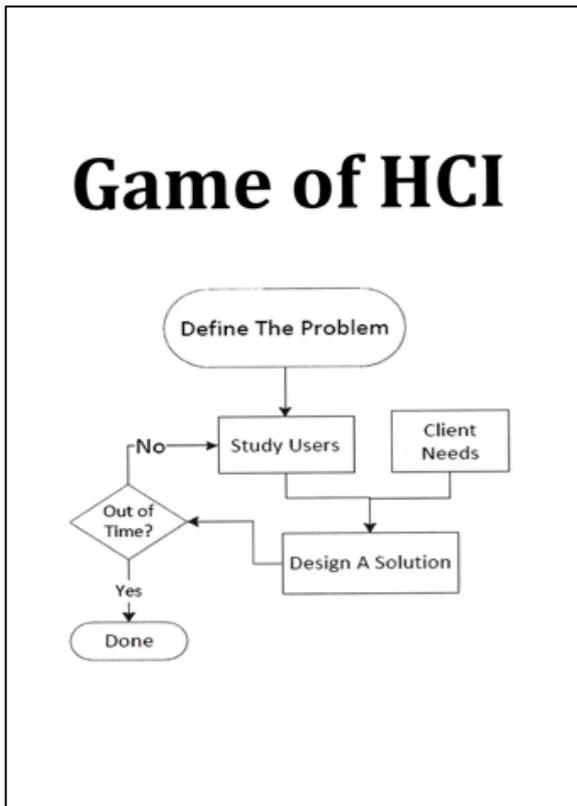


Figure 6: Parker, P1 Sketch

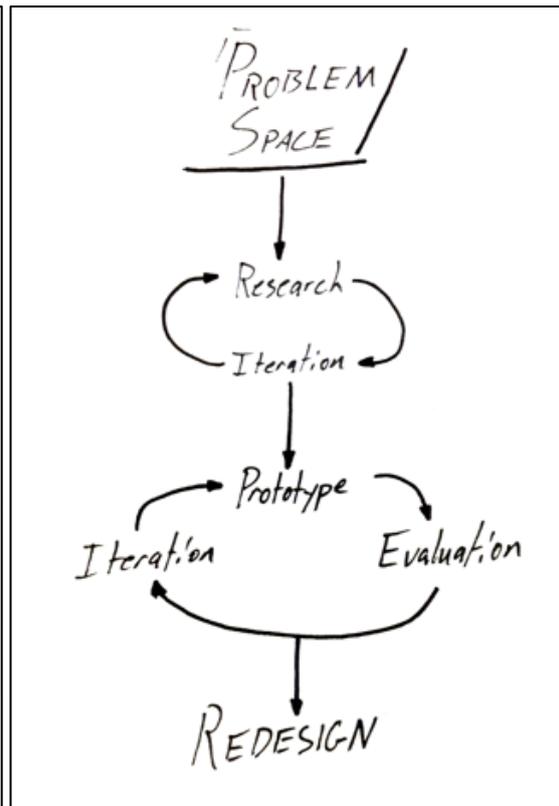


Figure 7: Adrian, P1 Sketch.

Parker came into the program with an expectation of failure: "I wholly expect everyone to fail miserably out of the gate and I welcome it" (W2). Early on he experienced "hectic schedules and lots of designing in circles" (W3), although this was not represented in his linear sketch. Even though the assignment called for a physical sketch, he chose a flowchart format because he liked this organizational paradigm. In reflecting on these actions in the interview, he thought the "design process seemed like a flowchart," and that it was not appropriate to bring his process into his personal life; Parker explicitly noted that he was actively trying to limit how much the design experience was affecting him personally, developing a barrier between his personal and design lives.

Adrian talked substantially on the blog about the importance of group work and the camaraderie he experienced with his colleagues (W3), but there was no such indication of group work in his sketch. Interestingly, there was no presence of a designer in his sketch, although he was actively discussing his personal experience and shift in identity on the blog. This was likely due to a lack of skill in sketching, as he explained in the interview that he was trying to articulate his feelings and experiences in a richer way at this point, but didn't understand how to visually represent his process.

Sketch 2 | Weeks 4-5

By this point in the semester, the goals of the curriculum were starting to take hold, and the students were being actively confronted with project work that greatly exceeded their level of ability. This sense of chaos and lack of control manifested in these reflections—as an increased complexity in the sketches, and as a sense of “letting go” on the blog—representing a dramatic shift in how students viewed themselves as developing designers. Although this milestone in the semester was only two weeks removed from the previous sketch, the changes in representation were dramatic, with most moving away from a flowchart mode of representation to a less centralized more iterative conception of design. In the blog, themes of crisis, teamwork, and letting design concepts go emerged, even though these themes were not represented in most of the sketches in a substantial way.

Mei-Xing was perhaps the most affected in the cohort by the increase in chaos and lack of control. While she was initially optimistic, explaining that “crisis for me is like a gift, because it shows me where I should focus on to improve” (W4), shortly after this, she had a minor breakdown and was excused from classes for a week. At this point in time, she felt that her identity as a designer was in question—“what does designer mean here?”—and it is this existential crisis that became overwhelming to her for a short time. Her experience and subsequent breakdown was perhaps the most extreme of any in her cohort, but represents the intense personal struggle that many students went through at this point in the semester.

