

Design, Technology, and Research (DTR)

Annual Letter, 2024

Dear members of the DTR family,

Thank you for your encouraging reviews of my second letter. Here is my third letter, which comes as we celebrate the 10 year anniversary of DTR. In it I share DTR's culture and practice, and my reflections on learning, growing, and mentoring. The letter is intended for anyone who learns, aspires, and grows; and anyone who wishes to foster that in others. I hope you find something in it that resonates with you.

In this year's letter, I reflect at length on what DTR has provided for my students, and how this learning can provide a valuable cornerstone in a student's college experience, and continue to serve them in their careers and lives. I try to highlight what is special about DTR as a learning space. I share this reflection in my role as keeper, as I remain responsible for maintaining and sharing DTR's unique culture.

While this letter largely celebrates a joyful occasion, I also share some uncomfortable truths about DTR and its acceptance in the academic environment in which it is embedded. I do this not so much to critique others, but to point out that I am part of a larger system. If the larger system is messy, well, I/we are in it. As I celebrate all that DTR has made possible and the possibilities ahead, I remain grounded in my own imperfections, and my being a part of an imperfect system. It's only fair.

10 Years of DTR

DTR turned 10 this year. I don't know how we made it to 10 years old, or how I got here exactly. But there are some things I do know about DTR, and what it has provided for me and for my students. I share that with you here.

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What is DTR? DTR is a learning community in which we use independent research as a vehicle for students to learn how to self-direct complex work, and to learn about

themselves as people. Students enroll in DTR as a course, which they take over multiple quarters to deepen their learning as they advance through a vertically integrated curriculum.

All students in DTR, regardless of seniority, lead their own research project from day 1. We teach students how to work with themselves, so that they have more effective models and processes for thinking about complex problems. Students learn how to lead their own projects, to formulate plans for next steps and present them to peers and mentors. They learn how to recognize risks and obstacles, and devise strategies for overcoming them.

Students learn to not only rely on themselves, but also to learn from others. They learn that self-directing complex work relies on a supportive community, and that self-direction requires learning to serve yourself, learning to serve others, *and* learning to allow others to serve you.

We learn also to take time to breathe, that learning and growing requires us to be able to slow down, find center, and engage with presence. We learn to reflect on our meta-blockers, or what prevents us from doing what we want to do and growing into who we want to be. And we make time to talk about all this, focusing not just on project progress, but on personal growth, and how we learn to work with ourselves as we grow.

DTR is a lot of things, but I think it's first and foremost, a community. It's where we come together to work and learn, yes, but also where we come to belong, and to be with one another. It's a community where students learn to lead, and lead everything — including committees for onboarding new students and social events such as create-a-thons.

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Over the last 10 years, we have had a lot of success in DTR. I have mentored 160 students, most of whom are undergraduate students, to self-direct independent research on 70+ projects through DTR. 46% of these students are women, which is rare for an engineering program.

DTR students won the most academic year research grants from Northwestern (65), published 30 academic papers, placed at 7 top international and national student research competitions, while getting jobs at top tech companies. At last survey, 40% of DTR undergraduates (44 out of 110) placed at Apple, Google, Microsoft, Meta, and Amazon; others have founded their own companies.

With support from the National Science Foundation, DTR pioneered a new model for research training and student learning, that we call Agile Research Studios. I have since founded the Agile Research University program, where we provide resources, tools, and guides to support 70+ faculty using our model to train their own students back home. We have also hosted a dozen faculty, for example from Harvard, MIT, Michigan, and the University of College London, on site visits to learn from us in person.

In 2022 we released the DTR documentary, Forward, to further share our culture of learning and growing. I also began to write annual letters, to initiate dialogue in and out of academia on what learning and growing looks like, and the challenges we face as students and educators.

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It's easy to look at the success that DTR has had, and see it as a way to produce research outputs, and to train students to pursue research as a career. But what's special about DTR are not these outcomes, but the profound learning and growth that a student can have through the program. On one hand, DTR students develops skills and dispositions for tackling complex problems that have no known solution. Students learn how to self-direct complex work, and become more comfortable with not knowing and with struggling, as they learn to approach challenging problems. This sets up our students to become resilient, life-long learners, out in the workplace and throughout their lives.

On the other hand, DTR students come to know themselves more fully, and to find what they want in life for themselves. It's a deep learning experience that shows us who we are as people. It exposes our souls. In that tender moment, DTR provides a loving community in which to hold ourselves, as we find ourselves expanding, in our self-direction. In this way, DTR is not just about doing research. It's about learning to lead a life that expands into our own, while being held by those who shower us with support and respect.

In talking to many of our alums during the 10 year anniversary celebration, what I found in them is an intense willingness to embrace self-direction, learning, and community. Those who I saw as kids (hey) grew up into thoughtful, caring adults, ones who care deeply about doing something meaningful in the world that aligns with their personal values and mission. I see them embodying the values that are core to DTR: building community, serving other people, taking care of themselves and finding their own way, learning and growing—it all makes for a life worth living. I am grateful to have such students in my life, and to have our community.

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We held an alumni panel as part of the 10 year anniversary celebration, inviting back students who had been in the 1st DTR cohort from 10 years ago, and others who had been in DTR for quite a while during their time at Northwestern. Here is what they had to say during the panel.

DTR helped them learn to approach complex problems:

In DTR I learned how to think about problems, how to identify problems, user research interviews, iterating, and scrappy prototyping. I feel like that's something that not as many software engineers have, so I've been able to take advantage of that.

