Design, Technology, and Research (DTR)

Annual Letter, 2022

Dear members of the DTR family,

As DTR's director and founder I am blessed with two jobs. One job is to serve as our community's *keeper*. By keeper, I mean someone who maintains and improves our community's practices and culture. How we mentor, how we learn, how we relate to one another. Over the years, I added to my role of keeper the responsibility of *sharing* what we do with others. First through papers, resources, and site visits, and more recently, through the release of the DTR documentary, Forward. This annual letter provides a new medium for sharing our culture and practice. I hope this inaugural letter is the start of a fine tradition.

The intended audience of this letter is broad: it is for anyone who learns, aspires, and grows; and anyone who wishes to foster that in others. The letter speaks of my experience running a community for learning how to conduct research in design and technology at a university, but it raises issues broadly relevant to learners and educators (broadly construed) anywhere in the world. Still, you will find this letter addressed to members of the DTR family. This is so that when I am writing, I am writing with my DTR family in mind. Regardless of whose hands this letter lands in, I want you, the reader, to know that it is written by someone who sees you as family. Because I do.

This and future annual letters will share how DTR's culture is evolving, and my thoughts on mentoring and learning - which are core to what we do. In addition to reporting on our DTR culture, I will also share some of our accomplishments each year. I sometimes emphasize "process over outcomes" too much, worry about gloating too much, get too scared to put ourselves out there too much, and ultimately, neglect to celebrate our achievements. I hope to course-correct by using these letters to celebrate some successes, too.

This letter will also share our practice. Before I say more about that, let me tell you about my second job in DTR, which is literally *to practice*. "To practice" is hardly a neat job title, but I think it is a core responsibility that I have (and must) take on. By this, I of course

mean the practice of mentoring students — with the intent of being more effective and kind in my facilitating students' learning, growth, and transformation (whoa, big word). But I also mean practicing alongside the students: that I myself practice what I preach. That I too jump if I ask students to jump.

This broader view of my responsibility to practice inspires in me feelings of tremendous privilege, honor, and gratitude. Practicing alongside my students gives me the gift of living up to what I think is important enough to share through teaching and mentoring. It gives me a chance to try to live up to the life I want for my students. Practicing also teaches me humility — that what I teach might not work for others or even for myself, and that I can fall for any number of human trappings that my students struggle with, in equal or greater amounts. Learning to see my own failings with honesty and kindness is just another wonderful gift from my responsibility to practice.

So this letter will share our practice: what it is that we do, how it is evolving, where it seems to be working well, where it might need some work. And because I practice, I can and will share with you my own experience, practicing as a mentor and also as a member of our community. In that way, this letter is part memoir. I will share our failures—largely, my failures—in my practice as a mentor, and as a member. In sharing my many mistakes and failures, my greatest hope is that it will inspire all of us (myself included) to try again —ideally with more wisdom the next time around, but more than anything, to simply try again. We are (translation: I am) bound to make many more mistakes in the future. We ought to try again, if only to find out what those future mistakes will be.

On with the letter.

Celebrating Success

Let's start by celebrating some successes. In the 2021-2022 academic year:

- The DTR documentary short film, Forward, was officially released! The film is available publicly at http://forward.movie. The film shares our culture and practice. If you haven't watched it yet, now is a great time.
- DTR students published and presented research from 4 of our Special Interest Groups (SIGs) at major conferences in Human-Computer Interaction, specifically at CHI, CSCW, CHI Student Research Competition, and CHI Late-Breaking-Work.

- Roxy Wilcox & Fardeem Munir, and Cindy Hu won first and second place at the CHI Student Research Competition! Check out this article detailing their work: https://www.mccormick.northwestern.edu/news/articles/2022/05/designing-practical-technology-solutions/

- Across 5 SIGs, DTR students won 15 (!!) undergraduate research grants from Northwestern this year. No other lab comes close.

- Ryan Louie, head of the Collective Experiences SIG, won a prestigious Google PhD fellowship! Ryan's work advances principles and tools for imbuing computational systems with a deeper understanding of human situations and contexts.

- Leesha Maliakal Shah, head of the Agile Research Studios SIG, has accepted a faculty job at Northeastern Illinois University (NEIU)! Leesha is excited to bring her energy and efforts to helping NEIU's diverse student population learn and grow, through models like DTR.

- We received funding for DTR's operating budget from Northwestern Computer Science (CS) and Segal Design! Next time you see Bruce Ankenman (Segal) and Samir Khuller (CS), offer them your thanks.

- Graduating DTR students continue to place at leading technology companies such as Google, Microsoft, and Facebook.

- I have now mentored 123 students through DTR. That's more than most faculty will mentor in a lifetime. I feel very blessed.

That is a lot of accomplishments in one year. We continue to be hungry for more.

One area where I was less successful this year is in acquiring more federal funds for our many research projects. Longer term, we need these funds to keep the lights on. My collaborators and I gave our best effort through two NSF grant submissions, but alas, no fruit. I will keep trying. Should nothing come to bear this coming year, I plan to double my fundraising efforts. Regardless of what happens, I will focus on what is within our control, and not be too wedded to outcomes, come what may. But make no mistake: fundraising is important, and I will be putting in work.

Thawing out of the pandemic

For me, our biggest success this year is how we thawed out of the pandemic. By this, I don't mean that case counts are down, or even that we are back meeting in person,

although both of these facts are welcomed. I mean how we, *as a community,* have thawed out of the pandemic. The warmth came back, little by little, and then all at once.

