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Learning that Matters is Messy: Experiments Revealing Hidden Potential in Higher Education

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Abstract: *Why are some learning experiences so profound that they alter our worlds, whereas others don't end up sticking at all? The author investigates this question in the context of undergraduate education, recounting several educational experiments that highlight subtle but powerful aspects of the student learning experience. By exploring a different approach to teaching a math course, an alternative framework for academic specialization instead of traditional majors, and a radical approach to designing new institutions, an encounter with the hidden, ontological dimension of learning becomes possible. Accessing the ontological experience of the learner opens up new possibilities for meaningful, deep, and transformative learning experiences in higher education.*

Not All Learning Experiences Are Equal

Early in my career, I was confronted suddenly with the realization that I was a far less effective teacher than I had thought. This was initially not an easy realization to swallow. As a young professor of mathematics at the American University in Cairo, I had just won a school-wide teaching award. My classes were popular and had long waitlists, and students often shared with me that they liked my classes. Things became unraveled, however, in a chance conversation I had with a student named Omar. He was a successful student in my calculus course from the previous semester, having performed well and earned a good grade. When I asked him how his current math course was going, he lamented, "I don't remember anything from your course, Dr. Ryan. It's like it's gone from my brain."

I have never gotten over that comment. After that encounter with Omar, I spent months trying to figure out what the problem was. Omar had basically said he hadn't learned what I thought he had from my course. Why was this, when he had done well on the assignments and tests? How could he forget what I had explained so clearly in my award-winning class lectures? Was it just a problem with him?

It wasn't. After much investigation, I discovered that for many students, including those who had earned good grades in mathematics courses (mine and others), much of their learning was short-lived at best. It turns out that this problem isn't isolated; learning is, in fact, much more fragile and fleeting than we realize (Brown et al., ch. 1).

Why hadn't Omar learned what I wanted him to from my course, and what could I do instead to improve the learning of students like him? As I investigated these questions, I began to encounter an unseen but striking dimension of learning, that, if engaged with intentionally, opens up more effective, deeper, and more transformative learning experiences than typically experienced. Encountering this dimension has altered what I see possible in higher education, harboring tremendous untapped potential for learners. Accessing it, however, is difficult, as it lies hidden behind assumptions that are hard to see in the day-in, day-out practice of typical university teaching and learning.

This article explores how higher educational learning experiences can be significantly enriched by paying attention to subtle but powerful dynamics that affect student learning. While education research offers many theoretical frameworks for conceptually approaching questions of teaching and learning, theoretical frameworks alone do not necessarily facilitate the direct encounter with the student learning experience needed to bring forth this hidden dimension of learning. The approach we undertake in this article, therefore—and the approach that I have seen produce the most powerful insights into teaching and learning—is to engage practically in experiments that seek to reveal dynamics of the student learning process. To illustrate, in this article I recount three significant such pedagogical experiments from across my career. I present each of these experiments narratively, sharing insights gained, ties to broader scholarly discourse, and suggestions for adapting to different settings. These experiments help reveal the hidden, ontological dimension of learning, and suggest how educators might facilitate fundamentally more enriching learning experiences for students in higher education.

The Cartesian Paradigm of Learning

To begin our exploration into student learning in higher education, consider first that canonical image of traditional university teaching and learning: the lecture hall. In a university lecture, one typically finds a professor speaking at the front of a large room, with students busily taking notes in seats. What underlying beliefs about teaching and learning are conveyed by this picture? We observe: the activity is a unidirectional conversation flow, from the actively speaking professor to the passively listening students. The professor is the source of the knowledge, which is to be taken in by the students. The students demonstrate their learning by reciting this knowledge back on tests and assignments. At root, this scenario suggests an understanding of teaching and learning that is equivalent to "information transfer"—knowledge making its way from one head to another through speaking and listening. We designate this understanding of teaching and learning as *explanation.*

Explanation implies that learning is a mechanical process, like two computers connected by a cable through which data travels from one (the teacher) to the other (the student) and is subsequently printed out linearly, like a dot-matrix printer, on exams and papers. The view of teaching and learning as explanation underlies many standard educational practices. When a student asks a question, a teacher answers; when a student makes a mistake, the teacher corrects them; when a student doesn't know what to do, the teacher demonstrates. Indeed, explanation seems to be the obvious way to conduct teaching and learning. How else could it be?

While explanation has a role in teaching and learning, it misses something subtle but significant. The conflation of explanation with teaching and learning assumes that being human ultimately comes down to aligning one's perceptions and thoughts with objective knowledge. This tacit and "obvious" view is, at root, the worldview of *Cartesian subjectivity*. Embellishing Descartes' fundamental separation of subject from object, this worldview considers objective knowledge as universal and separate from the sight of the knower. Learning amounts to exposure to objective knowledge, and one's understanding is judged to be correct or not based on how rightly it aligns with the objective knowledge. In this worldview, knowing is the same as "being right," and mistakes amount to having not accessed objective knowledge sufficiently. Through the lens of Cartesian subjectivity, an effective teacher is one who explains objective knowledge correctly and completely so that learners can access it. The lecture hall is a naturally correlative setting for this activity, as are many other constructs in conventional educational institutions.