A lot of traditional classes have very rigid structure that you follow, and especially after college, doing a couple different startups, you don't really have that structure. You need to figure out the problems as you go along.

The idea of self-directed learning, actually trying to come up with questions that are worth investigating or answering and then also how to break down interesting solutions.

DTR helped them learn through a long-term commitment:

The value of DTR looking back on it now is there's a long term commitment and a seeing of things through and kind of struggling with the same problem both personal and either professional or academic quarter after quarter that I think really models a lot of the commitment that's required in a professional context or also in a personal context.

I was part of DTR for two plus years and it was such a valuable part of my college experience and was also just really, really fun.

DTR informed how they approach life:

DTR gave me the most life skills of any course at Northwestern.

[In DTR] we talk about our growth and the metacognitive challenges we faced. That was an opportunity for me to reflect on those things and learn about myself in ways that I just couldn't delve into if I just focused on the research.

One that resonates a lot is just the feeling of purpose and calling and what human values mean and what that looks like in my life.

Savoring the incrementality of progress.

DTR helped them learn to work with others:

Feedback and asking hard questions and being prepared to answer the hard questions first has been something [from DTR] that I've really carried into my management practice.

Leaning on other people on your team to get unstuck and build culture of mutual support

Culture of mutual support, self-directed-ness, and independence and a sense of accountability

DTR cultivated their interest in learning, and in creating and sharing knowledge:

The DTR mindset of learning how to learn and self-directing in that process has been super important to me. I don't know if I knew that I liked learning so much, and I think that DTR very much taught that.

Creating generalizable knowledge that can be shared and reused.

Learning how to do research, so you can go do research in industry.

DTR helped them to embrace not knowing, and change:

Even though you may have career shifts and changes, DTR helped me learn how to learn. I feel like even if there's a drastic change, I am okay facing that. The skills of being able to approach new problems [that I learned in DTR], could be applied to kind of anything.

Not being afraid to not know the answer, not being afraid to fail a little bit.

So, what is DTR? Rigor. Warmth. Self-Direction. Community. It is our community. Happy 10 year anniversary, everyone.

The Good

I spent a good chunk of the year wrestling with the idea of the good and the beautiful, in what it is that we do in DTR. When I look back at my research career to date, my greatest accomplishment is in my learning to see the world differently, through my research and as my research changed me. What's special about DTR, and what is difficult to communicate about DTR, is that it's a space in which we can come to see the good and the beautiful in research, and in ourselves.

One of the beautiful things I love about research is that it can be about embracing not knowing. Approached as such, research is an opportunity for us to ask questions for which there are no immediate answers, and to be in an undefined "in-between." What's deeply appealing about this space is that it is brimming with possibilities. It is a space that welcomes exploration, experimentation, and trying to see things differently. This is a space for discovery, and for living a life that has yet to be written.

When I work with students, I take seriously this idea of not knowing, and work to shape a space in which we can explore together. Some students are inclined to want to get out of this space as soon as possible: they want to give an answer, or to show me what they already know. In such moments, I try to point out what we don't yet know, and to bring us back into the space of not knowing. Because to not know is to see clearly...

Sadly (for me), this (to me) compelling description of research is largely not how research operates in my field. For many researchers, the desire to know—and to share what they know quickly and widely—seems to outweigh the desire to dance with not knowing. The incentives are heavily skewed towards knowing something, and convincing others that we know something. This is shortsighted, but understandable.

As an educator, I help my students see themselves and the problems they work on more clearly. I polish mirrors, so they can see better. I point out blind spots that they have been trained to ignore, and dimly lit paths that can lead to new possibilities. I help them make sense of where they are, especially when they struggle to see where they can go next. When students want to settle for the comfort of knowing, I encourage them to move further into the unknown. I do this by conveying the beauty of what may lie ahead, and how they can never find out without moving their feet forward.

In the Fall quarter, I read to students this excerpt from my interview with Talbot Brewer, who in reference to Iris Murdoch, talks about how we might come to see and live more compelling descriptions of ourselves:

There are some prevailing descriptions of who we are, what makes us tick, what's possible for us in life, what it makes sense to do with our lives. There are some available descriptions and to a certain degree, they are self confirming, right?

I mean, we internalize these descriptions and we regiment our lives in accordance with that picture of ourselves. And making different pictures available is, it seems to me an important part of an antidote to the grip on the psyche of prevailing pictures. Will everybody go for them once they're available and when they're well articulated? I don't know. I mean, how do I know?

All I can do is say that I've been gripped by this way of thinking about my life and that when I talk to other people, I often find that there are loose ends and their self conceptions that open them, permit them to be open to a different way of picturing how it might be good to describe themselves in their undertakings.

And the more they inhabit that alternative description, the more they find that it's one that fits and that moves them. And that opens up a way of living that they find to fit them, to suit them, to remake them in an image that they're happy with.

In circle time throughout the year, my students and I tried to provide better descriptions of what we are trying to do in our activities, and how we are learning to embrace not knowing. One challenge, it seems, is in how we view ourselves as we are now, as we try to imagine a different picture of ourselves. In Winter quarter I shared another excerpt from my interview with Tal, this time on the idea of the beautiful:

The beautiful is that appealing dissonance that we apprehend when we see something both as it is and in light of its promise. And those two modes of viewing it sort of are superimposed stereoscopically upon each other. So that the world is brimming with a kind of potentiality.