In many ways, DTR worked fine during the pandemic (2020-2021), even as we move our in-person mentoring onto Zoom and our at-the-whiteboard work onto Google Slides. My best explanation for this is simply that DTR has structure. It has structured ways of working through risks and challenges that arise in research, and representations we teach students for thinking through those challenges. These representations are the same whether we use them online or offline. Moreover, we continued to help one another through pair research, working in pairs each week to resolve one another's blockers over Zoom. We continued to reflect on our process and practice, and on ourselves and our community, through self-assessments, (virtual) exit meetings, (virtual) circle time, and so on. We continued doing our create-a-thon events, writing stories and making digital art online in lieu of making face scrubs and screen prints in-person, as we had done just prior to the pandemic. In other words, our ways of working and relating simply moved online. Students continued to learn and grow.

But it was not business as usual. In many ways, DTR is about learning to find "center" in the mist of uncertainty and confusion. But COVID was a storm that blew us all way off center. People were scared, and self-regulation became way harder. It became difficult for us to be "open," whether that's to our inner experience or to the critiques about our research ideas and designs. No matter how good our structures for thinking are, when our ability to be centered enough to think is impaired, when we are less able or willing to be open to our inner and outer experience, we are going to be less effective in our work and in learning. There is no getting around that. Research progress slowed. Learning slowed. This I accepted.

What was harder for me to accept was the distance that COVID created, both physically and psychologically. We were further from ourselves, and scared to let others get close. As the pandemic went on, I felt that we needed a "space" for sharing and relating to one another. We needed a space where we can hear ourselves, and be open with one another.

I was on sabbatical in San Diego at the start of the pandemic, during which I spent time with folks at the Center for Studies of the Person (CSP), where person-centered approaches and encounter groups were still alive and well. I experienced how Will Stillwell, who facilitates encounter groups, was able to create space by listening, and through silence. Inspired by this, SIG meetings with my graduate students became encounter group-like. Instead of focusing our agenda on research progress, I created a space for us to share how

we were doing and feeling. When anyone spoke, the rest of us listened and tried to be understanding. My grad students explained these meetings to others as group therapy sessions. I don't think they were far off.

After coming back from sabbatical, I stretched circle time in DTR from 20-30 minutes to maybe an hour. We breathed over Zoom, and then sat until someone shared. Little by little, and with many awkward but lovely silences in between, people did share, and we did our best to hear one another. People were struggling. There was no getting around that. But at least we were hearing each other.

My teaching evaluations became flooded with comments that Haoqi should work on time management, not because there wasn't anything else to improve in DTR, but that my lack of time management in our studio meetings was so egregious and top-of-mind that I imagine it was impossible to ignore. Despite seeing this, I doubled down and continued to linger during circle time — holding a space for reflection and for sharing that was constant and unwavering, regardless of COVID case count and whatever the clock said the time was. I think this helped us find some solace, to have a space to come out of our shells in the midst of a storm…

Still, I had trouble accepting the distance that COVID created. In both my personal and professional life, I felt increasingly drained. I wasn't having fun, and over time I found myself withdrawing. My concentration waned at meetings, and by summer of 2021, I knew I needed a drastic change. I told the grad students that I wasn't doing so well, and that I needed to find a way back if I were to continue doing this at all. They were very understanding, but not without concern as I cancelled our weekly SIG meetings, and along with my fellow PIs at the Delta Lab, we cancelled our lab meetings for summer, too. For a community that prized learning from one another and being together through it all, this was quite the shock for our students. I didn't know how it would all go, but I knew that I needed a break. My body and mind were both breaking.

I took the summer to recover. One of my acupuncturists described my job as being similar to that of an athlete: the summer was the off-season, and I need to do what I needed to recover from the injuries I'd incurred, and, to get myself ready for the upcoming season. So I did that, as best as I could. I remember riding a city bike by the Chicago River, realizing that the trees were so big. They were wonderful. I had forgotten all about that, glued to Zoom all pandemic.

My re-dedicating myself to my well-being, and accepting that, my relationship with myself shapes how I relate to others, were the catalysts I needed to begin thawing myself out of the pandemic. It helped me recenter, to see that despite the storm, I had choices, and that I can find joy. And that I love our DTR community. As we returned to in-person studio meetings, as we got back onto the whiteboards, and as we sat next to one another, breathing or awkwardly in silence — I felt our coming back into ourselves, little by little, closer to center. By the time Spring 2022 rolled around, I could feel the warmth of our community. We were to truly encounter each other again. We could all see clearly that the research work was providing a path for our personal growth and towards self-knowledge, and that our community is with us, every step of the way.

I don't know what normal is, or what "new-normal" is. But I know this warmth is undeniable, and with it, we can be open to all kinds of possibilities. To the best of my ability, I will continue to foster the conditions needed for this warmth to sustain, and to grow.

Responsibility; Responsive

I made a fairly drastic mental shift over the pandemic: *I am not responsible for the work of my students*. This statement might baffle the reader in one of two opposing directions: (1) how could you not be responsible, as their advisor? Or, (2) duh, it's their work, why would you be responsible?

Over the years, especially pre-tenure, I had often taken on more than my fair share of responsibility. I remember once my wife was visiting studio, and she saw me pacing from student to student, coaching and mentoring without pausing to breathe. My thinking was simple: I had just the hour — of course I had to get to every student. What my wife saw was a person who was taking on way more than he can chew, forgoing lunch, and hunting for a way to collapse under the weight of all this "good work."

But did I really need to get to every student? And did each conversation have to lead to some kind of resolve? Did I need to speak so fast? Did I need to skip lunch?