The Ontological Dimension of Learning

While Cartesian subjectivity's account of learning as "explanation-via information transfer" may seem obvious, this view is, in fact, incomplete. It misses a critical ingredient of the learning experience: what the learner tacitly brings to their learning. What a learner learns is not just dependent on the clarity of the explanation given, but on how the learner can make sense of that learning given the context they bring to the situation. Consider the fact that the planets orbit the sun in ellipses. What is the difference between someone who merely can recite this fact because they have heard it in a class, read it in a book, or written it down in a notebook, versus someone who has watched the erratic motion of the planets in the night sky traveling back and forth against a backdrop of stars over time, and is finally able to see a coherence between their observations and the elliptical model of planetary orbit? For which is the learning more significant, deeper, longer lasting? Who can explain the phenomenon themselves, versus merely repeat the fact as a cliché?

The worldview of Cartesian subjectivity neglects the decisive role played by the background context a learner brings to a situation. Martin Heidegger's critique of the Cartesian worldview is that it overlooks the phenomenon of the *world*—the set of tacit understandings and ready-to-hand entities already settled into an individual's background awareness of being in the world (*Being and Time* 122-134). How one's world is *disclosed* is decisive for what one is able to see and do; it forms a transparent "horizon of obviousness" readily and invisibly informing experience, easily overlooked as just "the way things are." For example, a professional athlete engaging in a sport will see possible actions and hazards on the sports field that others do not; what they see is not some objective list of properties (indeed, do we ever hear athletes recount their remarkable performances as the carrying out of a list of predetermined objective tasks?), but a way that they act instinctively and responsively. The world of the sports field is disclosed to them in a way that reveals a different horizon of obviousness than others can see.

A key observation of Heidegger's *Being and Time* is that there is no universal disclosure of the world. Rather, what exists—what forms what is "obvious"—is worked out uniquely over time as one encounters entities within the world that show themselves as part of their "totality of involvements" with the rest of the world. Following Heidegger, the mechanism for working out new understandings—i.e. learning—can be summarized as a *hermeneutic circle*: "Any interpretation which is to contribute understanding, must already have understood what is to be interpreted" (*Being and Time,* 194). In other words, what a learner is able to understand newly is deeply and only informed by what a learner *already understands* in a situation. What one is able to "see"—as in what is "transparent," what is "cleared" or already there, what is ultimately disclosed to one, not as concepts one theorizes about, but as ready-to-hand possibilities for action, what is "uncovered," or more aptly, "dis-covered," in one's everyday dealings with the world—is determinative of what a learner can learn. Put simply, the act of learning is not fundamentally contingent on explanation, but on *discovery*—the working out of new understandings for oneself. Discovery points to the decisive ontological dimension of learning, overlooked by Cartesian subjectivity.

What does this have to do with Omar's experience of learning calculus? Or with higher education more generally? The fact that a student's learning is dependent on the context they bring to what they are learning and not only on what a teacher explains to them, suggests that the work to be done in teaching is not (just) generating explanations, but pushing students deeper

into the quandaries that make such explanations necessary in the first place. In other words, pushing students to explore the edges of their own understandings makes the discovery of new understandings possible, à là Heidegger's hermeneutic circle.

What might this look like in practice? I offer three pedagogical experiments from my own career that provide some insight: designing a novel approach to calculus courses at the American University in Cairo; implementing an individualized inquiry-based alternative to majors at Quest University Canada; and undertaking shared faculty-student curriculum design in the launching of Fulbright University Vietnam. These experiments help shed light on the decisive role that the ontological dimension of learning-as-discovery plays in producing powerful and transformative learning experiences in higher education.

A First Experiment: Projects in Calculus

Accessing learning beyond Cartesian subjectivity requires paying attention to the learner's experience of what they are learning. My first such experiment in this direction was in remaking my calculus courses at the American University in Cairo following Omar's disturbing revelation. To craft an appropriate intervention, I considered what had been the most significant mathematical learning experiences of my own life. These had invariably been when I had engaged in my own research, working through complex problems without ready pathways to follow, having to forge my own way through. To provide my students with similar such experiences, I replaced the exams in my calculus courses with projects.

These projects were deep and embedded problems that required calculus to solve, however neither explicitly nor obviously. For example, I designed a project asking students to predict the location of a missing fictitious plane in the Sahara Desert based on an incomplete set of velocity data. Another project was about predicting the path of a boat being pulled to shore by parallel motion along the shore.[1] I gave some minimal information and stated the problem, but that was it—no recipe, and no hints.

I was surprised by how strongly students reacted to this new approach, many frustrated and angry. "Dr. Ryan, what is the formula I am supposed to use!?" several asked exasperatedly in my office hours. Used to copying the professor's solutions, I understood that this was largely a new experience of learning math for them. My gentle, Socratic response of "That is a great question, and just what you have to figure out for yourselves," did not seem to relieve their angst.