What we all caught, as I read this quote, is how hard it is for us to see the dissonance between how we are and who we could become as appealing. How could this possibly be appealing? I pondered about how eager I am to shape students into who they can become, while my students shared how inadequate they felt in how they are right now (me too). Together we asked: how can we hold more space for this dissonance, and in doing so,

come to see the beauty in ourselves? How can we approach research this way as well, whereby the beautiful is precisely in embracing not knowing, to be in that in-between that is full of potentiality?

Having a space in which we not only do research, but can explore and come to see the good in being a researcher, is what's so precious about DTR. Both immediately and later in students' careers and lives, DTR helps students see the value of being in-between, and of the good of seeing themselves clearly, while moving through not knowing.

Love

Back in 2019, three professors, Elena Glassman (Harvard), Dominic DiFranzo (Lehigh), and Gabi Marcu (Michigan) visited me, mostly to observe how I was mentoring students in DTR and to see how they can adapt elements of what we do in DTR back home. They spent 3 long days with my students and I. Some time during the final day, after they had seen just about everything there is to see about DTR, one of them asked: "so, what is the secret sauce?" The four of us thought for a moment, looked at one another, and one of us blurted out: "love."

What is love? (Baby don't hurt me... don't hurt me, no more). What place does it have in DTR, and in learning spaces more broadly? And is love really our secret sauce?

My ideas about love have evolved quite a bit over the years, and even now I think I'd struggle to define it for you. Love is also a very strong word in some cultures, and using it at all may be asking for trouble. But I think one element of loving relationships that I stand behind is that there is an openness, or open-heartedness, towards oneself and another person that makes possible all kinds of things that are simply not possible without it. Deep learning—the kind that touches the core of who we are and what we see in the world—can only happen from a position of open-heartedness. As Tal puts it, "to be more alive to the goods that are available to you [...] is to make yourself available for that kind of birthing and to help others, and to be open to the input of others through their love in aiding with that birthing as it may happen in you." In this description, love is both that open-heartedness in oneself, and what makes that open-heartedness possible in another.

I don't want to say that I forgot the magic of love over the past few years, but I think there is a part of me that has become less willing to be fully open to its power. Somehow, the open-heartedness hurt one time too many, when others hadn't been so careful with my

heart (and me, with my students'). Yet, my belief in the power of that love has not diminished one bit. So how do we recover it?

I have a strange story to tell. In the middle of one night in Hawaii earlier this year, I couldn't sleep and went looking for turtles. I wasn't looking per se...I was feeling for them. After walking for a few minutes, there they were: two beautiful turtles, sleeping on the sand as the waves washed over them gently in the night. In that moment, my troubles seemed so insignificant, and the world, so beautiful. At once the thought came to me:

I will love, till my dying breath.

(I told you it was a strange story)

What I had forgotten, or misplaced, is that being open-hearted and loving is a core part of who I am. There will be pains, and I shouldn't ignore them. But love is essential for how I live my life, as both a learner and an educator. Whatever the difficulties may be in being open-hearted towards myself and others, I can live with them. But I cannot live without love, and without loving. And DTR can never be a space without love. It is our secret ingredient for learning and growing.

Breaking the jump

As I noted in my debut letter, one of my jobs in DTR is to practice: that I myself practice what I preach to students, that I too jump if I ask students to jump. In keeping with this promise, my new practice this year is...parkour!

I have always wanted to do parkour, but never thought I could do it. Now that I am 39, it doesn't look any more do-able than when I was younger. But alas, I found myself an amazing teacher in Kurt Gowan, and joined an amazing community that trains with Kurt at Parkour Ways. It's not easy (it's hard!), but I love it, and I am learning a lot that I feel is largely applicable to what we are learning in DTR.

Here are some things I have learned through parkour this year:

- The shape and size of my fears are rarely accurate. Things that I think are dangerous and impossible may not actually be. Likewise, things that I think are safe and easy, may not be either.

- I have a lot of made-up rules and ideas in my head. That I am supposed to do something in this way or that way. That what I do will piss off who and who, and they will have these ideas about me. These too, are rarely accurate (or verifiable).
- My fears can come from far away, unexamined places. For instance, while attempting to walk on a rail by a pond, I found my body screaming in fear. When I listened, what I heard was a boy who was afraid of water, because his relatives' way of teaching him to swim at a very young age was by throwing him into the deep end (note: this did not work for me.) Feeling into the pain of that experience, and how scary that must have been for little me, helped me to see my fears anew in the present. I cleared the rail on the next attempt.
- Having fun, and being in community, is so important, especially when what I am learning requires trying many many times (or precisely *is*, learning to embrace trying many, many times).
- Honoring the moment in which I and others are attempting to “break a jump,” or do something new that is meaningful for us, is so incredibly precious. Cheering one another on for breaking a jump, and just for trying to break a jump, is an incredible feeling and way to be.

In Spring quarter, I shared with DTR students this quote from Julie Angel's book on parkour, *Breaking the Jump: The Secret Story of Parkour's High-Flying Rebellion*:

Something changed in who I was the day I broke that jump. I had broken a pattern of behavior that said: “I can’t or won’t.” I had made a break with fear as a foe; it was now a discussion I was happy to have and spend time looking into. To break a jump was to change from ‘I can’t’ to ‘I did.’ To break a jump meant finding a way to overcome obstacles in every sense of the word. It was a change for the better. On my own I would have justified a multitude of excuses as to why that day was not the day to break the jump and would have left without attempting the harder option. I would have been OK with the idea that it was a better decision to stop trying and go home but, with my friend’s gentle yet firm support, I achieved more by staying and going through the process of learning what it meant to try.”