I remember also, a student would get dangerously close to missing a deadline, and I would be more worried than the student about it, trying with all my might to help the student muster up the energy to meet goals they had set for themselves. And I would grow resentful, feeling somehow that the student had placed the entire burden of their work onto my back. When really, they did no such thing. I did it to myself.

My sabbatical gave me multiple opportunities to reexamine the idea of responsibility. In talking to Will Stillwell, he mentioned the idea that other people cannot make you responsible. That responsibility is your choice. And you say, well, I'm responsible for this job and that job and that job. No, you're not. You took that on. And so you can't blame somebody else for making you responsible.

So I took on mentoring all these students in a single hour? And I took on reminding them of their deadlines and stressing over them more than the students themselves? You bet I did. And it hurt to *know* that I did. That I was the one hurting myself with the responsibilities that I'd assumed. In many ways, I was not *responsive* to my students. I simply reacted with assumed responsibilities. Not only was this hurting me, I realized that this too might be getting in the way of my students learning to be responsive to their own situations, and to consciously examine the responsibilities within themselves.

This mental shift has led me on quite a journey over the past year. Here are some things I tried along the way:

- I told my PhD students that I am not responsible for their work. They are. What I take responsibility for is in my role as an advisor and mentor, whether that is to give feedback, review drafts, or provide my perspective. If they send me something, I will read it. If they ask for a meeting, I will always find time. But they are responsible for their work, and ultimately, their own success.

- When coaching many students working at the whiteboard on their research at once (see later section on "How We Coach and Teach Design Research"), I did my best to get to everyone, but didn't make it my goal. I walked around the room helping whoever seems to need help, or who I think I can offer some helpful perspective to. In almost all cases, I tried to help my students see a path forward, and then left them to do the actual work. They have what they need to practice. It's a self-practice, after all.

- I resisted the urge to jump in every time I saw my students struggle. Even when I did jump in, I simply affirmed that they are struggling and laid out what might help them moving forward. I accepted their struggles more, and worked with them on strategies to overcome their struggles. But the work of working *through* is fully theirs.

- I began prioritizing my own work. I spent time transcribing and analyzing interviews from my own research on fostering self-direction. I started calling it "my

work" and "my student's work," which helped me distinguish and to make space for my work.

- I began prioritizing my personal wellbeing. I don't want to be responsible by running myself into the ground. I want to be responsible for taking care of myself. So I am (re)learning how to be responsive to my body.

In consciously reexamining and redefining the boundaries of my responsibilities, and what I want to be responsive to, I am trying to find a middle way between being a "helicopter parent", and "delegating just short of abdication" (as Charlie Munger had described Warren Buffett's way of managing Berkshire Hathaway). My students benefit from support — they can learn to become independent with help and support from myself and others. But I cannot take over the responsibility for their doing the work themselves — *whatever the outcome.* This last phrase scares me: what if they suffer *<some negative outcome>*? Wouldn't that mean that I am a *<some shameful label about how I am bad mentor and person>*?

I don't know if my current redrawing of responsibilities will work well in the long-run: time will tell. But I feel much better about it, and can live with the consequences. More importantly, I rediscovered the value of being consciously responsive — this is the gift. I will continue to be responsive to whatever comes — nothing is set in stone. Maybe I want to be more of an active collaborator, or want to give my students more structure and time with me than I do now. Maybe I will take more of a backseat, and give students even more room to experiment, flounder, and fail. As long as I am responsive and willing to revisit my responsibilities, I will figure it out.

Groundhog Day

At the start of every quarter in DTR I set a theme for the quarter. It's normally set to a quote from a book I am reading, or one of the tried-and-true: like Mary Oliver's poem *Wild Geese*, which I adore. From time to time during circle time, we then meditate on the theme and talk about how it arises within us over the course of the quarter. I choose the theme based on what I think would help our community to consider at that time. But of course, I choose the theme based on my subconscious desires, fears, and unspoken truths. So I try to meditate on the theme in the context of our community, but also onto my self.

Fall quarter, on the theme of doing things for their own sake, I shared a quote from William Deresiewicz's "Excellent Sheep: The Miseducation of the American Elite:"

> You need to get a job, but you also need to get a life. What's the return on investment of college? What's the return on investment of having children, spending time with friends, listening to music, reading a book? The things that are most worth doing are worth doing for their own sake. Anyone who tells you that the sole purpose of education is the acquisition of negotiable skills is attempting to reduce you to a productive employee at work, a gullible consumer in the market, and a docile subject of the state. What's at stake, when we ask what college is for, is nothing less than our ability to remain fully human.

Students really struggled with this one. Most of them were hunting for internships and job offers at the time, and I am telling them to think about doing things for their own sake? Are you kidding me? But to me, the quote was perfect timing: it raised something that lies dormant in most college students, at a time when successfully transitioning to the next phase of their lives took precedence (to many, "failure" was not an option). As we talked about it, the students saw themselves fighting it. This is important, I think: having a space that allows strong reactions to arise.

And I, myself, was trying to find a way back to enjoying the unstructured, the non-consequential. The important.

Over Winter quarter, the theme was simply, "to care." I shared a quote from Milton Mayeroff's book, "On Caring:"

> In the context of a person's life, caring has a way of ordering their other values and activities around it. When this ordering is comprehensive, because of the inclusiveness of their carings, there is a basic stability to their life; they are "in place" in the world, instead of out of place, or merely drifting or endlessly seeking their place. Through caring for certain others (whether other persons, or ideas, or ideals), by serving them through caring, a person lives the meaning of their own life. In the sense in which a person can ever be said to be at home in the world, they are at home not through dominating, or explaining, or appreciating, but through caring and being cared for.

