Journal of
Virtual Worlds Research
jvwr.net ISSN: 1941-8477

Pedagogy
Taking Stock and Looking Forward

January 2019 (Part 2)
Volume 12 No. 1

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Volume 12, Number 1
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January 2019

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Journal of Virtual Worlds Research
jvwr.net ISSN: 1941-8477

Volume 12, Number 1
Pedagogy – Taking Stock and Looking Forward (Part 2)
January 2019

Pedagogy of Productive Failure: Navigating the Challenges of Integrating VR into the Classroom

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Abstract

The surge of popular interest in virtual reality (VR), largely driven by recent advances making the hardware and software for VR development and use accessible to average consumers, is showing all the signs of a durable trend. One of those signs is active uptake in the academy, both for research (where it was pioneered) and in the classroom (where its footing is less certain). To be sure, VR offers exciting and relatively underdeveloped pedagogical terrain for teachers looking to enhance their curricula by deploying technologies that might optimize the learning process. This article offers a critical reflection on one such effort, specifically, our academic team's grant-funded digital humanities research project called Focused Associational Thinking-Virtual Reality (FAT-VR). The main premise of the project was to create a virtual reality environment where students could cultivate creative fluency in divergent thinking. Such competencies are thought to afford students with a means of "thinking things together" in the service of transdisciplinary inquiry and problem solving. This essay recounts how, as we attempted to "move forward" by harnessing VR, we often found ourselves going "backward" and "in circles" due to technological glitches and challenging student feedback. Putting our digital pedagogy project in conversation with phenomenological philosophy and critical theory, we offer a provocation on how forward motion can sometimes set us back pedagogically, and how disorienting experiences—even failure—can become productive.

1. Introduction

When Oculus VR announced its Kickstarter campaign for the company's Rift virtual reality headset in the third quarter of 2012, an unabated surge of interest in consumer grade VR technologies ensued. Such hardware/software combinations present exciting but underdeveloped world-building opportunities, especially for educators looking to leverage the captivating power of virtual reality for the screen-oriented curricula now necessitated by the learning styles of today's students. This article offers a critical reflection on our team's investigation of one such effort: Focused Associational Thinking-Virtual Reality (FAT-VR). The purpose of the project was to create a VR environment in which students could cultivate creative fluency in "divergent thinking" (Hussain, 1988)—a kind of directed brainstorming—by practicing associational thinking and back-formative explanation. Such competencies are thought to afford students a means of "thinking things together," and we were particularly interested to see if a VR environment could help students to develop these competencies in order to perform more agile and transdisciplinary inquiry, translation, and problem solving (McCrae, 1987; Steraberg, 1985).

As we attempted to harness the innovative potential of VR pedagogy, however, we often found ourselves going "backward" and "in circles"—descriptors we problematize below—as technological glitches and student feedback took us in unexpected and sometimes disorienting directions (Berlant, 2011). Putting this digital pedagogy project in conversation with phenomenological philosophy and critical theory, we ultimately embrace notions of failure, stupidity, and disappointment as provocations on how educational processes often actually *require* setbacks—sometimes unbeknownst to learners and teachers alike—and on how disorienting experiences can prove to be surprisingly productive (Ahmed, 2006; Halberstam, 2011; Stolley, 2016). Following Halberstam, we specifically describe how we came to embrace (some of) our moments of failure, seeing them as participating in a mode of undisciplined learning wherein veering away from structured instructional paths offered a compelling alternative to rigid "models of success" (2011). In turn, these moments opened for our students and us a more creative, cooperative, and counterintuitive way of thinking, doing, and learning, just as Halberstam discusses (2011). Readers of this article may find similar advantages in their own VR projects, especially if they make use of our hindsight and materials. This article aims to serve as a critical signpost to a set of pedagogical issues related to virtual, augmented, and hybrid reality experiences that are increasingly emergent and problematical for educators at all levels.

2. FAT-VR: Generating Creative Fluency in Virtual Space

Our initial research project was catalyzed by the following question: How might virtual reality environments facilitate rhetorical invention, particularly the creative fluency that is central to transdisciplinary problem-solving?

The mutually constitutive relationship between space and processes of the rhetorical invention is well-documented in rhetoric and composition studies, the transdisciplinary context from which we launched this digital humanities project (Mutnick, 2007). Indeed, the spatiality of invention can be observed in Aristotelian rhetoric, wherein the rhetorical canon of *inventio*—the "discovery of arguments"— is constructed around available *topoi*, a term commonly understood to mean "argumentative links," but that literally translates as "places" (Conley, 1990; Aristotle, 2004). As rhetoricians, we explored cognitive space in order to successfully navigate the invention process and "locate" a workable argument (see box[1]).