The periods that students worked on the projects reminded me of the emotional roller coasters of my own research experiences. They bemoaned the different ideas they had tried that hadn't worked out. They expressed discomfort in being confused. They got into heated discussions with each other over competing approaches. Then, slowly, I watched the frustrations begin to give way to insights, and the general mood shifted from anguish to curiosity, then to reverence, and ultimately to satisfaction.

The solutions the students created for the projects were varied, some clearer than others, some more comprehensive or more effectively explained. Nonetheless, just about everyone had a reasonable, basic approach. A few gave answers that exceeded the problem itself (and even my own ideas for solutions!). In conducting interviews with each student upon the submission of

[1] I was fortunate to benefit from and adapt many of the rich ideas from *Student Research Projects* by Cohen et al., an early publication on this front.

their solutions, I observed something striking: they knew their solutions—and the problem—inside and out. They could not only describe how their solution worked, they could tell me why it worked, how it fit the problem, how it overcame mistakes, how it could be improved. They talked about what made the problem hard, what formed its crux, and where it was easy to go astray. In other words, they weren't repeating something back to me that I had told them; they were describing something they had worked out for themselves. By arduously trailblazing their way through the problem, they achieved a new understanding of the world with the problem laid bare—as a serious researcher does.

In studying the impact of this approach with the University's Center for Learning and Teaching via follow-up interviews, I found that most students remembered the ideas from their projects to a surprising degree of detail, even years later. Almost all recounted what it felt like to go through their projects, describing the emotional experience: moments of frustration, then relief, then an ultimate sense of pride. I think their retelling of these journeys to peers was compelling—my project-based calculus courses generated more interest and longer waitlists than any I had offered previously at the American University in Cairo.

The results of this experiment in shifting from tests to projects suggested that students achieved better, longer-lasting understandings of calculus ideas through projects. Why? My conclusion was this: *the one who engages in the struggle is the one who does the learning*. This provides a clue as to how we might access untapped potential in college and university teaching.

First-Person Learning Experiences in the Mess

Polished lectures—the proud tradition of university teaching—can seem like compelling ways to learn, as they fulfill the Cartesian ideal of having ideas explained correctly by experts. However, such lectures surreptitiously pre-filter and remove the struggle that originally gave birth to the ideas in the first place. Studies in learning science support what I discovered in my conversation with Omar: the result of watching a clear presentation of ideas, despite its ostensible value, leads to limited learning at best (Brown et al., ch. 1; Carey, ch. 5). In contrast, going through the experience of working out ideas sourced from original problems via the pain-staking and bumbling process of self-generated research—including via trial and error, going down rabbit holes, getting confused and stuck, and persisting through the muddle—leads to better, longer-lasting understandings (Freeman et al.; Kolb).

Considering this comparison ontologically, the discovery-based approach facilitates something in the learner's experience not provided by Cartesian-based explanation: epiphanies. From the Greek root *phainen* meaning "to show," an epiphany is a sudden shift in sight resulting in a new understanding of a situation, the fruit of Heidegger's hermeneutic circle in action. A new understanding comes as one builds from one's previous understanding via the hard work of trial and error, careful and honest observation, attention to different results from different inputs, and, ultimately, insight into what were previously hidden dynamics at play in the situation. This discovery-based approach leaves a learner not only with a conclusion (new knowledge), but also with a new way of seeing the situation outright, from which the conclusion naturally "shows itself" from the problem. In other words, through epiphanies the learner comes away not just with a new statement of fact, but a new way of disclosing a world.

When talking about this distinction with students, I describe it as "learning in the mess." The metaphor of the mess captures the experience of confusion, struggle, and intellectual vertigo

that accompanies the working out of a genuine and new understanding for oneself. It is only by going "through the mess" that one sees how a solution emerges fully from the problem. In other words, the mess is the gateway to epiphanies.

The mess, however, is not an easy thing to tolerate—for either teacher or student. Learning in the mess is essentially a *first-person learning experience*, where the learner is the one responsible for the learning. In a first-person learning experience, the learner is at risk, vulnerable, reliant on their own insights and navigation to make their way through the inquiry. Such experiences are not uniform across learners; they may go all over the map in undertaking their learning (and they should), leaving the teacher in a different kind of role of supporting at the boundaries, rather than explaining the pathways.

First-person learning experiences mimic true research, where a scholar has to work their way through a conundrum en route to producing a new understanding. Teachers can best facilitate this kind of learning by supporting students throughout the entirely of the process: by steering them into problems and questions; by supporting them as they work through ideas with an appropriate balance of guidance, reassurance, correction, and caginess; helping them articulate their ultimate conclusions in alignment with the appropriate distinctions and terms of art of the subject matter; and then teeing them up for future learning by prompting further questions and directions of study. This can be done via discussions, assignments, in-class projects, research projects, or group activities. The point is to let the student engage in the full process of entering into a conundrum, working out a new understanding for themselves, and ultimately arriving at a self-won resolution—with proper guidance and alignment to the standards of the subject for which the teacher remains the authority.

