



”Where I’ve been, where I am, where I’m going”: Exploring Design Awareness through an Undergraduate Student Seminar

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Abstract

How does an individual keep track of where they are in a design process and know whether they are on the right course or if they should change directions? How does a designer realize that they do not understand enough about the problem they are solving and decide to gather more information? As a designer is in the midst of a design process, it is optimal if they can be aware of where they are in the design process so that they can make informed decisions about next steps. In this work-in-process paper, we describe a seminar with five undergraduate students where they explore the concept of *design awareness* and brainstorm ideas for a tool to help them stay aware of the design process even while they are deeply engaged in it.

Introduction

David Foster Wallace [1], began a commencement speech with this story:

There are these two young fish swimming along, and they happen to meet an older fish swimming the other way, who nods at them and says, “Morning, []. How’s the water?” And the two young fish swim on for a bit, and then eventually one of them looks over at the other and goes, “What the hell is water?”

In this story, Wallace is pointing to the concept of awareness of the “water” (or context) within which we live. In our work, we use this story as a metaphor for the work of a designer. It is difficult, while in the thick of doing design, to simultaneously be aware of the design process itself (or the “water” of design). Reflection can be a useful tool to support such awareness. Donald Schon uses the ideas of Reflection-in-action and Reflection-on-action to distinguish between reflection that occurs in the moment of a particular activity versus reflection that occurs after the activity is over. When teaching design the use of reflection-on-action can be a powerful tool that allows students to reflect on what was done and improve the quality and further develop understanding. Reflection-in-action can similarly help students deal with uncertainty, ambiguity, and complexity while in the midst of designing solutions for ill-structured problems [2]. We wanted to understand this reflection-in-action component. Like the “water” that the fish swim through in Wallace’s story, we see parallels to the ways in which our design students navigate the design processes they engage in. Here, questioning “what the hell is water?” is a moment of reflection-in-action. Schön writes that professional practitioners often consider their actions while they are doing them and states that they ask questions like ““What features do I notice when I recognize this thing? What are the criteria by which I make this judgment? What procedures am I enacting when I perform this skill? How am I framing the problem that I am trying to solve?”” (pg 50).

Our goal for our students is for them to be able to be aware of their process and to be able to question their design actions while they are engaging in the design activities. If they are able to

do so, they can be making informed choices of the next design activity to take. We developed a seminar for students to explore the concept of design awareness and learn how to engage in reflection-in-action activities. We also wanted students to explore the creation of tools that could help them become more aware of their design process while they are in the thick of doing design. This work-in-progress paper aims to provide an account of students' participation within this design seminar.

We use the term *design awareness* to mean a state of being in which a designer is attentive to and reflective about their current design behavior while in the midst of their design process. Sommers defines the term Design Awareness as "...the ability to conceptually step back and understand what actions are being done while in that act of designing in order to better access and align the next steps of design" [3]. Sommers suggests awareness is a spectrum and an incremental development rather than a binary of having or not having. This notion of design awareness as an incremental development relates to what Kees Dorst describes in his research exploring the differences in needs and questioning patterns across novice level designers to expert level designers [4]. Dorst examines Hubert Dreyfus's model for the levels of expertise and suggests certain distinctions between the varying levels of expertise and when moving to the higher levels. Dorst states "...each level comprises its own kind of problem solving and reflection. For instance, the kinds of issues that are faced by the designer at the novice level ('How can I use my methods?') are quite different from those on the advanced beginners level ('When should I use this particular method/rule of thumb?')" [4, p 9-10]. Dorst further qualifies that the reflections themselves are different and that "the reflection that takes place on the novice-level deals with the rules themselves, the reflection for the advanced-beginner centres on the applicability or a rule in specific design situation"[4, p.10]. These kinds of insights can be useful for students as they learn about the design process.