What I find so valuable in this quote is the talk of having a different relationship with our fears, than trying to ignore them or be rid of them. As I have started to do in my parkour practice, I encouraged DTR students to re-examine their relationship with their fears, and to try to approach research with “right” effort. For almost everyone in DTR, this is difficult:

it's all too easy to power through (painful, and not necessarily effective), or to be timid and run away from the jump. Despite challenges, as we progressed I could really see a lot of my students trying to stay with it, and starting to break jumps of their own.

As much as I value students breaking jumps, I can do even more to give students the time and space needed to do so. In my parkour classes, I don't ever recall Kurt rushing us to break a jump. If there is something we want to do, he stays, observes, for as long as we are trying to do something (and it can be a while! His patience is amazing). I can be more patient in this regard, and that will help students learn to be more patient with themselves, and to stick with what they are doing. I also need to create more (timely) opportunities to cheer students on when they break a jump. They have to know that it's a big deal, and it's awesome!! I want to think about how to recreate those moments we have in parkour class, where in anticipation of someone trying to break a jump, we are all observing with loving attention, and erupting in applause and cheers when they do break a jump. It's a wonderful feeling that I wish to bring to research learning much, much more.

Troubles in Goal-Oriented Thinking

In DTR we pride ourselves on learning how to be effective, and being effective in how we learn. So it's particularly unsettling for me to find myself challenging fundamental assumptions I hold on what effective learning looks like. You can think of this as my hot takes on learning science, if you will; I see it more as my questioning the foundations of how I work with students, when so much of what we do is framed as learning to be effective in reaching goals.

Scaffolding is short-sighted

A foundational concept in learning science is that of having a *zone of proximal development*, by which with the support of helpful others, one can come to learn to do something just outside of the reach of one's current abilities. *Scaffolding* is the further idea of constructing (a sequence of) learning experiences that helps a person to work towards a goal, until they are able to do it themselves. There are some important ideas about fading the scaffold as well, but for our purposes, this description suffices.

Over the course of this year, and perhaps due to the parkour classes I have taken with Kurt, I have come to see scaffolded learning as somewhat shortsighted. It is too goal-

oriented, too focused on learning the skill that the scaffolding is meant to teach. When it comes to research and parkour, what we hope to learn are not just specific skills, but *how* we approach what we do not understand, or cannot do.

As a parkour example, consider the task of vaulting over an obstacle in your way (wouldn't you want to learn how to do that? Wee!!). If the goal is just to learn to vault, then providing targeted and scaffolded exercises that help the person do the actual vault is an effective approach to learning. But what if the learning goal is not so much about vaulting, but learning how to deal with obstacles and with not knowing? Sure, a person can learn to vault. But would knowing that help them deal with their fears of not knowing, when it comes to a different task? When it comes to life?

When Kurt "teaches" parkour, he sometimes break things down but he often doesn't just tell us what to do exactly and drill us like robots until we learn a movement. In Kurt's words, he likes students "to have to explore, problem solve, experiment, get creative. When you find/ figure something on your own, the sense of accomplishment is much greater and I believe the knowledge you gain from it is more likely to stick." I think he is right, and moreover, not scaffolding things all the way can make space for students to learn *how to explore, problem solve, experiment, and get creative, for themselves.*

When it comes to DTR and to research, I don't want to just give students a way out of not knowing. I want them to learn how to work with not knowing, and to be with it. Sure, I will show them ways of working, and strategies and approaches they can apply to different situations. But this is no substitute for the experience of not knowing, and of not having a scaffold already built for you. The student then has to learn how to build a scaffold for themselves, and to be okay with themselves in their not knowing. This is what I want DTR students to learn, and too much scaffolding can miss this valuable learning.

Taking a step back: why is scaffolded learning so popular, then, if it doesn't actually give learners the experience of *research*: that is, learning about the world while dealing with not knowing and having to confront uncomfortable truths about oneself? Because it works! Because with scaffolding one can learn how to vault sooner, and publish one's first solo-authored paper sooner, than if one learns how to get there oneself. We can be more effective, and more productive, sooner, if we just scaffold getting to the result. But what we lose is our capacity for genuine engagement in a research process—in learning how we can be when we just don't know.

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Self-regulation lacks self-acceptance

Whenever I talk about DTR academically (for instance, in my teaching statement), I tend to say that DTR teaches self-regulation skills: cognitive, metacognitive, motivational, emotional, and strategic behaviors for reaching desired goals and outcomes. And DTR does this: it teaches students structures and representations for thinking; metacognitive skills and dispositions for planning, help-seeking, and reflection; emotional awareness and intelligence; and so on. But as I have suspected for some time, teaching students these skills, in and of themselves, is incomplete. Worse, I think it can miss the person entirely.

The problem with over focusing on self-regulation is that for all its effectiveness on achieving goals, it fails to help a person accept themselves as they are, and the world as it is. For me, my lack of self-acceptance is painful, and it leads me to frequently misapply effort and overwork, thinking that if only I can change things or myself, I will be acceptable. I don't want to keep living my life feeling this way, and I don't want my students to live their lives feeling this way. So any attempts at building our capacity for self-regulation, must come with its fair share of support for self-acceptance.