Note that learning in the mess is more than "learning by doing," as students are not just engaging in activities but are also responsible for making their own decisions and observations, taking risks, and articulating their own explanations and solutions. Students still can access resources and the teacher's support, and the activity can even be tightly structured.[2] Learning in the mess does not avoid previous knowledge or expertise, but rather ensures that the student is the one struggling to put together the ultimate resolution to the conundrum they are authentically facing. The teacher's job is to get the student into the conundrum, then help them make their way through, stepping in and backing out at appropriate moments of (non-)intervention.

Learning in the mess is notably unpredictable and uncomfortable, and this is one of the reasons that the common pedagogical default is to the *third-person learning experience*—where the learner is not responsible for their own solution, but instead the copying of the solution from an authority (the teacher, expert, or explainer). Indeed, students need not ever find themselves in a conundrum in undertaking a third-person learning experience, as their role becomes reduced to a replicator of information rather than an inquirer into problems. The third-person learning experience is the peak expression of the dominant educational paradigm of Cartesian subjectivity, the commitment to explanation as the mechanism of teaching and learning.

Third-person learning experiences are alluring but potentially misleading in the value they provide. For example, in a study conducted by Deslauriers et al. with physics students at Harvard University, instructors taught the same physics concepts, with the same assessment of knowledge at the end, to two different groups of students—one in a traditional lecture format,

[2] A great example of a well-structured, discovery-based pedagogical approach used for STEM classes is "POGIL," Process Oriented Guided Inquiry Learning. See https://pogil.org/.

and one in a problem-based experimental approach where the students had to work out the ideas together in groups. The knowledge assessment at the end indicated that the latter group—the students using the discovery-based approach—understood the knowledge better. However, when surveyed, the students from the lecture group reported that they *felt* they had learned the material better, indicating a stronger preference for the lecture method. They even evaluated the lecture-based instructors as better teachers. This is exactly backwards from what the knowledge assessment showed.

This study points to a phenomenon called a "fluency illusion"—the experience a learner has of *feeling as though* they have learned something upon seeing a clear and cogent explanation from an expert, when probing in fact reveals their understanding is fleeting and limited (Brown et al.; Carey, ch. 5). Fluency illusions falsely lead a learner to equate actual learning with a feeling of comfort upon receiving and reciting a clear explanation from an authority. Effective learning surprisingly requires the opposite of this feeling of comfort: although it might not feel like one is learning, research shows that the experience of struggle, stuckness, and frustration that accompanies earnest cognitive effort leads to better understanding and long-term retention (Brown et al., ch. 4).

This reveals the most pernicious feature of the Cartesian conflation of teaching and learning with explanation: it leads a learner to overestimate their learning without realizing anything is amiss, resulting in unseen blind spots. This indicates why my teaching award and Omar's complaint about not remembering anything from my calculus course go hand-in-hand: hearing my explanations felt like learning when, in fact, it wasn't. While, as human beings, we favor the feeling of clarity that accompanies a clear explanation, it likely leaves us with little more than a cliché, little more than the same disclosure of the world we started with. Engaging the ontological dimension of learning—the uncomfortable process of working out a new understanding and way of disclosing the world from hard-won epiphanies, first-person and in the mess—is the invisible ingredient essential to deeper and more effective learning.

Having gained a clue as to how the ontological dimension of learning-as-discovery can affect courses like calculus, a next question arises: how we might expand on learning in the mess from the level of courses to the level of the curriculum as a whole? This is the question at the heart of my next educational experiment, the replacement of majors with first-person generated inquiries at Quest University Canada.

A Second Experiment: Inquiry Through Questions

Dear reader, if you had to state a question of fundamental importance to you, a question around which to base your most important inquiries in life, what would your question be? Some examples I have heard: How do people make good decisions? What is the best life? How do we build a thriving society? How can one develop resilience in one's family? Go ahead, indulge me. It will make the reading of this section more meaningful. What would be your fundamental question?

I am always struck by the difficulty of this task. On the one hand, it seems like what we are most interested in, what we most care about, should be obvious. And yet, it is often buried so invisibly in the texture of our experience as to be difficult to discern. Certainly we notice it when we *feel* it. Consider when someone states a political position we disagree with, does something we don't approve of, or prevents us from doing something we think is important. The resulting

feelings show *that* we care about something. Just *what* it is we most care about *at root*, however, can often be surprisingly difficult to distinguish.

When it comes to learning, how frequently does a learner embed their learning in a deeper inquiry of fundamental importance? It is sadly quite easy for this to be missing, particularly in formal school environments where curricula are built on "educational requirements." In such systems, learning all too easily becomes reduced to marching through a sequence of sterilized content—courses, general education requirements, majors—as though the reasons for going through that content in that particular way are obvious and beyond question, covering over the original inquiries that made the discovery of such content necessary in the first place. Heidegger calls this kind of experience—the caught-up participation in tacit and inherited constructs of human activity without clarification or reflection—the trap of the inauthentic "they-self" (*Being and Time* 163-168). In such situations understandings are shallow and "fallen," consisting "in a mode of groundless floating" (221).