Zachary represented this transition more optimistically, but with similar feelings of duress: “I feel as though I’m learning to breathe all over again” (W2). He already had a command of representing his feelings in textual form: “the design process can be said to be...the first and the last: a continuous cycle of genesis that stems from problems and the pursuit of their solutions” (W3); “whether they’re yours or mine, any idea is equally subject to the chopping block: we just have to get to the point where we can let go” (W5). In relation to this textual reflection, Zachary also saw more of himself beginning to emerge in his sketches, focusing on the various lenses of design from class, and structuring his sketch around that learning. While the sketches helped him to distill his formal learning, he explained that the blog helped him to deal with the “chaos of experience”; as he viewed how various students had different transformations, he began to view these tools as a way to see someone’s identity unfold over time.



Figure 8: Jack, P2 Sketch.

Jack began the process of translating his reflections on the blog and overall transformation as a designer to his sketches, actively representing his new-found persona in a storyboard about his role as “fight[ing] for the user.” This dramatic evolution from a flowchart view of design to one where the designer played an active, highly personal role coincided with his blog reflections, where he increasingly saw himself as a member of a team—“together, design”—and noted “I can't imagine myself as an individual designer anymore.”

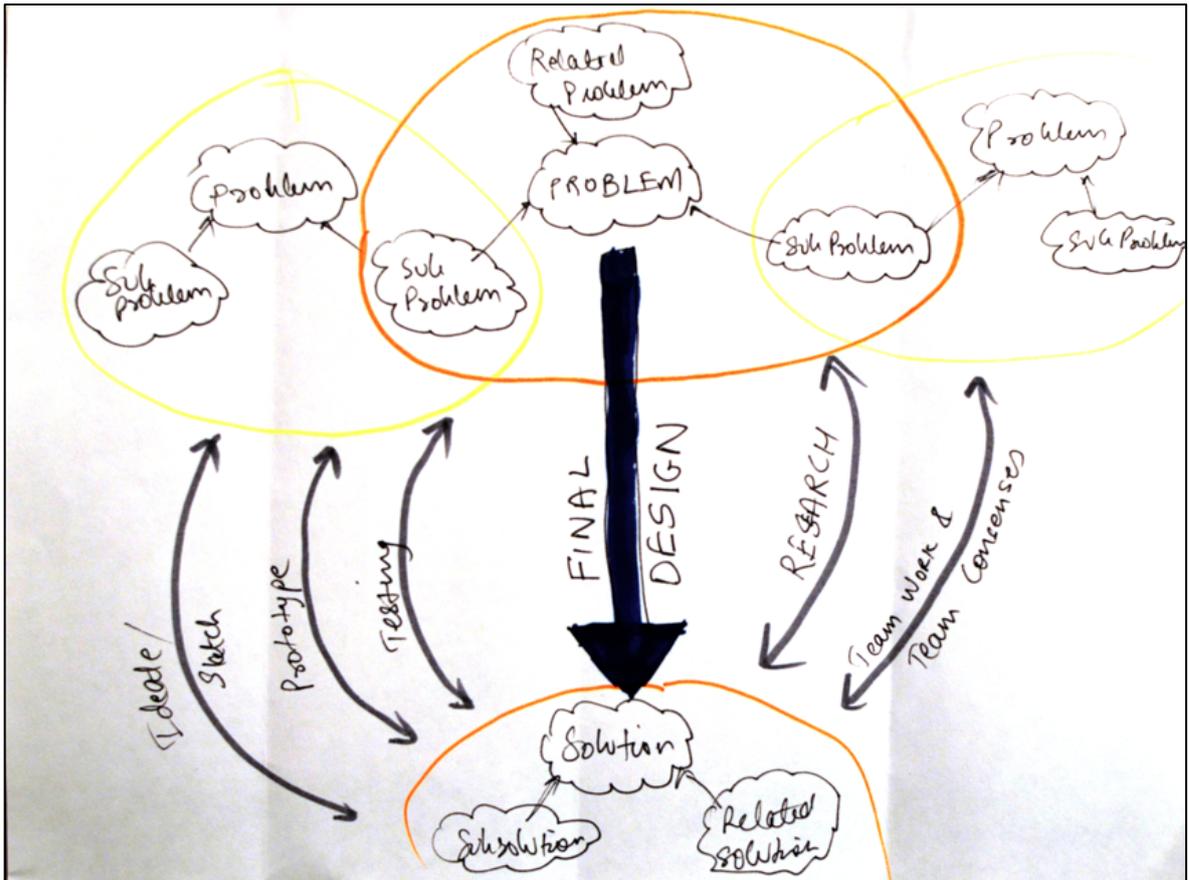


Figure 9: Naveen, P2 Sketch.

Naveen was relatively inactive during this part of the semester, but externalized his feelings about this period in the interview, explaining "[the professor] wants us to feel exhausted and suffocated by the way 'we think' design work is done." His second sketch shows a substantial shift in his view of design, moving away from a linear flowchart to a more iterative design process.