At its best, DTR helps students to look at themselves differently. They come to see themselves as, not so bad. As someone who is acceptable and lovable, just as they are. As someone who is capable of becoming, and who can also just be. What scares me is that as students and educators come to see the value of self-regulation skills and metacognition as I have, there is an increasing opportunity for such learning to be misapplied, and to be over applied, at the cost of essential developmental possibilities for the student in question. I am terrified of my imagined image of a student who is learning to be so effective in reaching goals, that they never rest and are terrified of what they may find, if they just stopped to look at themselves, rather than constantly pushing for change. As someone who struggles with this myself, I am particularly scared of my students learning to "suck it up" — regulating themselves towards a goal in the moment but suffering untold harms to their inner person. Whatever learning or success they would have, would not be well-rooted. We must learn to return to the ground, and to rest in acceptance of ourselves.

To be clear, scaffolding and self-regulation are critical to what we do in DTR, and they are not going anywhere. That said, I am committed to also creating space for learning how to be with not knowing, and for accepting ourselves as we are. We need this counterbalance more than ever, and DTR will be a learning space in which this learning is possible, too.

Sharing Models of Students

Weekly meetings with students to discuss their plans for their projects always go by too quickly. There is never enough time to discuss everything we want to discuss, or to ensure that we leave the meeting with a clear plan on what to do next. Some of this I think is unavoidable, but there are aspects of communicating around how students are thinking about their project, and their ways of approaching it, that I think are important and ripe for improving.

All year, my PhD student Kapil Garg has been working on a system to support mentors in tracking and communicating their understanding of issues that students are encountering in their projects, and of the underlying gaps in ways of thinking or working that are contributing to those issues. While the focus had largely been on making sure that students have actionable next steps for their work, learning, and personal development, what I have found most useful about Kapil's system and the way of thinking it promotes is the structured sharing of my model of a student, to the student.

Having a more structured and open way to communicate a model of the student is important to me because so often, students and I have totally different ideas about what's going on. Things get lost in translation during the rapid fire of words in a 30 minute meeting, and discussions about the finer points of the project can become misinterpreted as personal critiques of the student.

I have no way of knowing how often such misunderstandings happen, but I know for a fact that they do happen. This year, I had multiple students in DTR who thought my opinion of them and their work was far harsher than it actually was. Often, this can happen in the worst of times: just when a student is starting to become more self-directed and taking responsibility for doing something that is difficult (i.e., they are trying to break a jump!), they interpret my feedback about their way of working as a dismissal of their efforts (or sadly, person), instead of enthusiasm for their trying to break the jump. In other words, just when I am most excited about a student trying to do something on their own in the face of the unknown, they see my lack of direct support and critical feedback as a dismissal of them, at the worst possible time. Of course, this can feel horrible, and a student can feel quite upset (at me, at themselves), to the point where DTR feels hardly worth it. When I see students get discouraged and quit DTR in these important moments, I feel terrible for having missed something critical in our communication.

With the help of Kapil's tool, what I am getting to practice is to more explicitly communicate to students how I am seeing their struggles, and how I am seeing them progressing on their struggles. The structure that Kapil's tool provides is a linking of project issues, to assessments of their underlying causes due to our ways of approaching the work, and to a practice. It makes visible to students what it is that I see as needing attention, and calls for reflection within this framework of issue, cause, and practice. Communicating around research is hard enough, and when we add in communication about the person and their approach to the project, clarity, attunement, and building shared understanding really matters. It's helping me to be more aware of the discrepancies between what I intend to communicate and what I actually communicate, something that, will continue to be a focus for me in the coming years.

The Value of DTR in a CS curriculum

My primary academic department is in computer science (CS), and as such, from time to time there is a need for me to explain and advocate for how DTR should fit in the CS curriculum. Such a situation came up this year, when the CS department began contemplating having optional "specializations" or "concentrations," that signal to employers that students are in some ways specialists in some area of Computer Science. Seeing as DTR has been very successful in training students to excel in design and computing jobs, I put forth DTR as its own concentration, with (what I thought to be) the simple argument that students who enroll in 4 quarters or more of DTR tend to do quite well in a variety of job roles in the computing profession.

To my surprise and consternation, my proposal was met with a lot of resistance from my colleagues. Some faculty simply thought that 4 quarters of DTR would be too concentrated (...I thought we were forming a concentration?): to them, students taking a single course with a single professor for 4+ quarters is simply too much. As I understand it, these professors felt strongly that students should have a wide range of experiences in college, and that specializations should be at least as much about breadth as it is about depth. In other words, specializing in a subarea was less about what students could do in that subarea, but more about having a breadth of knowledge and skills across the subarea, gained from learning from multiple professors in the department.

I disagreed with my colleagues, and spent hours upon hours writing emails trying to convince them otherwise. This was largely counterproductive, and I have for the time

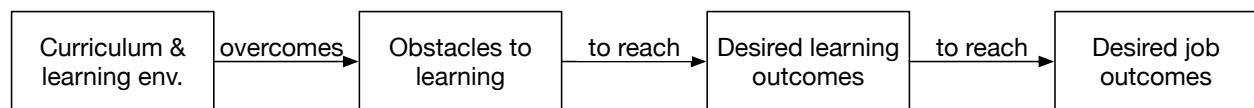
being shelved my proposal. Disagreements can happen in the best of situations. However right I feel, acrimony won't get me anywhere.