Bringing research about design processes into the practice of design is an important part of the seminar we developed. Specifically, we designed the seminar to help students explore different models of design, (e.g., the models of design presented by the Dubberly Compendium [5]) and research results from in-depth studies of the design expertise (e.g., research by author [6, 7]). Those in-depth studies of design suggest that individuals with design expertise are more likely to gather information throughout the process, use a breadth of design activities and transition frequently from one design activity to another. These findings can be conveyed in a compelling timeline representation of a tracing of a set of 8 design activities over time, that can also be described as a "design signature" [7]. Seow et al. (2018) also describe the concept of design signatures as tracing elements of a design innovation process [8]. In this case they utilize a model of design from the UK's Council: Discover, Define, Develop, Deliver [9] and trace a process across these design elements to graphically display how designers allocate time across the four activities. All of these representations (models, timelines, design signatures) can be used as ways to help students think about and picture the design process they are engaging in- essentially helping them to conceptualize *design awareness*.

Further research on the teaching with design timelines indicated when asked about how these timelines might inform future design activities, students articulate intentions in line with metacognitive awareness [10]. This research analyzed the use of the Design Timelines within a

classroom seminar to explore students' understanding of design and metacognition e.g planning, monitoring, and evaluative qualities of design from a worksheet of an in-class activity. A main finding in this paper shows student instances of metacognitive monitoring, defined as "one's performance selectively for signs of progress. Self-monitoring like self-observation, refers to one's cognitive tracking of personal functioning" [11].

The behavior of monitoring as it relates to metacognition, has similar parallels to Donald Schön's idea of reflection-in-action. Donald Schön expresses reflection-in-action as an internal conversation or "back-talk" that occurs when a designer's action leads to a situation and is further negotiated. Schön states a designer's action elicits an inner dialogue where "the designer reflects-in-action on the construction of the problem, the strategies of action, or the model of the phenomena, which have been implicit in [their] moves" [2, p.79] . This system of negotiation and internal conversation relates to aspects of monitoring we want our students to tap into as they explore the concept of design awareness.

Reflecting ourselves on our past work, we decided to offer a seminar for undergraduate engineering students to explore the concept of design awareness. We designed a set of activities that guided students to reflect on their own design processes, learn about research on design, and define for themselves what design awareness is in their own design practice.

Describing the Seminar

This seminar, called a Directed Research Group in our undergraduate program, is a 2 credit pass/fail elective course. Five students self-identified as interested in the topic and enrolled in the course, which met weekly for 2-hours over the course of nine weeks. The seminar was co-designed and co-led by a professor and a post baccalaureate research assistant.

The objective of the seminar was for students to explore their own experiences of design from the perspective of design awareness and to develop ideas for ways they could stay aware of their design processes in future engagements with design. In the spring break week prior to the start of the quarter students documented a design project that they were engaging in. These projects were either part of a course or project they were already working on. Each student journaled about their process and notes using a basic design notebook template. This journal was then built-upon and examined using different lenses (e.g., design models and research results on design expertise) throughout the seminar to deepen their understanding of design processes and what design awareness could mean. See Table 1 for the list of class activities. Students participated in brainstorming and ideation sessions to generate ideas for tools that could help them maintain design awareness. Finally, they chose one idea and participated in short design sprints to create a final sketch of their idea. Students kept portfolios of their work and wrote reflections throughout the quarter.

Table 1 - Seminar Structure for Exploring Design Awareness

Activity Name	Description	Duration
Diving into Individual Design Data	Examine personal design data after partaking in some design work. The goal of this early-stage development are: <ul style="list-style-type: none"> • Better understand patterns that might arise through collectively looking at our design processes • Identify areas of themes, ideas, or concepts that designers might need to be aware of when designing 	Session 1 & 2
Design Models and Design Research Findings Investigation	Learn about different design models, specific research results about design processes, and visualization of design. The goals of these sessions are to: <ul style="list-style-type: none"> • Investigate how we might help designers notice/be more aware of “something” within the design process 	Session 3 & 4
Brainstorm Session	Choosing one (or couple of) idea(s), concept(s), and theme(s) that are interesting, most frequent, and or exciting relating to designing for design awareness.	Session 5
Design Sprint	Engaging with design in a sprint that will allow us to use findings we define as well as our brainstorm of ideas to sketch & prototype a potential “something”	Session 6 & 7
Testing and Feedback	Get some feedback from peers, experts, other designers as well as refine the potential “something”.	Session 8
Debrief & Reflection	Present our narratives around a concept, idea, and design with each other.	Session 9