Figure 10: Isabella, P2 Sketch.

Isabella's personality began to emerge even more strongly in this second project. In reflecting on their first formal critiques, she dramatically intoned: "Oh, there will be blood on room 150 by the end" (W5). She also noted the difficulty in "kill[ing] the babies," an intentionally impactful term used by the professor to describe the need to let design concepts go, actively working through issues to reform her identity as a designer, rejecting her old conceptions. Her sketches became more documentary in nature, and she increased her ability to visualize the things she thought were previously lacking.

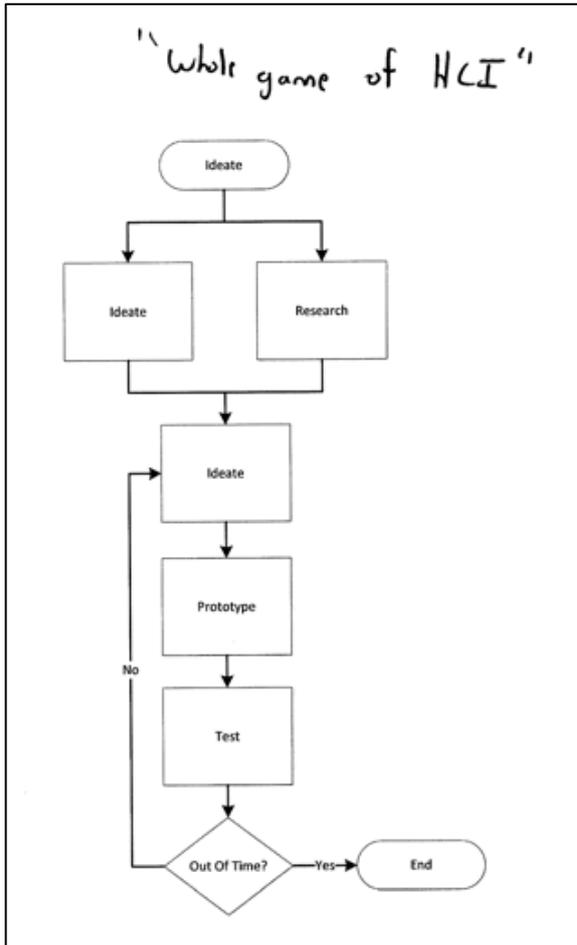


Figure 11: Parker, P2 Sketch

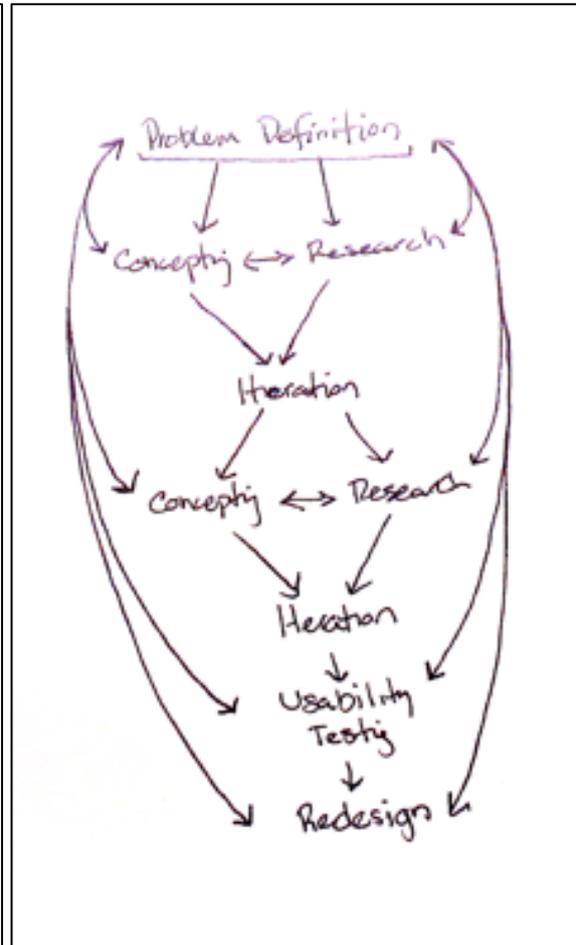


Figure 12: Adrian, P2 Sketch.

Parker did not actively reflect in this part of the semester, and his sketch represents few changes from the previous version. His understanding of HCI and design were limited to relatively few design activities, with a lack of designer presence and highly linear view.

As the semester progressed, **Adrian** became more obsessed with the challenges ahead, wondering in his blog post, "What if I fail?" (W4). Although this concern was apparent in textual form, his sketch merely included more arrows of iteration, not representing his deep concern. It is unclear whether this was a representational issue, or whether an awareness of how his design identity was changing was not yet clear.

Sketch 3 | Weeks 6-9

These central weeks of the semester proved to be a dramatic period of change for these students—as Mei-Xing noted, a “journey inward.” Students were actively juggling multiple elements of *becoming* a designer, including not only their personal identity as a designer, but also how that intersected with expectations of other designers, conceptions of the client and user, and the ethical implications of design. The sketches also began to take on this overall sense of overwhelming complexity and a turn inward, focusing more on the personality of the individual designer.