> (edited slightly for clarity and pronouns)

I remember at the time I was afraid that the fabric of our community — built on caring — was being stretched thin by COVID. I didn't want our community to be a place where

people were there just to be there, but where people came to learn to care deeply, and to give their work, others in the community, and themselves their caring attention.

For me, caring for my students helped me grow roots and feel at home. It took years, but caring for my students and being rooted in my values gave me a certain stability that allows me to be creative and "out there," constantly exploring. I want my students to find this kind of stability in their lives — whatever their caring may be organized around. Ultimately, I am not sure what impact these conversations on caring had on my students (do I ever know?), but it felt like a good meditation.

Come Spring 2022, I came in without a quote on the first day of studio and instead brought in the movie Groundhog Day. We watched that together and talked about it, and continued to return to it over the quarter. This had a huge impact on my students.

If you haven't seen Groundhog Day, give it a watch: roughly, it's about a weatherman living a day over and over again, stuck in a town he can't get out of. Until his perspective changes and then, everything seems to shift. I actually hadn't seen the movie until Chase Bossart, a yoga teacher in Mill Valley, CA, told me about it when I interviewed him for my research project early in the pandemic. He thought it might help my students to see the film, and he was right.

For my students, the film contextualized their day-to-day life in DTR, where everything seems so damn repetitive: planning a sprint, assessing risks, getting it wrong, getting feedback, trying again, failing some more, trying again. Over, and over, and over again. It can seem as if none of it matters and nothing changes. The pandemic lockdowns and remote learning that followed only added to this.

In DTR and in the film, a change in perspective can shift everything. All of a sudden after some considerable struggle, a student comes to see themself and their work differently, and they break *through*. They do something different, find new meaning in their work, and see themself in a different light. And everything shifts from there.

In many ways, DTR feels repetitive *because* it provides a structure for practice that surfaces patterns of behavior. A student's behavior or reaction can stay remarkably constant, even as situations change across weeks (still, it takes a good coach to recognize this). Their impatience with themselves, their fear of failure leading to avoidance, and their jumping ahead may manifest slightly differently from week to week, but it's the same underlying struggle that they are having with themselves (this goes for me, too).

DTR's practices make our patterns repeatedly visible to ourselves, our peers, and our coaches. For some of us, seeing ourselves more clearly only adds to the frustration: why am I like this? Until we start to see ourselves differently, and start trying something unfamiliar, we are stuck. Groundhog Day provides a wonderful depiction of this journey, and a way for students to look at their own journey and make sense of it in a new way.

For me, one realization I had from watching the film is that while a change in perspective is what helped, the way the main character got there was by realizing how much of his life isn't under his control. It is only when he has come to accept this, after every attempt to escape and control what cannot be controlled — that his perspective shifts. I am seeing this in myself — that my perspective doesn't shift until I understand and accept deeply what isn't in my control. That for me, deep change begins with acceptance, and not with attempts to control. I'd like to meditate on this thought some more, and to share this idea and discuss it with the DTR students in the coming year.

Sharing: Putting It Out There

We had a near final cut of the DTR documentary in Fall 2019. The film was just released in May 2022. What took so long?

We have a model for coaching and a process for learning to work on design research problems that is now fairly mature, I would say about 4 years old. Yet we have never written it up or shared it broadly (until later in this letter; see section on "How We Coach and Teach Design Research"). Why?

I had written up a position paper on Computational Ecosystems — a core theme of my research — that was rejected by CACM years ago, prior to my getting tenure (note to junior faculty: that one paper you think you absolutely need to have accepted and published prior to getting tenure? You don't need it to get tenure. Just do good work, and try to sleep well. You will be fine.). I have never revisited that paper or tried to resubmit it, despite multiple colleagues asking me for the paper and wanting to know how I would like them to cite it. Why?

There are many reasons—and excuses—for why it takes me a long time to share. It is hard to separate the reasons from the excuses, but they include things like needing to polish and refine prior to sharing, having trouble connecting with audience, being too busy with other projects that became higher priorities with bigger fires that need putting out, and simply waiting for the right time (for the documentary, once the pandemic was in full

swing, it *never* felt like the right time). Regardless of what the reasons and excuses were, they conveniently hid the fact that I was struggling with *wanting to* share what I was doing. With putting it (and myself) out there. I held back.

I held back because I was hesitant and afraid to share something so personal. Unlike sharing some other projects of mine, sharing these works felt particularly vulnerable, because they are about me. The film, for example, shows how I work with my students each and every day. That's scary for me to share, and feels a bit like undressing in public (I don't have much experience with this, but my imagination is active with embarrassment). And DTR *is* a bit strange, isn't it? We sit down on the floor to breathe together. We write on the whiteboard a lot. What are we writing, anyway? I didn't want them to judge me, and much less, my students. Don't they dare judge my students… (who is this judgmental *they* that I am imagining, anyway?)

In academia, it is easy to hide behind the objectivity of science, by pretending to share what is scientific and leaving out what is personal. But over the years — and with some help from Will Stillwell again, citing Michael Polanyi's work on personal knowledge — I have come to see knowledge as largely personal. Sharing isn't simply about dumping out facts — moving facts from a brain warehouse into a paper repository. Sharing is making something private, sometimes something intimately private, public. This can be a very big step, and of course this can be scary. Not all the things that we know are so easy to share, and not all that we share will be heard or acknowledged, particularly in the ways that we'd like it to be (think Darwin, think Galileo).