Student Work and Preliminary Observations

While inquiry about the student work in this seminar is still ongoing, our initial insights are about the generative nature of the seminar and the creative ways of describing design that the students documented in their reflections. Session 1 through 4 were primarily about student immersion into their own design models from field notes and orienting their own models with the design expertise timeline research [6] and Hugh Dubberly Compendium models of design [5].

We engaged in several activities to have the students explicitly work with the topic of design awareness. First, several times in the quarter we asked students to define the term in reflective essays at the end of each session. Second, halfway through the quarter, we asked students to

move from the abstract concept of awareness to identifying specifically what they wanted to be aware of while they were designing. They filled in the “X” and “Y” in the following statement: “I want to be aware of X while doing Y”. Table 2 contains the student’s responses to that prompt in week 5, and also their redefinition in week 9.

Table 2 Students’ X&Y Statements from Session 5 and Session 9

Design Awareness Statement: “I want to be aware of X when doing Y.”		
	Initial (Session 5)	Revised (Session 9)
Student A	a) “I want to be aware that design is not a linear process when doing art and design projects” b) “I want to be aware that going backward in the cycle is still progress when doing art and design projects”	“I want to be aware that the process isn’t linear when living”
Student G	“I want to be aware of fluidity and cyclical nature of the design process when working on graphic design projects”	“I want to be aware of fluidity, complex, and non-linear nature of the design process when working on graphic design projects”
Student K	“I want to be aware of looking back at initial research , overarching goals, and process when designing using a design process”	“I want to be aware of time spent in one place versus another place.”
Student N	“I want to be aware of what stage of design I am in when I am working on design projects”	“I want to be aware of where I’ve been, where I am, where I am going, when working on design projects”
Student R	“I want to be aware of design habits when designing for users”	“I want to be aware of design habits and current stages when working on ux design projects”

After defining their intentions through “X and Y statements” students generated a list of potential ideas of ways to design for design awareness. Using the information from their tagged journals, definitions of design phases, and exploration of design models and research results described above, each student generated a list of ideas for how each of them could be aware of their design as they are in it (see table 3) .

Table 3 - List of Brainstorming Design Awareness ideas from Session 5

Brainstormed Lists of Ways to Promote Design Awareness (Session 5)	
Student A	Alarm button, journaling exercise, app for random research exercises, robot that researches for you, voice only notes, timer with suggested times for design phases, progress data visualization
Student G	Phone reminders, curated playlist to fit design activities, computer tracks process, timer or countdown, wall art representing the fluidity of the design process, checklist of design activities including repetition of steps
Student K	Design steps across a physical space, design process tracking, metronome/pendulum between moving forward and looking back, design process interactive building blocks, design process 'gps', gamification of design, verbal reminders from...something
Student N	Interactive waterfall, button box, design sprint street light, LED strip design timer, interactive blocks design awareness tracker
Student R	Reminder pen, sticky note reminders, Time table, a ring that tracks and sends data to phone, phone notification, sand timer, awareness app to log process data

Finally in the final design session each were asked to generate a list of synonyms that correspond with their current understanding of Design Awareness (see table 4).