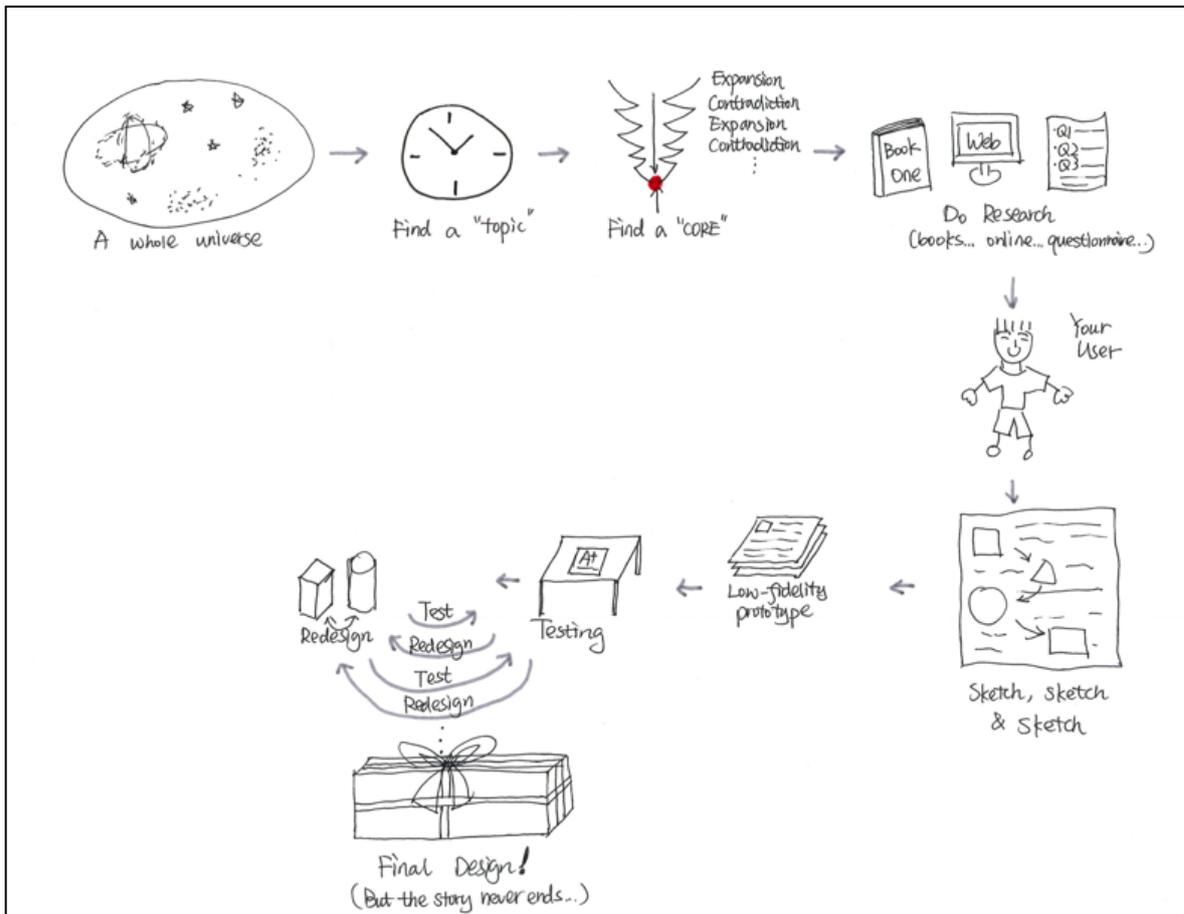


Figure 13: Mei-Xing, P3 sketch.

After a difficult few weeks of struggle, **Mei-Xing** came to the conclusion that “one of the most difficult things is to be honest with myself” and to “stay quiet and focus, and do the things that you truly love” (W6). Even though she was emotional during this period, she felt it was important to follow “a journey inward”, with a video on Maya Lin shown in class moving her to tears and teaching her how she could fight for her ideas. “In a sentence, I’m traveling on a journey inward, past, present, and future [...] this is a lifelong journey.” While this dramatic surrender to her new designer identity was taking hold, her sketch was more clinical, with no representation of her identity, maintaining a professional distance. Interestingly, she explained that the sketches got “easier over time...because I knew what [the professor] wanted.”