This insight has been adopted and extended by new media composition scholars (e.g., Wysocki, 2002; Brooke, 2009), who have written at length about the ways that digital platforms such as Web 2.0 and social media encourage networked and linear composing practices. However, the impact of virtual reality environments on composing processes—and the invention stage more specifically—remains understudied. By tapping into VR, we hoped to create an alternate space beyond—yet accessible from within—the university classroom, where participants could think, imagine, and write differently than is ordinarily encouraged in college courses.

[1] The connection between invention, memory, and space is perhaps nowhere better illustrated than in the rhetorical techniques generally known as ars memoria. From as early as the 80s BCE (e.g., Rhetorica ad Herennium), western rhetoricians have been designing memory palaces, theaters, and other spatialized tools for recollection and association. Many of these techniques, which today go by the name "methods of loci," remain in use, especially by the world's top memorizers.

Our team was particularly interested in the role that VR environments could play in facilitating creative and innovative thinking across disciplinary boundaries—a mode of creative fluency that we termed Focused Associational Thinking (FAT). FAT is a type of "divergent thinking" (Hussain, 1988) that has long been associated with *ideational*, *expressional*, and *associational* fluencies (Christensen & Guilford, 1957a; 1957b). These fluencies will be further exemplified in the FAT case studies outlined in the "From Experimentation and Exhibition" section of this article. In particular, FAT is an active combination of these three cognitive fluencies, and together they enable a state of mind in which the multiplicity of interconnections associated with a given challenge can be imagined and explored regardless of technological, disciplinary, or theoretical precedent. In effect, FAT is the ability to comprehend and imagine a solution to a given problem in numerous ways. This is accomplished by connecting the fundamental elements of the problem (physical and conceptual) to a pool of perceived available resources. Studies by McCrae (1987), Steraberg (1985), and others suggest that Focused Associational Thinking may be among the most important cognitive factors in problem-solving domains where disciplinary practices (e.g., research methods and taxonomies), cultural determinants (e.g., language and education), and personality (e.g., introversion and generosity) diverge within a cohort or team. In other words, FAT may be a mode of creative thinking that is crucial for transdisciplinary and team-based projects. As North American universities increasingly create space for inter- and transdisciplinary scholarship through digital humanities and STEAM (science, technology, engineering, art, and mathematics) initiatives, we believe it is important to consider how the composing practices we introduce in our classrooms can better enable students to develop the creative fluency these projects necessitate. Surprisingly, while research in writing across the curriculum programs (WAC) has documented the increased necessity of teaching composing practices across disciplines (Russell, 2002), less attention has been paid to the invention and composing practices that are necessitated by the growing trend of transdisciplinary collaboration.

2.1. The Project

Over the course of about eighteen months, our project team (Figure 1) set out to develop a collection of tools and curricula around FAT to be deployed in courses in which success was expected to correlate with a student's ability to readily engage in purposive transdisciplinary problem-solving (see box 2).

These courses consisted of four undergraduate writing courses including one lower division and three upper division courses. While the implementation of FAT varied across the courses depending on the theme and subject matter, the basic premise remained the same: to facilitate FAT through virtual reality brainstorming activities in which participants were encouraged to generate connections between seemingly random and unrelated objects. The goal was to encourage as many different *connections* as possible among as many *objects* as possible—even when the connections initially seemed irrational, ill-fitting, or absurd. By encouraging participants not to self-censor in search of a single "right," "best," or "smartest" connection, we hoped to destabilize rigid and unidirectional forms of thinking.

Figure 1: Project team meeting (PC: Arizpe Ellinwood)

Our project team, comprised of four graduate students and two faculty members, set out to build a virtual reality environment where participants could immerse themselves in the aforementioned exercises. We ultimately decided to create a virtual storehouse—akin to an antique apothecary's shop filled with dozens of drawers, shelves, and jars—displaying an eclectic array of objects. Visitors in the virtual space could choose several objects, then transport them into another virtual room to reflect upon them and begin generating connections. Figures 2 and 3 show an early, unpopulated version of the storehouse; the double image is due to the stereoscopic display needed for the Oculus Rift and cardboard viewing devices we used as our testbed.

[2] We differentiate "interdisciplinarity" from "transdisciplinarity" in that the former requires people in different disciplines to contribute their expertise to a collaborative project, while the latter entails the uptake of these contributions by others, that is, everyone begins (or continues) to actually learn their collaborators' disciplines.