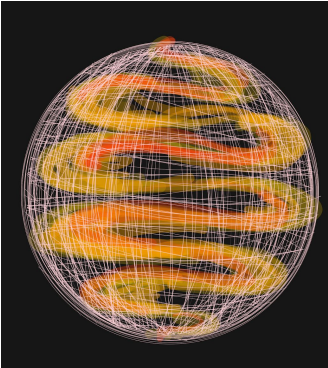
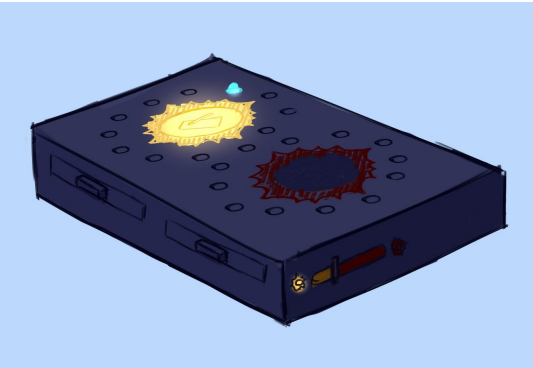
Table 4 - Students' design awareness synonyms from session 9

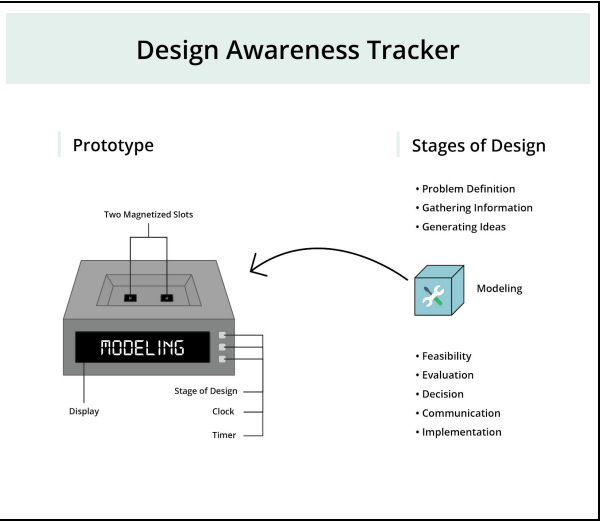
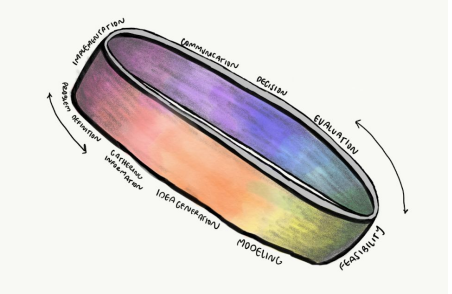
Design Awareness Synonyms (Session 9)	
Student A	Nonlinearity, Cyclical, Creativity, Converge/Diverge, Fluidity, Self-awareness, Imperfect is perfect, Understanding, Reflection Process
Student G	Process Awareness, Patterned, Chaos, Know the rules to break them, Awareness, Design flow, Active reflection, Cyclical progress
Student K	Learning how you learn, Self-reflection, Seeing the rest of the iceberg! , Revealing the..., Understand the whole picture, No more blind steering
Student N	Meta-Cognitive Development, Thinking about thinking, Understanding your, personal process, Collaborative design with your unconscious, Processing your progress
Student R	Self-awareness, Smart designing, Process appreciation, Process awareness, Looking deeper, Meaning of process, Know process, Conscious Design, Making connections

Final Sketches

In the final session, students presented their final designs as well written statements about their final sketches(see Table 5).