But sharing — especially sharing as it relates to personal knowledge — *is* how we can contribute to the world, how we can relate to others, and how we can come to accept ourselves. This is so important, and is why I include sharing in my responsibility as DTR's keeper.

When my students hold back from testing a prototype they've built on actual users, write a paper draft passively without including what they really wish to argue for, or sit during circle time, unsure of whether to say what they really think, I think they too are struggling with sharing, with putting out what is personal for them. So we encourage students to share, and provide ample opportunities for sharing throughout our DTR practice. As students practice sharing (their prototypes through frequent testing, their selves through circle time and end-of-quarter exit meetings), they come into a deeper alignment with their work, and with being okay with putting themselves out there, as they are.

Still, I think it important to not only encourage, but to *honor* sharing. To respect how hard this can be. I remember a meeting I had with Yongsung Kim, when he was still a PhD student at Northwestern, working to revise a paper of his. He had twisted himself so hard to address a reviewer's comments that the paper was actually getting worse with each revision. Fed up, finally he exclaimed: "This is my paper, not the reviewer's paper! Why am I making the reviewer the main character of my story?" In that moment, he gave himself permission to share — to tell the story that he wanted to tell. Instead of working to placate a reviewer, he made the decision to share his personal knowledge, while still respecting what the reviewer had shared, too. I am so proud of him for that.

And back to myself: sharing the documentary, scary as it is, feels good. The documentary shares a snapshot of our community, captured and shown from a particular perspective, at a particular point in time. It's wonderful how the film shows our students being vulnerable, and working through their personal struggles as they grow. It is wonderful how some students and faculty who have seen the film have responded — and how the film has inspired them to ponder how they learn and mentor. I just had to get over the barriers I had put up and share the film. Once I did, I felt like the Wild Geese, announcing my place in the family of things (see Mary Oliver, *Wild Geese*).

It is really wonderful to see how DTR has become a place for practicing sharing — for coming out of our shells and becoming more willing and capable of putting ourselves out there and sharing our truths. I am not sure if I intended this, but I like it very much. I myself intend to share more, and more honestly, with each opportunity.

What Students Get out of DTR

Last year, I sought out letters from DTR students and alums, asking them to share what they got from their DTR experience. We received about 30 letters, and the students' words provide a *much* better picture of DTR than our website does. I share some excerpts from these letters below.

Students shared that DTR helped them learn to approach and solve problems:

> I think DTR was the purest form of learning I encountered at Northwestern. I learned new mindsets and approaches to problems I had never considered before the class.

From DTR, I have learned whole-brain engineering, CS, HCI skills like design arguments, agile work, time management, abductive reasoning, conceptual thinking, mindfulness, research literature analysis, metacognitive analysis, qualitative and quantitative study design, abstract thinking, concrete reasoning, design approaches, user empathy, help seeking, risk assessment, thoughtful writing, self-reflection, and process thinking.

A lot of the students in DTR came in just looking to code and came out with a whole new approach to coding. We learned to not just build something and then find a problem that it resolves but instead to find real problems and figure out if we can come up with a solution. To truly understand who are the users, what are their issues, and what are the various solutions to their problem.

As a wide-eyed sophomore just trying to do as much coding as possible, DTR and more specifically Haoqi, pushed me to slow down, think about the "Why" and the hypothesis that I was trying to solve. Looking back on it, this may have been the most impactful point in both my career as a student, and career as an engineer. A lot of entrepreneurs and researchers just want to build things, but without asking the right questions first and slowing down, you could be working on things that aren't useful at the end.

DTR taught me how to pursue my goals, question every assumption, and work to find comprehensive solutions to novel problems. It also taught me to manage my time, emotions, and workload.

Students emphasized that the learning did not stop at picking up problem solving skills, but in their orientation towards learning:

DTR provided me an opportunity to not just develop my technical and research skills through the projects we worked on, but most critically the skills that have helped me be a successful thinker and learner well beyond the scope of the course.

DTR was the most important part of my CS education and I think what defines me as a CS student from Northwestern, instilling in me the mindset of being a life-long learner. Plenty of classes at Northwestern could've told me that, but none of them are designed in the way that DTR is that that skill becomes like a muscle that we are actively strengthening.

As a student, I have always been worried about getting things right, sometimes losing track of the learning itself. This has hindered me in classes before, when I focus more on studying to do well for an exam than studying to really understand the concepts. DTR has helped me break out of this mindset, by shifting my focus to the learning process itself and caring less about the outcome. That way, I build problem solving skills to better approach questions I don't know in the future. It's okay to struggle! This idea is something I have been uncomfortable with throughout my life - I think most students at Northwestern are uncomfortable with it. But DTR has given me the tools to face my struggles and to use them as learning opportunities. Anywhere I'm struggling is an opportunity to learn something, and instead of being afraid of it, I tackle it head on, starting by addressing the risks.

Students highlighted the value of being in community:

I cannot think of another place that emphasized a community of independent undergraduate researchers. The community aspect of DTR not only facilitates better research by giving access others' knowledge in seeking help, it also is incredibly motivating— to see your classmates succeed, to have them encourage you into your own successes.

DTR has given me life-long friendships and a community.

The experience of working by yourself, reflecting about what gaps exist in your learning of the problem space, and planning how to overcome those problems, all while being in a supportive community with helpful peers, mentors and professor(s), is unique to DTR.