Still, I want to understand the root of our disagreements, and perhaps, to open up a broader dialogue about how we can talk about pedagogy, in CS and in formal education. Luckily for me, Samir Khuller, who chairs the CS department, made space for me to share with him the values I saw in having DTR in the CS curriculum. Over the course of an hour, he carefully listened to my thinking, responding and asking further questions to build shared understanding. This I really appreciated, especially because Samir and I have not always see eye-to-eye on how DTR fits into my teaching in the department.

What follows is largely what I shared with Samir, on how I think about pedagogy and curriculum design, particularly as it relates to helping students learn how to self-direct complex work through a learning environment such as DTR. Largely, these thoughts explain not only the value of DTR, but the inherent tensions of creating space for deep, practice-based learning environments in CS departments, that over the past decade have had to deal with a huge increase in student enrollment, often at the cost of pedagogy.

A simple picture of curriculum design

I started the conversation by sharing a simple picture of what curriculum design should look like, as shown here:

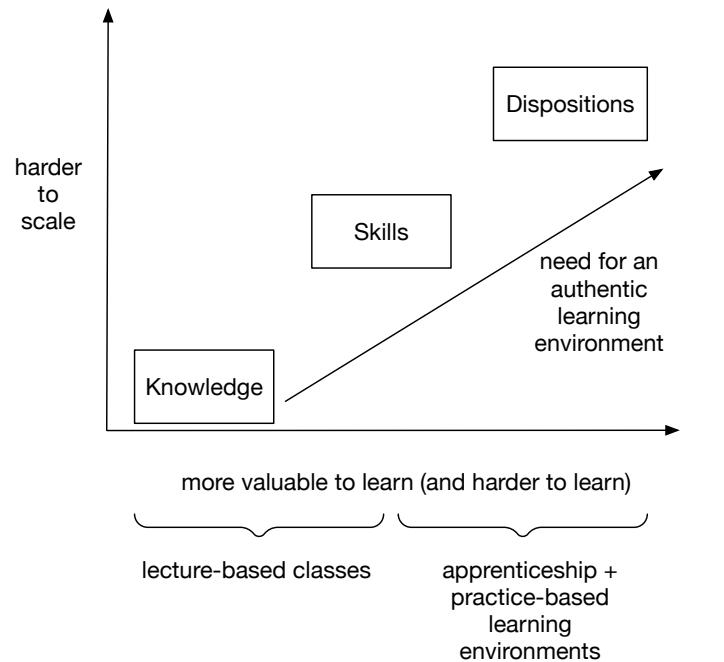


The core idea here is simply that we should make well-reasoned arguments about a curriculum that are aligned with how its design can help to reach the desired learning outcomes we have for students, by overcoming particular obstacles to reaching these learning outcomes that we may encounter. These learning outcomes in turn should be aligned to the desired job outcomes we have for our students, especially if and when our stated goal for making a curriculum change (such as with concentrations) is to improve job outcomes for our students. In other words, when designing a curriculum we should think like designers, thinking critically about each component of our model for reaching the desired outcomes, and their interactions.

Knowledge, Skills, Dispositions, and Scale

To understand the value of DTR, it is important to highlight the differences between the learning that happens in DTR and that can happen in a typical, lecture-based classroom. I drew this diagram to draw out this distinction:

This singular diagram explains much of what is hard about the learning that happens in DTR, and why it is so difficult to support it in a CS department. To have the skills needed to become a professional in a field, students need authentic learning environments that provide authentic practice for thinking in the modes of the discipline. The skills and dispositions needed are highly valuable, yet difficult to learn, particularly in lecture-based classrooms that can only focus on teaching knowledge and some foundational skills. What is needed are practice-based learning environments that are heavy on coaching, mentoring, and apprenticeship. But such learning environments do not scale well to many students, and can never scale as well as lecture-based classes can ("butts in seats").



In CS, the rapid increase in enrollment over the last 10 years have made it increasingly difficult for departments to offer (at scale) the kind of authentic learning environments needed to help students gain valuable skills and dispositions. Our reaction to the increased enrollment have been to scale up lecture-based classes to accommodate the increased demand. While this was necessary given the situation, these adjustments largely led to a broken curriculum that focuses primarily on the breadth of topical knowledge and skills over the learning of more complex skills and dispositions. As such changes became normalized, the culture and norms of pedagogy in CS departments also shifted towards emphasizing coverage across topical areas as the desired learning outcome, when such coverage cannot possibly imply deep expertise when students have little access to authentic learning environments such as DTR.

The distinction between the best learning environments and what scales well to many students is well understood in the learning sciences. Apprenticeship, or 1-on-1 mentoring, is a highly effective approach for learning complex practices. Having an effective teacher who knows you and your learning needs well, and who can attend to them, really helps with learning effectively. More simply, direct interactions and participation in learning matters: there is a reason that studio courses for art and design, and seminars and discussion-based classes in the humanities, have to remain small. But of course, this is difficult to do when you are a department such as CS, where the increase in the number of enrolled students significantly outpaces our ability to hire qualified faculty who can teach them.

Learning to self-direct complex work

In terms of learning outcomes (that are particularly relevant for good jobs and careers in design and computing), DTR helps students learn how to self-direct complex work.