Table 5: Students' Final Sketch and Personal Descriptions

<p>Student A</p>	<p>“Although I really liked some of the ideas to come out of the last design sprint, I felt like my original idea of a neon sign was the thing I’d derive the most value out of. Having a simple reminder in my workspace that also passes as a work of art would be the most beneficial; I don’t think I would use any of the services or other ideas more than once or twice, however, this could hang in my office for decades. I also like how generally applicable it is, this concept of progress not being linear applies in every part of life – not just the design cycle. A drawing of the final neon sign is below.”</p>	
<p>Student G</p>	<p>“After talking with my roommate, I decided to create a visual representation of the design process which more clearly articulated its complexity and cyclical nature. I also wanted to capture the idea that even though you may go back to a previous stage in the design process (ie researching or ideation) you are not actually going backwards and you are still making progress. This idea is illustrated through the helix shape that I drew in the middle of the sphere.”</p>	
<p>Student K</p>	<p>“My final design included the binary stars and the orbiting planet (which is represented by a light blue LED light) on the infinity shaped path. The front side of the box has handles to open the small drawers where I could switch out the images that show up in the stars. Whichever star the ‘planet’ is closest too would light up, illuminating the image in it’s drawer while the other star would stay unlit. Keeping with the ability to change the time of the orbit, I included a slider on the side of the device that can be changed to set how much time should be spent around each star.”</p>	

<p>Student N</p>	<p>“During the brainstorm I generated many useful ideas, but the one that I was drawn to the most was the Design Awareness tracker. Throughout my iterations and critiques on the original prototype, I found myself changing the use and purpose of the device, but not the appearance. I became aware of its many uses, in design and outside of it. I decided to move from trophies to cubes for the tangible stage pieces for the sake of practicality. With the size of the two magnetized slots, two trophies would struggle to fit next to each other. I envisioned the Design Awareness tracker to be a small desk artefact that has presence, but does not take up a lot of space on a table. Each stage of design would be represented by a colored cube with an icon. The device allows you to set a timer, see the clock, or view the current stage of design on the display screen. It is a simple, yet pragmatic way to track your progression through a project and develop more efficient work habits.”</p>	
<p>Student R</p>	<p>“I decided to continue with the abstract progress report idea and created another prototype. I wanted to think of the feasibility of the data collection through the ring more as well. This ring would allow the user to rotate the outer display around to the stage they’re retransitioning into and the color would click into place. The ring would then collect the data as the user rotates through stages. The outer display can rotate either direction as to not limit the user. An algorithm can then transform the data into a weekly progress “report” in the form of the users choosing, varying from 3D printed sculptures, paintings, to laptop wallpapers. Rather than focusing on numbers the user can instead view their process in a way that makes sense to them and be more aware of their design habits.”</p>	

Discussion

In this seminar students brainstormed ideas and then created a sketch of one idea of how to promote design awareness for themselves when they engage in design in the future. The seminar was kicked off with students journaling a design experience and in the first few design sessions reflected on their actions through tagging exercises using design research [6, 7], design process

models [5], and their own perspectives to create their own ideas to answer how they could be more aware of their design process while in the thick of the design process.

The variations of final sketches, “X and Y” statements, student’s brainstorming sessions, and synonyms for design awareness indicate the spread of ideas that mattered most to each student. We also see that the students’ final sketches fell into two categories: visualizations of design process and design process tracking. The outcome for each student wasn’t generalizable to a single design concept or single understanding about design awareness, but rather a variety of interpretations. This demonstrates, albeit with small numbers, that although we teach the same design process or run the same design session for all our students, each student has a differing interpretation of what design or design awareness means to them. More importantly in this instance is that how they might engage in reflect-in-action is also unique and individual. The students had different levels of questioning and reflection when tasked to create using the concept of “design awareness” and thus this insight falls closely to Dorst’s research on the variance in the types of questions, and reflection patterns differ with varying levels of expertise [4].

Visualisations of design processes

Student A and Student G indicated within their “X&Y statements” and in their final reflections, the importance of non-linearity, fluidity, and complexity as aspects to be aware of when in the process of design. While each student chose a different form factor that resonated closely to their own interests, their final sketches indicate an idea for visualizing design and the design process in a nuanced way different from their more “classic” training in design process models.

Student A and Student G wrote about their own interpretation about design awareness in their final reflection. In the following passages these students convey the way in which engagement in understanding design awareness produces a deeper understanding about design and the design process.