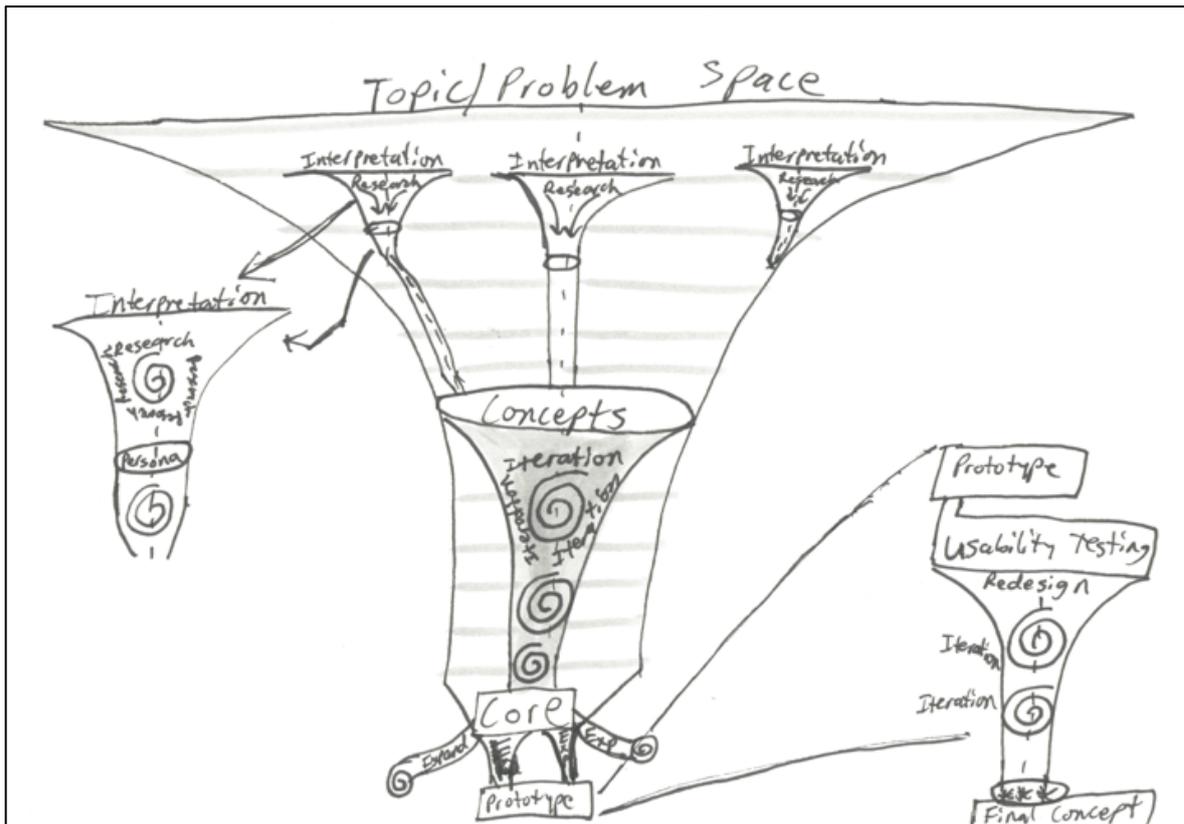


Figure 14: Zachary, P3 Sketch.

Zachary felt more empowered at this stage, triumphantly stating: "we are free to forge our own path if it serves our purpose and accomplishes our goals." Even while he was confident on the blog, he explained: "I find myself struggling with the cognitive offloading [of doing the whole game sketch]"; and "I feel paralyzed by my process; that my ideas are caught in limbo as I unconsciously run through each of them through this stripped book in the back of my mind before they ever make it onto the page" (W7). Zachary concluded that "design is a conversation" between designer, user, and artifact, and that this conversation includes a substantial ethical component because "you can harm with design." Ultimately, he thought that "in design, people on both sides leave their mark" (W9), but this dynamic was not present in his sketch.

Jack struggled how to keep mean "designer [Jack]" and "boyfriend [Jack]" separate as he dealt with his shifting identity (W7). By Week 10, Jack had broken up with his girlfriend, and he came to the realization that "you're taking a step. you're changing"—ultimately, he needed the "freedom to find [his] core" as a designer. He was the "one being designed," and this epiphany allowed him to change the way he perceived himself.