By reducing education to a process of sequenced hoop-jumping, what is lost is the world-altering power of *inquiry*. Inquiry is not just taking in knowledge, but the entire process of working out a new understanding and way of disclosing the world. As we saw when discussing first-person learning experiences, the process of inquiry begins with an authentic conundrum, when one is confronted with a revealed limitation in one's understanding, e.g. a conflict, breakdown, question, puzzle or problem. The learner then launches into "the mess," where they painstakingly work out a resolution through direct engagement with the situation, bringing in whatever knowledge, methods, and skills to which they have access. Through the slow accumulation of insights, ultimately (although it is not necessarily guaranteed to happen) the learner emerges from an inquiry with a resolution that coalesces into a new understanding of the problem itself. This process of direct discovery highlights the ontological dimension of learning, as the learner works out new ways of disclosing a world built from their own understanding. The question then emerges as to how formal educational systems might incorporate inquiry, beyond just requirement-fulfilling, as an anchor of the student educational experience.

One such experiment in this direction was developed at Quest University Canada. From 2007-2023, Quest provided a new approach to a liberal arts-based undergraduate education.[3] The university featured small classes, no academic departments, courses taught one-at-a-time in a "block plan" format, and a completely circular academic building with no linear hallways or dead-ends. Courses were largely interdisciplinary and inquiry-based, with faculty and students going by first names. Additionally, Quest had no majors. Instead, students articulated an *individual question* they used to shape their studies in their upper years, under the guidance of a faculty supervisor. Questions were meant to be broad, compelling, and significant. Some examples include: "What is the science behind choice?" "What is social inclusion?" and "What are the limits of communication?"

The question component of Quest's curriculum was what most drew me to the university, where I joined the faculty in 2009 shortly after its launch. I supervised several students over the years as they developed and carried out work on their questions, many of them venturing outside of my home discipline of mathematics. The statement of the question itself is only a part of the

[3] Quest sadly closed in the spring of 2023, due to financial difficulties. As discussed in Warren, those challenges were reflective of unfortunate business practices and arrangements, not directly related to the unique academic model discussed here.

student's intellectual project. They also had to propose a substantive course plan, a set of focal readings, an academic background and justification, and proposals for experiential learning and thesis project work in an overall "question plan" for approval by a faculty committee.

Questions can result in students carrying out interesting work, particularly in the form of self-generated projects. For example, a student whose question was "What is the role of collaboration in developing effective institutions?" designed, with faculty support, her own research study to survey farmers at a local farmers' market to determine how they shared resources. She was curious about how farmers could contribute to each other and to their communities. Another student studying the question "How do limits foster creativity?" developed a proposal for a landscaping business that he started the next summer, and even built a pond on campus for his senior project. The projects were not stipulated degree requirements, but grew naturally out of the larger inquiries of the students' questions. In their cases, the inquiries have even grown into successful professions: as a municipal counselor and consultant, and an owner of a successful landscaping business, respectively.

Professional Specialization Through Inquiry

The formal approach of Quest's question plan is not the only way a learner can connect to a sense of intrinsic motivation and natural inquiry. However, an advantage of questions compared with traditional majors is that they force students to engage in an entire process of inquiry themselves. Questions force students to interrogate personal interests and values in choosing a direction of specialization, beyond what it can take to "select" a major. Moreover, as a colleague and I have argued, questions seem to facilitate student maturation better than traditional majors (Wonham and Derby-Talbot). At a minimum, aspects of the question process can potentially enhance more traditional approaches of university specialization, including, as Wonham and I suggest, in scientific research projects or capstone experiences.

In considering the ontological dimension of learning—of how a learner's world is enriched and deepened through the accumulation of insights gained through direct experience—questions suggest that university learning not embedded in full processes of inquiry may be diminished and incomplete. The traditional construct of a major risks leaving a student with nothing more than a third-person learning experience, the exposure to the knowledge of a subject spoon fed by experts—the fundamental approach of Cartesian subjectivity. As we argued in the previous section, this approach can result in diminished learning when compared to first-person learning experiences in the mess.

Questions, on the other hand, require engaging in the full process of inquiry. They acknowledge that inquiry begins with a conundrum, asking students to give an explicit articulation of their proposed problem of study. They compel the student to engage in direct contemplation of this conundrum, through courses, readings, conversations and projects, evolving the conundrum as it is explored—as in true research. And they let the student arrive at self-won understandings and conclusions inside of inquiries that are not already predetermined for them in advance. The result is that questions push students to develop new understandings from their own experience. Following Heidegger's hermeneutic circle, this results not only in new information (the acquisition of new knowledge) but in transformation (new ways of disclosing the world). Questions thus suggest the importance of requiring students to enter into a full process of inquiry in their undergraduate education.