Personally, DTR was a community for me where I felt accepted and supported by all members. Everyone was extremely approachable, open, and candid. This was enabled by a lot of structures past community members and Haoqi helped design. These structures prompt us to actively be involved, take responsibility and help each other out. Much like a symbiotic relationship, being a part of DTR is as much as giving to the community as learning from it, mutually helping one another grow.

Another specific aspect of DTR is the community— it is truly an inspiring community where we learn from each other and teach each other.

Students shared how DTR provides a mix of support *and* rigor:

I think DTR offers depth to the CS experience; depth in technical skills, depth in argumentation, and depth in thinking. Even the relationships that form in DTR offer more depth than regular classmate relationships.

When I think of DTR, I remember a strong feeling of warmth and caring, as well as a relentless push for excellence.

DTR provides students with a supportive, intellectually challenging community.

And with support and rigor, students are able to do truly independent research, where they learn to drive the research:

The powerful part about DTR is that undergraduates are doing actual research, and doing research is challenging. As a result, I learned how to think critically and have the grit to overcome obstacles.

There are exceedingly few places where you can work on large projects for multiple quarters in CS, but this type of technical experience is invaluable when working.

DTR's structure encourages students to tackle independent research projects, which is highly unusual for undergraduate research.

Students learn how to self-direct complex work, which in turn gives them the confidence to do so (I will say a bit more about where this confidence comes from in the next section):

DTR gives undergraduate students the rare opportunity to conduct truly independent research and fosters an environment in which they can succeed and prove to themselves that they can tackle novel problems.

I learned how to be curious, to think critically, to self-reflect, to seek help. It is because of DTR that I am confident in my work to tackle ambiguous problems, design entirely new systems, make important product decisions, talk with stakeholders, and collaborate with dynamic teams.

DTR's unique teaching approach puts me in the driver's seat from Day 1, for everything from setting high-level goals to planning weekly tasks. I never thought I could do research, but Haoqi and the community had so much faith in me even when myself did not.

There are plenty of skills I can directly point to that could have only been developed in the unique environment DTR provides: REAL design thinking, prioritization, self-directed project management, bottoms-up reasoning, effective argument development. But most importantly, DTR provided an opportunity to learn that I am capable of doing great work, and inspired the confidence in myself needed to tackle large problems that don't have their answered listed in the back of a textbook.

Looking back at these letters reminds me of what a spectacular learning space we have created, and how important it is to keep it that way. My job as keeper is clear. As long as DTR continues to do right by students, we will do just fine.

How We Coach and Teach Design Research

As this point, DTR has a fairly well-developed model for coaching and teaching design research. It's quite involved, but it is built on a few simple ideas that are useful for problem solving and coaching generally, that I will share below. These ideas build on work from Matt Easterday and Dan Rees Lewis, with whom I run the Delta Lab with; see their research for more on this topic.

To start, I think it's important to emphasize that our primary goal for DTR students is that *they* learn to self-direct complex work. It is not to provide students with solutions to complex problems so that the problems get solved. This orientation is important to

understand and underlies how we work with students: we are trying to help them towards independence, and not with just getting their problem solved.

Specifically, then, at any point in the research process, we want students to be able to answer the following 2 questions:

1. What are the riskiest risks in my understanding right now?
2. What are effective ways to work through these risks to advance my understanding?

It's really hard to answer these questions without having:

1. Ways to represent and analyze what I know and don't know about the problem I am working on, and the solution space.
2. Effective representations and structures that I can use to figure out how to learn more about what I don't know, and to analyze and synthesize what I do know.

Our model for learning and coaching, then, provides students with the tools for representing their knowledge, assessing what is risky (what do I not know that is getting in the way of my understanding and solving this problem?), and thinking through what can be done to address the risks. In other words, we teach structures and representations for thinking about every aspect of the research and design process. Students learn these representations and use them to guide their thinking over risks and situations they encounter in their research process.

The key idea is that once these representations are mastered, a student is never stuck; they can assess where they are by noting what is known and what are the risks, and then use (or come up with on-the-fly) a representation for guiding their thinking that will help them progress. This representation might, for example:

- help students synthesize their findings following a prototype test to reflect new learnings about their problem statement, design argument, interface/system arguments, and testing approach, which they can then use to plan the next test.
- help students recognize risks in their design argument prior to testing (e.g., outcomes that aren't measurable, user obstacles that are not overcome by the characteristics they propose to test), based on which to improve their design.
- help students distinguish their conceptual approach from existing approaches, so they can recognize gaps in their understanding of why existing approaches are ineffective for the class of problems they are studying.

And the list goes on and on and on…. because there are a lot representations and structures for thinking that are useful for doing research. The most effective representation to use depends on the particular situation that the student is facing, and of course, depends on the area of research, the type of research (e.g., a needfinding study, a novel system design), or even the medium of presentation (e.g., a talk, a paper, a grant proposal). *But the key idea is that these representations can be externalized and taught*, and that students can learn to use them while facing a wide range of situations they might encounter in the research process. Ultimately, what helps our students learn to self-direct their research projects is growing their ability to risk assess and to then effectively structure their thinking to make progress.

My guess is that all research mentors teach some version of this: after all, they themselves have structured ways of thinking they use to make effective research progress. But mentors often focus more on helping students solve whatever problem is arising than on teaching effective representations for thinking. What makes DTR special is that we teach representations for thinking explicitly, and infuse them into students' weekly practice and our way of coaching. Here is how it works:

- Students maintain a *research canvas*, which represents their current and changing state of knowledge about the problem and solution. Think of the research canvas as an (incomplete) model for what will eventually go into the research paper: students capture in it their understanding of the problem statement, their design argument, study design, findings, etc, all subject to change. In addition to providing a space for students to record what they know, the research canvas contains prompts that help students reason about what they don't know — based on which they can identify risks (e.g., parts of their research they hadn't thought about in depth; arguments that don't quite line up or work as expected).