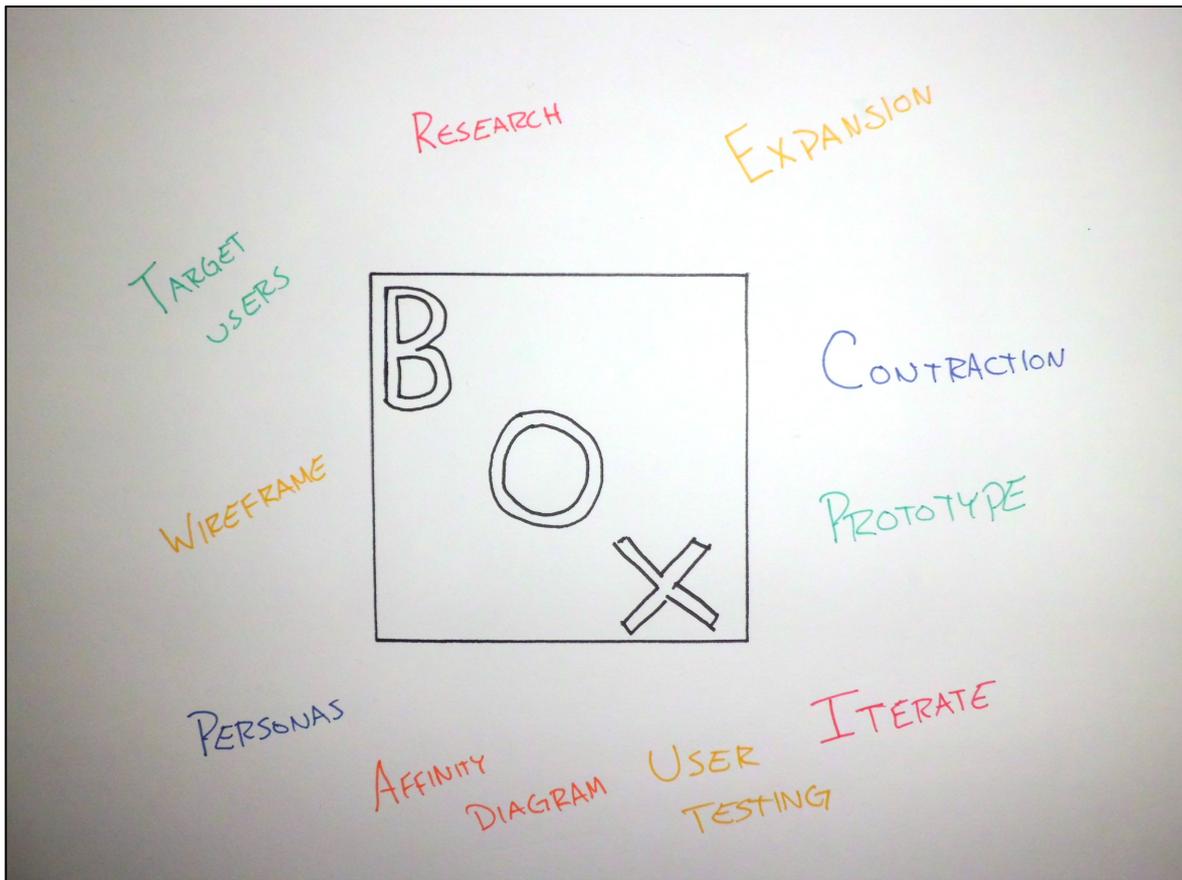


Figure 15: Thomas, P3 Sketch.

Thomas explained that he saw the sketches and blog entries as two separate activities, with the sketch in particular not considered a process of reflection, and largely impersonal. This was visible in this third sketch, with attention largely focused on design activities, and no relation to him as a designer or how these activities are enacted.

Isabella was increasingly frustrated with the feedback she was getting—she "felt [her] spirits falling" when reading the comments from a formal critique, asking "why should we not defend the design?" (W6). In Week 8, she continued working through issues, noting that she "hit an inspiration withdrawal last week." Isabella concluded that representing her process should not take into consideration her personal feelings—"I didn't think how I felt mattered" in representing her personality in the whole game sketch. In contrast, she felt her blog entries could be more personal, but her personality should not be included in the sketch.

WHOLE GAME OF HCI

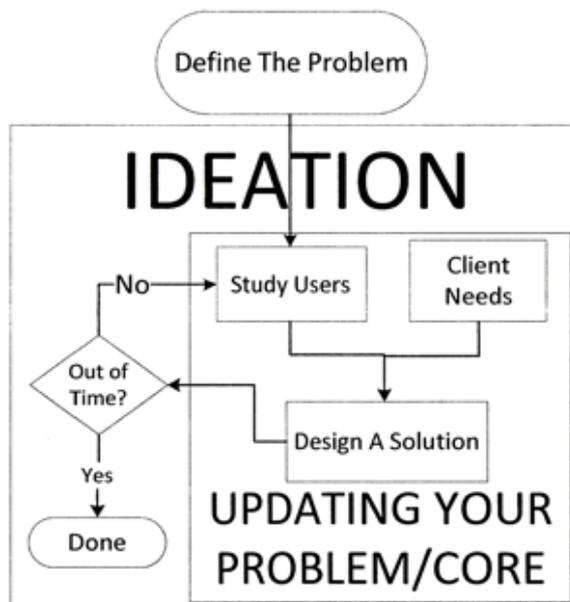


Figure 16: Parker, P3 Sketch.

Parker was feeling the heat of project work, having had to quit a sports team: "I had a little breakdown in how I was prioritizing my life [...] so I was a little distant" (W8). Despite this breakdown of prioritization, his sketch retained a flowchart paradigm. Even though he missed multiple weeks of blog reflections, he explained that he kept some private reflections in his notebook that were never made public. He felt that the sketches were more of an assignment, and he didn't internalize this as a deep reflective activity, although he saw the value of blogging as a reflective tool in a more substantial way.