Student A writes:

“...nobody explicitly tells you that there are a multitude of design models out there, and that you don’t have to follow any one to the letter. This was something I was vastly unaware of before this [seminar], and I often felt imposter syndrome because certain parts of the models I was taught didn’t feel intuitive to me. Although I knew the proposed reasons for why I was supposed to do certain forms of research or types of prototyping, I was often spitting out the textbook definition rather than something I genuinely thought...Having awareness of one’s own model is critical as to be unaware is to be static; a machine always outputting the same product. In order to best cater to our medium and users, we must be flexible and deliberate; aware of what we are doing and why. Having awareness is also required to evolve, without critically understanding one’s process, it is impossible to get better. In summary, in order to be the best designer one can be, one must be aware of their past, present, and future actions.”

Student G writes:

“Design awareness means something different to everyone. An organized chaos is sometimes the definition that makes the most sense to me however. It means being aware of your own process even if it is slightly different every time you cycle through it. The more aware I become of my own design process and design choices the more I begin to realize that design is never linear and although one may be able to define individual steps in the process there is no set or correct way to move through those steps. Design awareness then becomes more about being aware of when you are moving through those steps and the decisions you made along the way rather than try to follow a design model that has been defined by someone else. I think that reading and learning about other people’s design processes helps you to identify crucial parts of your own and develop strategies to move through design and grow as a designer and design thinker.”

Students here are articulating their perceptions of design awareness and the importance of reflection-in-action within their own processes. At the same time these understandings are nuanced to each student’s individual expertise and experiences with design. Students A and G both emphasize the process as a whole and Student G specifies realization that design often can take multiple forms. Student A articulates the understanding that design is not linear and complex. These student understandings and reflections are further demonstrated in their final sketches.

Design Process Tracking

Students R, K, and N took the approach of design awareness tools through the lens of process tracking. Student R embraced the linearity of the design process choosing to be attentive to the stages of the design process to adhere and make decisions upon the next course of action. Student R writes:

“After reflecting on my design process I have realized that there is some linearity to my process due to the inevitable timeline that a project requires and that there are high level stages to any of my processes, such as preliminary design and detailed design (as depicted in Mesarovic’s model). But there are also cyclical processes embedded in that linear system that I noticed, the most common being modeling → evaluation → decision → ideating → modeling. I noticed that that modeling process does not include preliminary planning materials such as revising the defined problem or the information that has been gathered. This is what I want to be more aware of when designing and make efforts to revisit these important design principles rather than losing sight of them. This goal is what I used to drive my creation of a design awareness ‘tool.’”

Student K sketched a tool for which they related the experience with cyclical and orbital movement. This particular sketch indicates a hybrid of the visual and process tracking categorizations. They write in their final reflection of the seminar:

“Throughout the past few weeks I’ve started to gain a better appreciation for design awareness. I know that it's important to track your progress as to not get stuck in one

phase or not spend enough time in another. While I haven't had the chance to immerse myself into the full design process since spring break, I've found myself applying design awareness concepts to various aspects of my academic life. I want to continue to build a visual representation of the design process as a reminder to myself. I want to remember to spend a lot of time gathering information and defining the problem and scope. I also want to remember to always look back to these stages throughout the entire design process. So far, I have decided to develop my design awareness pendulum idea. It is a straightforward concept but provides a reminder for moving forward and looking back. That way, you can have a reminder to not stick in one place too long and to look back to the beginning steps to aid the rest of your design."

Finally Student N devised a device with interchangeable parts that can track different aspects of the design process. They write in their final sketch description (Table 5) "The device allows you to set a timer, see the clock, or view the current stage of design on the display screen. It is a simple, yet pragmatic way to track your progression through a project and develop more efficient work habits." In their final reflection of the seminar they write:

"Based on my experiences, my definition of design awareness has become more representative of my individual insights and less regurgitative of institutional teachings. Heavy introspection has lead me to define design awareness as knowing what steps you need to take to produce the best results efficiently. Once you have design awareness, you will be able to see your progress as a non-linear process. Knowing where you are in the design process can help you orient yourself towards your goal when you get lost or stuck during a project. Being able to "zoom out" and see the bigger picture allows you see where you are, where you've been, and where you need to go to move forward in a project. Sometimes moving forward means revisiting earlier steps in the design process. When you take a step back, it gives you a running start to make greater strides. Defining design awareness has made me more cognizant of my actions, helping me to design with intent and rationale."