- Each week, as part of planning, students use their research canvas to assess their *riskiest risk*. Based on this they orient their sprint towards *deliverables* that address this risk. This might include testing a critical design argument (hypothesis) for which they yet have evidence for; designing an interview protocol that seeks to better understand obstacles users face than is currently understood; addressing a key weakness in argumentation in a paper draft, and so on.

- Through *LIP (Learn, Instruct, and Practice)* sessions during studio, students learn and practice using representations for assessing and addressing their risks with the help of their coaches (myself, and a couple of my senior PhD students who are

learning to coach). The role of the coaches is to teach students the representations, and to *promote effective practice* using the representations. In other words, the coach focuses on helping students develop a practice for thinking through specific problems they face, guided by the structures provided in the representations they are learning.

- The various representations we teach (e.g., design argument, problem statement, interface model, approach trees, etc) for thinking through different aspects of the research problem are taught verbally (1-on-1), via workshops and office hours, and via a set of *learning modules* we provide for the students. Each learning module generally provides some guidance on how to use a representation and provides a few examples — just enough to get the student started. The rest of the learning happens through practice and coaching in LIP.

- LIPs are taught *mysore style*, modeled after the mysore-style practice in Ashtanga Yoga, which supports individualized self-practice and coaching within a community setting. In a typical LIP session, a mentor coaches 6-8 student teams in a one-hour period (we go for 2 hours, with half of the teams doing pair research while the other half is doing LIP). Students work at the board, with each team using whatever learning module or representation that they and their coach think may help them in their situation. The coach walks around the room to address any questions and to facilitate students learning to use the representations effectively. Once a student or team has a path forward, the coach leaves the student to practice on their own. At its core, despite the significant amount of coaching that happens during LIP, mysore is first and foremost a *self-practice* that helps students build a practice of their own.

Focusing student learning on representations and ways of thinking for assessing and addressing the risks that arise in their research, and promoting their practice thereof, is how we help students learn to self-direct complex work. This is not to say that we as mentors don't help students think through conceptual issues in their research, or share ideas for advancing their projects—far from it. But it is to say that we help students build a self-practice that allows them to effectively pursue research on their own. One of my most rewarding moments as a mentor is when a student comes up to me, tells me that they are stuck, and then I ask them what their risks are, and what representations they know for thinking through it—and they know exactly the risk and how to approach it. Having a process for how to proceed doesn't provide students with an immediate answer, nor guarantees one — but it helps students know how to move forward in their search, and how to search effectively. Ultimately, *our practice* is what gives our students the

confidence to lead projects and to seek new knowledge and solutions. They practice a process for intelligently moving forward in the face of the unknown.

Four years in, this aspect of DTR's model has proven its worth by reducing students' reliance on mentors (more independence), promoting clarity and depth of thinking while surfacing risks sooner for discussion, and generally increasing students' abilities to identify risks and to address them. Still, our way of doing things is not easy:

- For students, facing project risks head-on by frequently externalizing their thinking about what they don't know on the whiteboard requires a tremendous amount of courage and vulnerability, as does receiving coaching on how *they* are thinking about the problem. This is the "sharing" that I discussed earlier: making the private public. And since we are always working on what we know the least about each week (our riskiest risk), there is a certain tenderness in such sharing.

- For mentors, coaching multiple students and projects in LIP simultaneously is a real mind exercise. Having standardized representations through learning modules is essential, as they provide structured windows into the students' thinking that mentors can readily follow and analyze. But still, to truly understand how each student is thinking, and to identify ways of practicing that are helpfully tailored for each and every student, to their particular needs and where they'd like to focus each week, takes a lot of mind and practice. As a mentor, I still find it hard to leave LIP feeling fresh.

I have no intention of moving away from our model for learning and coaching design research anytime soon, but it is important to acknowledge just how hard it is, and how much commitment it takes from everyone. And this makes sense: what we have is a model for deliberate practice in design research, no more and no less. Deliberate practice is effortful in nature. Luckily, DTR provides a wonderful environment in which to apply good effort, making such practice a good fit for our culture.

I will share more reflections about our model for learning and coaching design research in the years to come. So far, so good.

Sustainability

As we come towards the tail end of this letter, I want to zoom out a bit from our inward-looking focus to talk at large about the sustainability of DTR, and broadly of our kind of learning environment and way of mentoring.

DTR started in Spring 2014: we had 8 students, then 14 the next quarter, 20 the one after. I started with very few formal structures, and relentlessly iterated on DTR's design with a singular focus on student learning and growth. Over the years, DTR became a class that students can take for credit over multiple quarters, and a recognized part of the CS curriculum. There was really nothing like it before (or since), but we found ways to make it work. Many helpful folks and funding sources made it possible for me to have a space in which to continuously innovate and refine our model for mentoring and learning.

Even today, DTR looks "strange." It's not a single-quarter class, nor is it just a research lab. Learning happens in an active community that students take responsibility for, rather than in a chair at a lecture hall. Of course, there is nothing strange about it if we approach DTR as an apprenticeship-based learning community, a lens through which DTR appears rather ordinary while college classrooms look very strange.

But still, DTR *is* at a university, and possible today because of the support of my university, my dean, and my department chairs (I am jointly appointed in Computer Science and Design). No matter how awesome we think DTR is, we are never an island onto ourselves, but part of the larger learning ecosystem the department, school, and university provides.