One objection to deviating from the approach of traditional majors is the concern that it does not leave students technically prepared for work in a profession. While this might be true in certain cases, there is evidence to suggest that, paradoxically, the approach of questions may better prepare students in the long term for mastery of technical knowledge when compared with traditional majors. Donald Schön's influential book *The Reflective Practitioner* directly makes the case that inquiry facilitated through discovery leads to better professional preparation than simply exposure to technical knowledge. In his book, Schön explored the question of why some professionals are more effective than others, despite having similar technical backgrounds. For example, what makes some doctors more effective at diagnosis than others, despite graduating from the same medical school with similar grade point averages? Schön finds that more effective (and, interestingly, happier) professionals tend to exhibit a similar approach to their work, what he calls "reflection-in-action." Through reflection-in-action, practitioners treat their work as an on-going process of inquiry, each new situation a new conundrum, worthy of investigating in its own right, ultimately developing an ever deepening repertoire of knowledge and understanding in one's professional field. This contrasts with an approach that treats situations as merely input for routine applications of technical solutions (e.g. a doctor prescribing a drug solely on the basis of a description of symptoms matching a textbook diagnosis). Reflective practitioners demonstrate deep familiarity with and commitment to the process of inquiry, with each new professional situation a new opportunity for learning and further mastery.

What lessons might this have for undergraduate education? An example from my experience at Quest suggests how a question-based approach can result in the kind of professional development highlighted by Schön. Several years ago, a Quest student whose question "What are the physical and chemical processes that cause pollutants to move through the environment?" led him to create, for his senior thesis project, a model of pollutants from runoff water into the New York City water supply reservoir system. The idea was his own, and he made the model himself, learning how to program in the process. The model provided insight into the cleanliness of the water system after storms, led to a conference presentation and publication co-written with his faculty supervisor (Nguyen and Wildman), and purportedly influenced the New York City water authority's approach to water management. It also led the student to being hired right out of university at an environmental engineering firm *having never taken a single engineering course.* The student demonstrated, through his question work, he could engineer (a verb); not just that he had followed the prescribed major required of an engineer (a noun).

This example suggests the intrinsic and professional value possible from requiring students to undertake full processes of inquiry, beyond merely passing content-based milestones in their undergraduate education. We acknowledge that it is much harder (and takes significantly longer) to assess student development as inquirers, versus testing their retention of content in exams. Nonetheless, as Schön argues, the benefits of developing oneself through inquiry can outshine what is possible through content acquisition alone. Whether through an explicit question plan, or through a different process of specialization that may or may not adapt traditional approaches such as majors, there is benefit to be had in prioritizing the ontological dimension of learning in the larger curricular structure of higher education.

We have seen how the process of inquiry—stepping into a conundrum, earning hard won insights through the discomfort of direct observation in the mess, and ultimately articulating self-won resolutions—harbors the potential for deeper, more meaningful learning on the levels of

both courses and curricula. What if we now go "meta" with this idea, and inquire into inquiry itself—asking what makes for an effective inquiry-based education. This is precisely the context for my third experiment in undergraduate education, the shared faculty-student co-design of a new university.

A Third Experiment: Co-Designing Fulbright University Vietnam

In late 2017, I joined Fulbright University Vietnam as the founding chief academic officer. As part of its mandate as a new startup university, Fulbright declared it would feature an innovative approach to undergraduate education, based on the American tradition of the liberal arts, offered in English but tailored specifically to Vietnamese students, and built on new ideas and discoveries about the science of learning. How to go about starting such an ambitious undertaking?

Our answer was to undertake a large, shared inquiry: what we called Fulbright's "co-design year." Fifty students were pre-admitted to the university in the year prior to the launch of its undergraduate program, to work with the founding faculty in building the program together using methods of design thinking. This idea was inspired and supported by Olin College of Engineering, who pioneered the approach in its "partner year" prior to its launch in 2002. The purpose of the co-design year was to produce, with genuine student partnership, a model of undergraduate education with innovative features and adapted to Vietnamese students. More importantly, the co-design year was meant to foster a culture of buy-in and ownership across faculty and students, founded in continuous improvement of the university (Derby-Talbot and Ellis, "Institutional Development via Co-Design").

In its modern guise, the word "innovation" typically means the implementation of new technology. Often, however, what this produces is merely a faster, larger or more convenient version of what is already done. A deeper understanding of innovation, however, means producing fundamentally new ways of disclosing the world. This requires not just coming up with new ideas, but reflecting on the basic purposes of and assumptions lurking within our activities in the first place. A co-design year, if directed towards this deeper sense of reflective contemplation, holds great potential in developing new learning experiences for students.

In Fulbright's case, the co-design year was set up for students and faculty to engage together in a collective inquiry about the purposes, structures, and opportunities of higher education, practically through design-based experiments. The year was not organized into courses and semesters, but instead into "design modules," where teams of students and faculty created new, interdisciplinary courses, tested various approaches to teaching and learning, and built features of the undergraduate program together. (Talk about learning in the mess!) To prepare, the faculty and students started the year with a collective experience called the "Learning to Co-Learn" module, where they read articles on learning science together, faculty members taught lessons to students and fellow teachers and then "pulled back the curtain" to discuss the pedagogical choices they had made in teaching the activity, and students ultimately designed a learning experience for the faculty members in a role reversal at the end of the module. The purpose of the Learning to Co-Learn module was to open up the undergraduate learning experience for inquiry, giving everyone a shared vocabulary and set of experiences for doing so.