Design Synonyms and Changes Between Pre and Post

In the students' free writes of design awareness synonyms we found that many of the indicated synonyms linked to associations beyond the scope of design such as active reflection, learning how you learn, and thinking about thinking that connect with concepts like metacognition. There are also many instances of framing that suggest other types of deep connections, for example:

- Seeing the rest of the iceberg
- Process appreciation
- Imperfect is perfect
- Collaborative design with your unconscious
- Know the rules to break them

Limitations and Future Work

The preliminary observations we present in this work-in-progress paper come from a small sample and will not lead to generalizable claims. With more offerings of this seminar we will be gathering a larger number of ideas about how to design for design awareness. As this happens, we may see similarities or differences across contexts to help students better understand, better reflect, and become more aware about the aspects of the design process that would help improve their own design processes.

Students in subsequent quarters have been exploring options to progress the ideas of design awareness. One set of students is currently extending an idea from the seminar described in this paper and are building a physical prototype that is an expanded version of Student N's Design Awareness Tracker. With this tracker, designers will be able to input via a set of buttons which of 8 design activities the designer is engaging with. Another set of students is building a Design Awareness App, essentially an electronic version of the physical tracker.

Closing Remarks

To summarize, students participated in a design seminar that explored the question: how can designers be more aware of the design process while they are in thick of design? To answer this question we approached design awareness from the student perspective, providing a series of activities and through those activities asking students how they would be more aware of their own design process. This seminar generated a variety of ideas and sketches that provided representations of what was most important for each students' own individual design perspectives.

In this first experience of instantiating the concept of design awareness with a small number of students, we are able to make several observations and think that we have a promising path forward. As we see from students' design sketches and final reflective statements about what design awareness is, we can see that their perspective has changed. To summarize some of the students reflections:

- Student A writes about defying the norms that there is more than one way to do design
- Student G writes about non-linearity and learning from other people's process as means to identify gaps in your own
- Student N states that "once you have design awareness, you will be able to see your progress as a non-linear process."
- Student K writes about the process of looking forward and back and to not get stuck in one place but to keep iterating
- Student R writes about experience in exploring their own linearity and being more aware of the gaps in planning and revisiting the problem at hand

The participation of this seminar has shown how different levels of understanding, reflection, and experiences contribute to students' perceptions of design and design awareness. A major contribution of this work are the artifacts, ideas, and experiences from the question we asked students to consider: how we could help designers be more aware of the design process while in

the thick of it? Through the acts of creating with the intention of design awareness and reflect-in-action for designers, the students developed their own understanding about design awareness in the context of their own design practices. Through designing for design awareness they became better versed at understanding what design awareness is and how it is further applicable to them.

Our preliminary insights tell us not how to be more aware of the design process, but rather *what our students consider worth being aware of* given their expertise and experiences with design. This shows consistency with the research by Schon and Dorst in that differing levels of expertise constitute different kinds of reflection and questioning. Through further exploration of design awareness, we hope to develop suggestions for how to refine how we teach about design, introduce strategies for reflection-in-action behavior, and develop tailored learning engagements that help students improve both their knowledge and quality of design work.

We end with the words of two of the students. Student A, who concludes that “having awareness of one’s own model is critical as to be unaware is to be static; and Student N, who states that their new-found ability to engage in the concept of design awareness enables: “Being able to “zoom out” and see the bigger picture allows you see *where you are, where you’ve been, and where you need to go* to move forward in a project.” We hope that this work brings us a step closer to developing tools that can assist students across various design disciplines to have similar insights.

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