Roughly, we can think about DTR as helping students develop skills and dispositions across three buckets: (1) cognition; (2) metacognition; and (3) emotional regulation and dispositions towards self and learning.

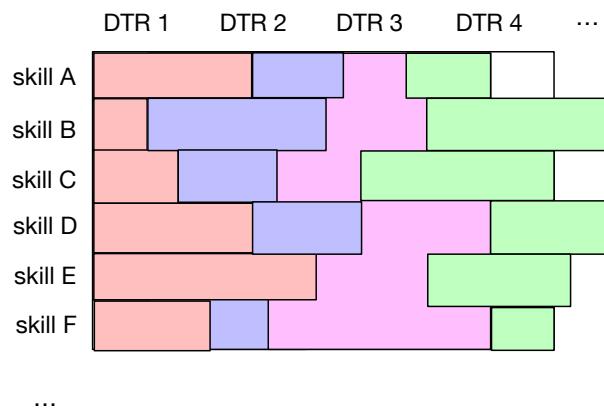
- (1) Cognition: DTR helps students develop a range of cognitive skills for approaching problems for which we don't know the answer, or even, what the problem is exactly. This includes: learning representations and structures for thinking (see "How we coach and teach design research," from the 2022 Annual Letter); risk assessment, critical thinking and argumentation; and core design and research methods and techniques.
- (2) Metacognition: DTR helps students develop metacognitive skill and dispositions, particularly in the areas of planning, help-seeking and collaboration, and reflection. This includes: forming feasible plans; agile techniques such as slicing and scoping; seeking and getting help; communicating and working with teammates, peers, and mentors; and awareness of one's own skills, abilities, and metacognitive blockers.
- (3) Emotional regulation and dispositions towards self and learning: DTR helps students learn about what affects their cognition and metacognition. Understanding one's fears and anxieties, and how one deals with failure, are critical for effectively self-directing work. As can embracing challenges and learning, looking inward, and embracing one's own independence, responsibility, and self-direction.

The learning environment for self-directing complex work

To help students develop the above skills and dispositions, DTR provides an integrated curriculum that teaches students important self-regulation skills, applied to research and design problems in the area of human-computer interaction. It is entirely practice-based, with significant coaching to help students build skills and dispositions across the various dimensions of learning to self-direct complex work that I highlighted above. Students learn across multiple offerings (quarters) of DTR, and in any given quarter, may gain skills across the various dimensions of learning:



And since DTR's instructions are tailored to each student's needs and development as they are learning, in reality each student's progression and learning focus will be different. So for any given student, their progression across skills and dispositions and quarters of DTR may look more like this:



Having this learning happen within a long-running learning environment and community is critical, as this makes it possible for students to grow over time under the guidance of a mentor and coach who gets to know them as they progress in their development and in their project. Having an integrated learning environment in which students practice a

variety of skills and dispositions on an actual research project is also critical, since isolating the teaching of these individual skills does not provide authentic practice nor imply that students will be able to integrate them into an effective practice. Having a community also helps, as students learn not only from me but from one another.

Said differently, DTR provides a community of practice in which students engage with authentic research projects as a means for them to develop significant skills and dispositions needed to self-direct complex work. The learning happens over time through an integrated curriculum that is tailored to each student. 4 quarters of DTR, effectively amounts to a year-long apprenticeship (only a quarter time, as students tend to take 4 classes at a time)—which is hardly excessive when you think about how long it takes for people to learn any complex skill, outside of the college setting. If anything it's too short.

A few points of reflection are in order:

- First, to have proper, critical discussion around pedagogy in university departments, it seems necessary to separate out discussions of scale, from discussions of pedagogy. This is not to say that scale isn't important, but to say that confounding problems of scale with pedagogy draws our focus away from thinking carefully about the learning outcomes that matter, whether we can reach them or not (at scale).
- Similarly, it is astounding to me how much a disconnect there is between what scales (and what is seen as normal in universities), and what effective learning looks like. When I proposed DTR as a concentration, that looked strange to faculty in my department. But when you think of DTR as an apprenticeship-based learning community, it couldn't be more natural. Separating learning into isolated classes and quarters may be an academic necessity, but it hardly represents what good learning should look like.
- There are real challenges to constructing authentic learning environments, when scale is a significant concern. This is a reasonable position for someone to take, as long as they acknowledge that many important skills and dispositions cannot be effectively learned in lecture-based classrooms. Said differently, there is a cost to scaling up, and unless CS departments (and universities) recognize that fact and try their best to preserve and advance authentic learning environments that do not scale as well, we will lose them. What will be left is a commodity learning experience that is easily replaceable.
- I myself (and DTR by implication) am part of this university machinery. If the answer is that the university machinery is mucky, well then, I am covered in mud myself. While I

intend to do what I can to support the CS department by advancing and sustaining authentic learning environments, I appreciate and understand how high enrollment puts significant pressures on a department to put butts in seats. There is no way around that. While DTR barely counts for my CS teaching load (I am joint between CS and Design; DTR is counting for the design side of my teaching)—I understand and appreciate how my colleagues in CS, having had to deal with scaling issues, may not have had the breathing room to focus on the pedagogical concerns that I have raised, nor see DTR in the endearing light in which I see it.

Junior Faculty Support Group

In last year's letter I highlighted how the long-term sustainability of having effective learning spaces such as DTR requires our caring for the wellbeing of dedicated faculty mentors who create such spaces. This realization led me to create a junior faculty support group, which I facilitated for the 2nd time this year.