For the rest of the year, teams of faculty and students engaged in a variety of pedagogical experiments. For example, the instructors of a proposed core course on "Scientific Inquiry" chose not to emphasize a particular scientific subject for the course, but instead made the scientific process itself the central organizing principle. To see how far they could take this, they asked students in the design module to come up with their own scientific experiments on things about which they were genuinely curious in their daily lives, and to create a robust scientific investigation complete with a hypothesis, summary of background literature, experiment, summary of results, and conference-style poster presentation.

In another design module, the faculty members developing a course on writing and composition decided to throw out initial ideas for the course outline. Instead of having students add to the faculty members' ideas, they asked the students to design the course themselves, newly from the ground up. The students reported that they were initially uncomfortable and overwhelmed with the situation, however they then expressed pride in putting together a new course outline for a rhetoric course based on their own research and with the support of the faculty. Notably, they articulated their journey in the co-design of this course as a "wild ride," but a major source of growth (Chan and Stacey).

At first pass, a co-design year might seem like a crazy idea. Why give students who haven't yet been through a university experience the chance to have a role in the design of a new university? Why wouldn't we just let the faculty—the content experts—put together the curriculum? Answers will differ depending on whether one views the question through Cartesian subjectivity or ontological inquiry.

Calculative Versus Meditative Thinking

The work of the co-design year calls to mind another of Heidegger's distinctions, the difference between *calculative* and *meditative thinking* (Heidegger, *Discourse on Thinking*, 46). Calculative thinking is about adding more to what is already understood as the way things are done—an extension of knowledge but not a shift in worldview. Meditative thinking, on the other hand, is about attempting to see into the hidden assumptions and beliefs upon which the already-adopted practices and understandings are founded in the first place. Through the lens of Cartesian subjectivity, thinking *is* calculative thinking, as the goal in Cartesian subjectivity is the alignment of one's thoughts with objective knowledge independent of the thinker, an extension of what one already "knows" as correct and right. Alternatively, accessing the world that already and tacitly shapes one's thoughts and forms one's adopted "right" positions, requires meditative thinking. When it comes to learning, meditative thinking helps reveal the world of the learner, the ontological dimension of learning that is key for discovery and the working out of new understandings and disclosures of the world.

Applied to the project of curriculum development, calculative and meditative thinking result in different approaches. On the one hand, "curriculum-building" understood calculatively aims to develop a curriculum created from other already-established curricula, "innovating" by incorporating the latest knowledge, practice, or technology as an additional layer to what has already been established. In other words, the calculative goal is to put together already-understood approaches in new ways. A meditative approach, on the other hand, frames curriculum development as an inquiry, building from what is already known but subjecting it intentionally to reflection, particularly into fundamental questions of purpose. Thus it follows the

path of inquiry: starting with a conundrum (e.g. What is an effective way to educate students for today's world?), entertaining a shared "mess" of collaborative exploration and contemplation, and ultimately arriving at a new model responding to the initial conundrum. This model itself may incorporate elements from other models, but only ones that feel appropriate to the insights from the inquiry. Moreover, the new model will likely become the source of a further inquiry, as inquiry never stops but builds in a growing spiral of understanding (the repetition of the hermeneutic circle). A co-design year shows what a process of meditative inquiry can look like when taken to the level of design for a new university.

The resulting innovations of Fulbright's co-design year included new features, such as a new course in active design in a maker space, interdisciplinary assignments exploring different regions of Ho Chi Minh City, and an economics course taking on real problems with real data from Vietnam. But it also produced something more profound: a culture of inquiry into education itself. Students and faculty came out of the co-design year able to contemplate questions of education together more deeply, and able to generate new ideas beyond what they already generated. This shared culture of inquiry stood out as the profound achievement of the co-design year (Derby-Talbot and Ellis, "Faculty Growth via Co-Design").

There is, however, a hard lesson we learned through the co-design year. Heidegger's hermeneutic circle implies that new understandings can only be understood by those who have developed eyes, so to speak, to see those new understandings. If one cannot access a new understanding worked out by another, they might not only miss out on the other's new perspective, they might not even realize they are missing anything in the first place. In the case of Fulbright's co-design year, the faculty and students participating in the year certainly developed eyes to see the new educational possibilities opening up from their work. But Fulbright was a highly public undertaking, and for those on the outside of that process, including sponsors, supporters, board members, and even members of the university community not directly involved in the co-design year, their responses to developments from the co-design year were increasingly to compare them with other institutions, particularly those with strong reputations and rankings, ultimately favoring those conventional approaches as more revered and less risky. In the end, as more people were brought into Fulbright's broader circle of decision-making, enthusiasm for the co-design year—from those not directly participating in it—waned. The result was the eventual return to a more conventional academic program. Indeed, this is reflective of the larger trend of higher educational institutions to seek organizational convergence rather than divergence, driven particularly by their prioritization of institutional prestige over other factors (Pak).[4]