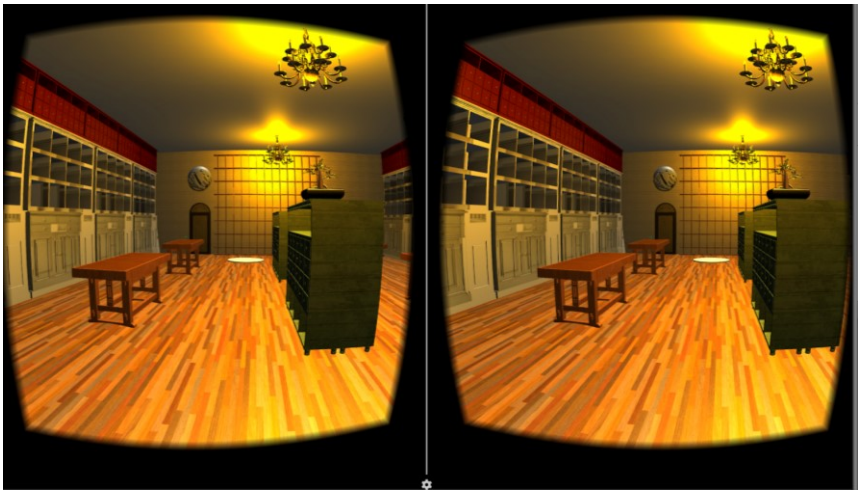


Figure 2: An early version of the FAT-VR storehouse

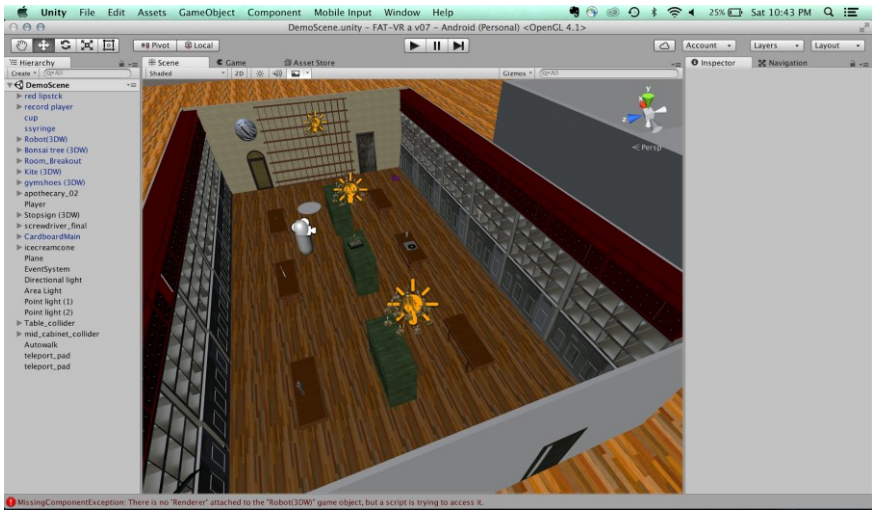


Figure 3: Aerial view

With the assistance of a University of Arizona Catalyst Grant, we purchased enough cardboard viewer kits (Figure 4) for all of our students so that they could, using their own smartphones, experiment in class with this virtual reality environment.

In the remainder of this article, we draw directly from our development and deployment experiences to provide a critical reflection on the potential of virtual reality technologies for cultivating Focused Associational Thinking. We also highlight the relations among space, learning, invention, and ideology that our project made so apprehendable once the project was underway. Apprehending these relationships was ultimately what led us to a critique of new media progress narratives, especially those that advance unrealistic expectations about experimental technologies (e.g., VR). Such narratives, we discovered, can—sometimes for better, sometimes not—elide technologies' most profound limitations. In short, we think forward from the ambivalence generated by these experiences of success and failure, and argue that while they are sometimes disorienting, they are also often surprisingly productive for students and teachers alike. In the sections below—tellingly named "Forward," "Backward," and "In Circles"—we attend to the productivities that emerged in the FAT-VR project, and also document how many of the challenges that tried us most—as teachers and as a team—were actually of our own making.

Figure 4: Cardboard VR Viewers (PC: Arizpe Ellinwood)

2.2. Forward

Heidegger's essay "The Question Concerning Technology" (1977) casts a shadow over the terrain of conversation encompassing new media technologies. In this widely-cited essay, Heidegger contends that "the essence of technology is by no means anything technological" (1977). Less abstruse than it might seem, Heidegger's observation about technology's motile force stems from his related recognition that people often think of technology as both *telos*—that which gives direction by providing boundaries (think of a glass that holds water)—and *techne*—the deepest, most creative form of knowing (imagine a dancer dancing to an unfamiliar song). In understanding technology as always

a combination of *telos* and *techne*, Heidegger argued, disciplines such as engineering develop in ways that ordain a perpetual aim toward the invention of objects or systems (*telos*) by the most efficient means (*techne*). But Heidegger says this view misses the *essence* of technology, which he argues is located neither in goals nor technique, but rather in humanity's relationship to the universe generally. He describes this relationship as being marked by a studious compunction to measure and know the world with exactitude. Heidegger terms this exacting, measuring, calculating human impulse a kind of "enframing," a kind of skeleton that lends a recognizable shape to everything that surrounds it. This shaping happens, in part, due to the form of the skeleton itself, and also because that which is shaped is itself gradually optimized for the supporting skeleton. Heidegger's way of describing this adaptation is to say that enframing is a way of revealing, and by revealing things in a particular way—the skeleton, for example, and everything upon it—they come to be understood as real, natural, and destined.