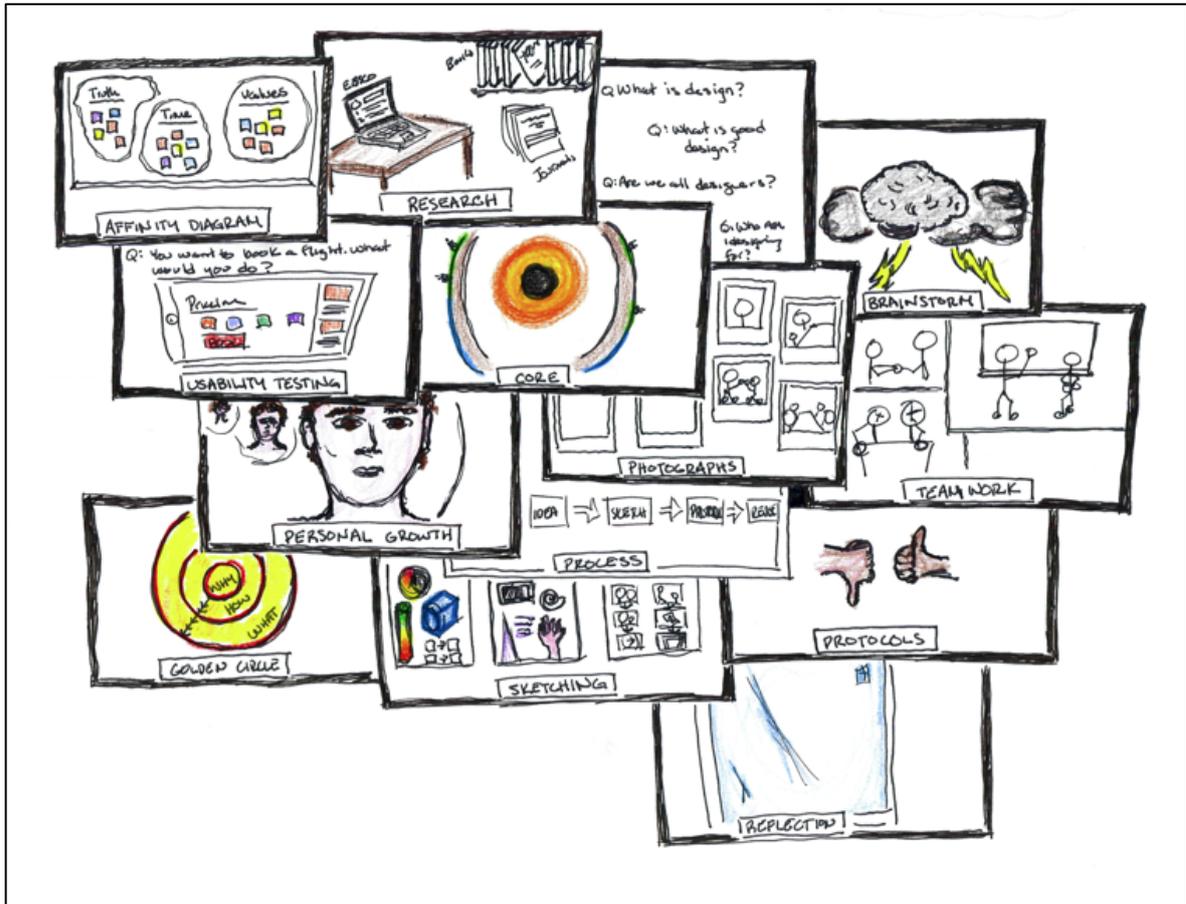


Figure 17: Adrian, P3 Sketch

As the semester drew on, **Adrian** focused inward, asking “What do designers do?” (W8), while “invit[ing] the pain” by requesting critique. This deepening focus is apparent in his sketch, where he addresses many of the issues surrounding his identity—“surrender[ing] to the chaos” that he can’t represent. One of Adrian’s most substantial challenges was that his ability to sketch what he is thinking was not developed enough, which is revealed in themes of surrender and uncertainty; instead, he addresses his “big ideas” in the textual narrative, which is abstracted a step or two beyond the situatedness of his sketches. Factors such as teamwork or time management did not appear in earlier sketches because Adrian “took these factors for granted.”

Discussion

In triangulating the student experience across several sources of data, additional cues to their development and shift in identity become visible. While some of the transformations unique to HCI are already known (Gray, in press; Siegel & Stolterman, 2008), this evolution of identity provides a fuller picture of how this transformation is felt from a student perspective. This transformation manifests through the reflection modes chosen for this course, each of which present a different portrait of what change is being felt. The contribution of this work is in highlighting the disjuncture between these forms of reflective representation, understanding some issues surrounding representational skill, and how the act of reflecting in this way can encourage active awareness of identity.

Disjuncture between visual and textual reflections

Students formed a delineation between modes of reflection early in the semester, creating constraints around what kind of representation of self was desirable. The most substantial differentiation externalized by students was between a professional and personal representation of self—the blog as a “safe space” to reveal one’s personal identity, and the sketch as a professional representation of process. This delineation of modes resulted in certain ideas—especially soft skills such as time management or prioritization, teamwork, critique, and iteration—being weakly represented, if at all, in the sketch record. While some of this may be due to issues of representational skill, there might also be a level of awareness that is foregrounded when writing that is not similarly triggered when sketching, or a lack of visual acuity by naïve designers.

Issues of visual representation in early design education

As referenced in the disjuncture between sketches and blog posts as forms of reflection, there was a substantial inability on the part of the majority of students to represent what was to them is ineffable or tacit—at least in visual form. While most participants were able to adequately express their sense of conflict and shift in identity around becoming a designer on the blog—even non-native speakers with less verbal skill—few were able to express this thinking until the third sketch, if at all.