As I look back at the "startup" phase of DTR behind us, I never thought much of being a part of something. If anything, I played up the idea of "we" and "other." Look at how *we* do things in DTR, and how *other* classes do what they do. I also generally kept a distance from the university leadership, sharing good news as it came in, but never really taking the time to share how DTR fits into our larger learning ecosystem.

Today, I see this as largely shortsighted. It is my mistake, and a mistake of the times, to not engage beyond reporting our successes. Today, I see how foolish that is and how important it is to work collaboratively with my department, school, and university to make DTR a long term success. And while I have always appreciated all that others do to make DTR possible, appreciation is different from engagement, and engagement is necessary. If DTR looks strange, it is my responsibility to help others see it as less strange, and to share how if fits in as an important part of our learning ecosystem. Without this work, we cannot have DTR as a sustainable, long-running program at a university. This is my goal: to make the learning and growth that happens in DTR possible, at universities, especially in science and engineering, where such learning may be more difficult to come by.

Turning briefly inward, what about the sustainability of DTR's operations, that is, our own learning ecosystem? Are our ways of doing things within DTR sustainable?

They certainly were not when I started DTR. By the time I had 20 students doing independent research with me, I was up till 2AM most nights trying to help every student. I liked the work and felt it meaningful and important, but that didn't change the fact that I was struggling and suffering on the inside. That suffering was not sustainable.

What DTR has evolved into — particularly in the ways in which the entire community comes together to operate the community — I believe *is* sustainable. Surprisingly so. As an example, the DTR interview committee is ran by the students. I am simply a participant on that committee, without which we cannot effectively recruit new students and DTR would wither. But what makes this and other DTR operations sustainable is not our practice itself, but our community culture that surrounds it. It is in the ways that students willingly take responsibility for core aspects of our community that we have our community. This we must safeguard, by cultivating the values of self-direction and community that are core to DTR. In other words, our practices work because we maintain a culture and place that students want to be a part of. If we can do that, DTR remains sustainable as an operating model, even as our practices continue to evolve.

On a more personal level — DTR is sustainable as a practice for students and mentors as long as we remember to balance our rigor with our warmth. We mustn't lose rigor nor warmth.

Zooming out again, as I'd been screening the DTR documentary and talking to junior faculty this past Spring, I am reminded of how difficult it is for junior faculty to be junior faculty. The job is simply overwhelming. The junior faculty I meet are loving mentors. They often put their students before themselves, and lose sleep to help a student on a paper in between parenting duties or while on vacation. Yet they themselves don't always receive the support that they need, and are in a race to produce scholarly outputs to get tenure. And while some junior faculty are lucky to find supportive colleagues along the way, it's generally difficult for junior faculty to share their difficulties in an open way, especially with senior colleagues who might be responsible for their promotion. I don't think it's a stretch to say that the long-term sustainability of having good, dedicated faculty mentors will require us to do a better job of sustaining and advancing the wellbeing of our junior faculty.

At its core, DTR is about learning to self-direct. If we zoom out beyond the academic setting, what can be said about the sustainability of our nation and our world's ability to broadly support people learning to self-direct? Even arts education—intended to foster creative self-expression—often translates in actual practice as product-based by valuing making facsimiles (Gude, "New School Art Styles: The Project of Art Education," 2013). Where will people learn to self-direct? Is the task delegated to therapy and religion? Can we also find ways to infuse learning to self-direct into other aspects of life, and into our many professions and activities?

I don't have answers to these difficult questions. But what I know is that like most other humanly important activities, learning to self-direct can only be sustained through the effortful provision of time, space, resources, and loving attention that together provide the conditions for such learning and growth. And this can only happen by valuing what needs to be sustained, and by supporting the people who do the work to preserve and advance what's core to the human experience. We simply cannot take sustainability for granted.

An Invitation

DTR is no stranger to having visitors. We have always had an open door policy, and faculty and alums visit us from time to time. If you are on your way to the Chicago area, don't hesitate to reach out to me, and to come visit us in studio. We welcome you.

DTR alums have an extraordinary record of telling me that they are visiting *on the day of their visit*. Alums: while I appreciate the lack of formality and the closeness to our community that this signals, would it kill ya to let me know that you are visiting ahead of time? Alas, you are *always* welcome, my frustrations be damned.

Faculty interested in learning more about what we do, and adapting our model for running your lab back home, should see Agile Research University (http://agileresearch.io) for resources and possible workshops and visits. I encourage you to also write me directly to let me know of your interest. That will help kick me into gear and improve our offerings.

In addition to impromptu visits and scheduled workshops, my hope over time is for us to have a few occasions for gathering each year that we can expect, and have on our calendars. It's too early for me to know the shape of these gatherings, but I better figure it out soon: 2024 is the 10 year anniversary of DTR. I can't wait to celebrate that occasion with you all, but we needn't wait till then to gather.

In the meanwhile, we need better ways to connect our alums, with one another and with current DTR students. If you are a DTR alum interested in helping us get this off the ground, don't hesitate to reach out to me (now is good).

Last but not least: do enjoy the DTR documentary! http://forward.movie. Spread the word.

I hope you are all doing well. Whatever is happening in your life right now, DTR is a home you can always come back to. Remember that you are never alone. We are here for you.

Cheers,
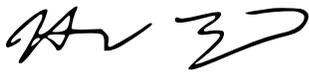
Haoqi Zhang

Director and Founder, DTR

August 1st, 2022