I have spent considerable time since Fulbright's co-design year thinking about how to support meaningful and lasting programs of educational improvement that are built through the transformative potential of meditative thinking. The challenge is that meditative thinking is harder to undertake, tolerate, and measure than calculative thinking. Indeed, I am reminded of Thomas Kuhn's observation that scientific progress is wound up in implicit paradigmatic understandings that are rarely glimpsed and only transcended when pushed into conflict through new observations that significantly challenge those accepted understandings. Otherwise, things proceed as "normal science" (Kuhn 5-6). The current paradigm of "normal higher education"

[4] Pak's article, "Competition and Reform in Higher Education," discusses exactly this trend with respect to new universities being opened in Asia.

prioritizes certain forms of content organization and academic specialization, particular constructs of learning delivery, and specific standards of evaluation and approaches to change. Challenging this paradigm is not easy.[5] Moreover, much of the current paradigm reflects understandings steeped in Cartesian subjectivity. The concern is that this is not what is best for student learning.

The co-design year, however, also provides a clue about how to improve student learning in higher education. The most important feature of the co-design year is that it made legitimate space for educational experimentation. The root of the word "experiment"—*ex-* meaning "out of," and *peri-* meaning "to try or risk," as in the word "peril"—suggests that taking risks is critical to discovering new approaches. Indeed, this is perhaps the root observation at the heart of the ontological dimension of learning: new understandings come—and only come—from taking risks. *The one who engages in the struggle is the one who does the learning.* This is true for educators attempting to understand education just as it is for students attempting to learn new subjects. If we want to enhance learning in universities, we need to find ways to open up spaces for risk-taking, for both students and teachers.

While few will likely have the chance to join a brand new university in its initial stage of development, I have encountered many pockets of educators trying out new approaches to teaching and learning across a broad range of institutions. So long as educators have some space for risk-taking, they have the possibility of undertaking a meditative process of exploration into student learning. Even in more limited capacities—including down to individual assignments and classes—new insights and approaches become possible. Small experiments can produce significant insights, just as my project-based calculus course did for me. The point is that inquiry into learning, whether in a classroom or through a co-design year, can help reveal untapped potential for higher education.

The Future of Teaching and Learning

Several years ago, a colleague and I were engaged in a conversation about how we could improve our teaching. As we talked, we realized that, despite our different academic backgrounds (he is a philosopher, I am a mathematician), we shared a common limitation. When learning to teach in graduate school, both of us ended up thinking that what is most important in teaching is the presentation of correct information. In our minds, it was as if there were an imaginary committee of disciplinary experts in the back of the classroom, listening carefully to our statements and ready to pounce on anything we said that was wrong. We realized that our tacit commitment in the classroom had been to this imaginary committee, rather than to the learning process of the students. (Manifesting, for example, in insisting in particular terms of art in our classrooms that students would have no way of understanding the importance of themselves.) We had, in other words, been viewing our roles as teachers through the lens of Cartesian subjectivity, rather than ontological inquiry. As we investigated, we discovered that, as had happened with Omar, student learning had been suffering as a result.

Our discussion in this essay of the ontological dimension of learning in higher education has not been to reject Cartesian subjectivity outright, but rather to reveal the limitations it imposes on learning when given exclusive dominion over our thinking as scholars and teachers.

[5] For further discussion about challenges to innovation in higher education, see (Coburn and Derby-Talbot).

There is tremendous value in expertise. Indeed, I cherish the rich and deep knowledge of my own academic discipline. However, we impoverish teaching and learning when we assume the road to mastery is explanation. It is not. The ontological dimension of learning—how learners work out new understandings by discovering and disclosing their worlds newly—is the hidden gateway to discovery, deep and authentic learning, and new possibilities in higher education.

Ontological inquiry goes on as a process without end. The three experiments I have presented here are but a few examples of how the ontological dimension of learning can be explored at various scales. The arenas for experimentation are vast. Currently, as the Dean at Deep Springs College in California, I am in an entirely different arena for educational experimentation, where students not only take classes but work on the college's cattle ranch and engage in self-governance (sharing observations from this approach is a subject for future work). Environments like these, that put students into places of struggle to facilitate their learning, help reveal the hidden potential of the ontological dimension of learning in higher education. By bringing our commitment as educators not to the reinforcement of predetermined content but to awareness of the subtle process of the learner, we can better help students achieve authentic, deep and transformative learning—learning that really matters.

Much hangs in the balance. Our "information age" is knowledge-rich but wisdom-poor; our technological expansions magnify complex problems just as they solve simple ones; and our public discourse lacks the curiosity and reflection of genuine inquiry. Conversations about the future of education often focus on the external issues of technology and access, while neglecting the internal experience of learners. We won't be able to meet the demands of our challenges if we don't transcend the positional focus of Cartesian subjectivity, and embrace the discovery, epiphanies, and transformative possibilities available from the ontological dimension of learning. Indeed, not all learning experiences are equal.

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