There were 10 of us from 9 different institutions, and we met over five long sessions across 10 weeks (2 hours each), during which we shared and listened to our experiences on many facets of academic life. We also talked about our lives beyond our careers, and raised larger questions about how we wanted to be as academics, and as people. You can learn more about the support group at haoqizhang.com/group, where I also share what group members said about how they experienced it.

As was the case in the first offering, especially in the first couple of sessions, there is a tendency for faculty to want to use the group to share advice, and to be as helpful as possible in solving one another's problems. This isn't what I personally desire, but I generally try to keep from interfering with how the group members wish to use the group, even if I think there is often more value in hearing one another, and hearing ourselves, than in advice. Still, as the weeks went by, I could feel us listening more to one another, and to ourselves. Certainty and sure advice gave way to sharing not knowing and discomfort. In my eyes, the group became really, really, beautiful.

In one session, a junior faculty member shared a story about how despite the week going well professionally, he felt the need to call in sick and take a day for himself. He was unsure if this was okay to say (or have done!), but he courageously put it out there, as something significant in his own experience, even if he didn't quite understand it completely. After he spoke, spontaneously one and another member of the group jumped

in to “confess” their calling in sick themselves, when they too needed a day away from work. While the initial sharer had thought himself in some ways “dishonorable” in having done the deed, here he finds out that he is not the only one! That a bunch of us have done this, and recently! He finds that he isn’t the one that’s crazy—but instead that the job of being a faculty member is utterly insane. We deal with an impossible number of responsibilities, and have to justify taking a day for ourselves, when all we are doing is calling a timeout so we can take care of ourselves.

To me, this story comes closest to capturing what I value most about the support group that we have. It is a place where we can learn to be honest and kind to ourselves and to one another, as faculty. It’s a space where right or wrong give way to our feelings and experience. It’s a space where we learn to reconnect to ourselves, and with one another.

I am thrilled to be facilitating the group again this Fall. If you are a junior faculty, you are welcome to join us.

Perfection

I want to say a short word on perfection. When I wrote my philosophy paper this year, my aim was to have a paper that no one can critique for 50 years. Perfection.

My focus, then, turned to tightening every argument. And when I had done all I could do there, I looked for every grammar mistake, every typo. Perfection.

When I talked about my approach to refining the paper with my students, Ella Cutler, who had been in DTR for a few quarters, said: “Isn’t the point of papers to be able to have debates around an idea, and to hear different perspectives? Isn’t it boring if a paper is beyond debate?” I didn’t have an answer for her, as all I thought about was: perfection.

As Robin Williams says in Good Will Hunting: “You are not perfect, sport. And let me save you the suspense. That girl you’ve met, she isn’t perfect either.” Yet somehow, I wanted so badly to be perfect, to be fully accepted. There was little I wouldn’t do, to gain that level of acceptance.

It’s hard for me to talk about this, when so much of what I admire in myself and other people seems to be in our pursuit of perfection. There seems to be a real difference, though, in pursuing perfection, than saying that I am not acceptable unless I am perfect. That latter trap is what I see myself falling into. It’s not too late to let it go a little. Perfection has its place, as does letting it go.

I wonder how many of us see ourselves as unacceptable. How many of us are able to pursue perfection in our work, without the shadow of our lack of self-acceptance? When I show up for my students in DTR, I want to show up as myself: an imperfect human. I make mistakes in manuscripts. I say things that are hurtful to students. I do things that I later regret. This is me, and I am human.

I want my students to believe that what's more beautiful than perfection, is embracing the imperfection of being a human. The work of self-acceptance starts with me.

An Invitation

DTR's 10 Year Anniversary Celebration was something special, and it couldn't have happened without the extraordinary efforts of DTR students who led the alumni, outreach, and social events committees. They organized events and dinners, curated a DTR art exhibition (!), made iconic event posters, and reached out to alums and student groups. It was an extraordinary effort to plan an entire alumni weekend, *and* an entire week of public-facing events. Special thanks goes out to Grace Wang and Linh Ly for creating the DTR exhibition, Jackie He and Shirley Zhang for outreach, and Ella Cutler for connecting with alumni and organizing events. Please join me in offering them your thanks.

I share with you a few pictures from our festivities below. You can also read about the public events we hosted as part of the celebration here: mccormick.northwestern.edu/news/articles/2024/06/celebrating-10-years-of-dtrs-self-directed-learning-community/.

Of course, the very best part of the 10-year anniversary celebration is simply having an occasion to connect with DTR students and alums (over food, yes). Those who I saw during the celebration: please come visit us again before long. For those who I didn't see: come visit. We welcome you.

For those less familiar with DTR but would like to learn more, I invite you to watch the DTR documentary, available at <http://forward.movie>. 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.

Junior faculty interested in joining our support group this Fall can find more information at <http://haoqizhang.com/group>. Please apply to join soon; spots are limited.

I want to end with one small story. Near the end of the alumni dinner, which we enjoyed at my home in Logan Square, my former PhD student Ryan Louie came up to me to thank me for what I and DTR had provided for him. I remember him saying: "Thank you for having me." Without realizing it, I had responded: "Thank you. We had each other." We looked at one another, and knew in that moment that DTR provided a home for both of us. Come visit us, and see for yourself the human spirit and warmth that we embody.

Cheers,



Haoqi Zhang
Director and Founder, DTR
July 31st, 2024