This lack of visual capability has significant implications for developing designers, particularly as the literature suggests that sketching is a primary vehicle for the communication of design ideas. In the explication of design thinking or description of identity formation, this also presents challenges for early designers that do not have access to these forms of expression, especially early in stages of designerly development.

Revealing individual conceptions of designerly identity

Ultimately, these reflections serve as an individual record of one’s experience in and out of the classroom environment, externalizing a designer’s depiction of their development of a design identity over time. Reflection has been raised as a hallmark of professional practice in a variety of disciplines (Schön, 1983), with this metacognitive ability enabling an individual to understand and evolve their conceptions of expertise (Lawson & Dorst, 2009) in the context of professional activities. While some attention has been paid to encouraging reflection in the studio mode of education (Schön, 1987), this has largely been a verbal exercise with little encouragement to document this reflection through formal writing or sketching.

The reflections from these developing design students indicate how textual and visual reflections reveal different conceptions of designerly identity, which might indicate future use in a descriptive or evaluative way within the studio pedagogy. It is important to note, however, that some students attempted to “game the system” by projecting what they believed the professor would want to see, rather than revealing their true self. This highlights the secondary value of these reflections in revealing how elements of the hidden curriculum affect the overall learner experience, including social, personal, and cultural factors as they are enacted through the studio space and critique.

Conclusion

In this work, I have extended existing knowledge regarding barriers early design students go through as they evolve into a richer understanding of design (Siegel & Stolterman, 2008) and how visual reflection might play a role in evaluating change in thinking about design over time (Gray & Siegel, 2013). This paper addresses the developing identity of early design students through multiple forms of reflection, using these reflections as a way to understand how these students increase in design ability.

While the visual and textual reflections used in this study were not the only mechanisms used for metacognitive activity by students, they do appear to be helpful tools in building knowledge of one's own identity, and tracking changes in that identity over time. In addition, multiple forms of representation appear to promote a fuller explication of identity, enhancing skills in textual and visual representation in the process.

References

- Carspecken, P. F., & Cordeiro, P. A. (1995). Being, doing, and becoming: Textual interpretations of social identity and a case study. *Qualitative Inquiry*, 1(1), 87-109.
- Do, E. Y. L., & Gross, M. D. (1996). Drawing as a means to design reasoning. In *Artificial Intelligence in Design 96 Workshop on Visual Representation, Reasoning and Interaction in Design*, Stanford University.
- Ellmers, G., Bennett, S. J., & Brown, I. M. (2009). Graphic design pedagogy: Employing reflection to support the articulation of knowledge and learning from the design experience. *Proc. EKSIG: Experiential Knowledge, Method Methodology*, 66-81.
- Gray, C. M. (2013a). Emergent critique in informal design talk: Reflections of surface, pedagogical, and epistemological features in an HCI studio. In *Critique 2013: An international conference reflecting on creative practice in art, architecture, and design* (pp. 341-355). Adelaide, South Australia: University of South Australia.
- Gray, C. M. (2013b). Factors that shape design thinking. *Design and Technology Education*, 18(3), 8-20.
- Gray, C. M. (in press). Evolution of design competence in UX practice. In *CHI'14: Proceedings of the SIGCHI conference on human factors in computing systems*. New York, NY: ACM Press
- Gray, C. M., & Siegel, M. A. (2013). Sketching design thinking: Representations of design in education and practice. In *DRS // CUMULUS 2013. 2nd international conference for design education researchers* (pp. 2008-2031). Oslo, Norway: HiOA
- Lawson, B., & Dorst, K. (2009). Expertise in design. In *Design expertise* (pp. 81-112). Oxford: Architectural Press.
- Nelson, H. G., & Stolterman, E. (2012). *The design way: Intentional change in an unpredictable world* (2nd ed.). Cambridge, MA: MIT Press.
- Ockerse, T. (2012). Learn from the core—design from the core. *Visible Language*, 46(1/2), 80-93.
- Rogers, R. (2001). Reflection in higher education: A concept analysis. *Innovative Higher Education*, 26(1), 37-57.
- Perkins, D. N. (2010). *Making learning whole: How seven principles of teaching can transform education*. San Francisco, CA: Jossey-Bass.
- Schön, D. A. (1983). *The reflective practitioner: How professionals think in action*. New York, NY: Basic Books

Schön, D. A. (1987). *Educating the reflective practitioner: Toward a new design for teaching and learning in the professions*. San Francisco, CA: Jossey-Bass.

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.

Verstijnen, I. M., van Leeuwen, C., Goldschmidt, G., Hamel, R., & Hennessey, J. M. (1998). Sketching and creative discovery. *Design Studies*, 19(4), 519-546.

Webster, H. (2008). Architectural education after Schön: Cracks, blurs, boundaries and beyond. *Journal for Education in the Built Environment*, 3(2), 63-74.

Yin, R. K. (2009). *Case study research: Design and methods*. Los Angeles, CA: Sage Publications.

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Acknowledgements

This work is supported in part by the National Science Foundation (NSF) Grant Award no. 1115532. Opinions expressed are those of the author and do not necessarily reflect the views of the entire research team or the NSF.