Left here, the idea that enframing is a mode of revealing—the skeleton "reveals" the human by giving shape to the flesh—is compelling enough, and foreshadows a range of critical approaches that have as their theoretical province ideology, gender, race, and sexuality among others. Yet Heidegger, returning to the question *What is the essence of technology*, identifies another consequence and manifestation of enframing: when the human impulse to be precise, to measure and calculate, is enframed through technology to "reveal" humanity's *telos*, it inspires a broad social phantasm—a convincing fabrication—that humanity itself is meant to be the enframing's agents, its "standing reserve" [*Bestand*] as Heidegger called it. The *essence* of technology, in other words, is a kind of psycho-social force that amplifies the human proclivity to know things better, so much so in fact that we attach and commit ourselves to performing this function whenever we are called upon to do so. The *essence* of technology, according to Heidegger, is that it plays on our own obsessions and—without the arresting power of questioning and art—tends to advance a dangerous discourse of techno-scientific progress.

Notably, our proposed solution—a digital environment that would enable writers to catalyze conceptual and then cognitive progress—emerged during a road trip. Ken and José had spent a Saturday morning helping a colleague move into a new house in Casa Grande, Arizona, ninety minutes north of their home city, Tucson. On the road between these two points, there isn't much to see. José is an Olympia, Washington transplant who at the time still hadn't adjusted to the open, barren landscape of the Sonoran desert. His spiritual orientation was to something far more green. Ken was also an Arizona transplant, having moved from the southwest side of Chicago to take a faculty position at the University of Arizona. On the way home, the conversation ambled comfortably around topics related to life in the academy, including, inevitably, ones related to finding and keeping one's job. This led to the prompt—who knows who asked it first?—that ultimately gave rise to FAT-VR: "What puts you in the mood to write?" We surmised that space had something to do with it. We were both used to writing against the backdrop of rainy or sometimes bitter weather and confessed that this hot, open land was proving to be a stingy muse. We wondered: "Would it be possible to fabricate an inspiring writing space with just pixels and bits?"

As the team—populated by specialists in identity representation (Lizzy), mindfulness pedagogy (Kate), and maker culture (Maggie)—formed around this question, related queries began to emerge: How does one manage meaning in order to influence everyday practices? How do we teach students to see the contours of context, to pull into relief the available means of persuasion that give shape and impact to writing? And finally, if, as Dobrin argues in *Postcomposition*, *space* is the name for "potential," "imagination," and the possibility of the dialectic (2011, p. 41), and *place* names a "moment when space is defined," where the dialectic is arrested and where meaning happens (2011)—in short, if place is produced space—what additional meanings accrue when composing places are produced *digitally*?

Our wager for the originating question was that it would, in fact, be possible to create a virtual inspiration environment for writers and other composers who wished to enter an uncensored, hyper-connectional state to help produce new work—especially work weaving together multiple ways of knowing. We believed from the beginning that when students began to practice FAT, they would also begin to practice what Burke referred to as "perspective by incongruity," which he described as a "method for gauging situations by verbal 'atom cracking'" (1984). Such lexical fission is triggered, said Burke, when you take a word that "belongs by custom to a certain category [...and] by rational planning you wrench it loose and metaphorically apply it to a different category" (1984). We predicted that students would—presuming we could build the environment well enough—begin to rethink how categories of disciplinary knowledge are constituted, and the extent to which disciplines could be reimagined. An environment like we were proposing had the potential, in other words, to reveal how the framing of conventional disciplinary knowledgeand categories shapes one's capacity to have meaningful conversations and effective collaborations with people from contexts constructed differently from our own.

As problems with the project began to arise, however, and as students began to question the relevance of the technology itself, we came to realize that we had committed the same lethean act Heidegger warned of: forgetting that the question concerning technology has nothing to do with technology but rather with those desires that *constitute* technology. We had forgotten, in other words, that virtual reality does not present a new way of looking at the world. Instead, it enforces the opposite, teleologically binding our VR environment to a profoundly *conventional* way of experiencing the world. In becoming captivated by the idea of VR and how it could facilitate academic writing, we reinscribed into a relatively cutting-edge technology a pedagogical model that fabricated writing as a system for producing optimizable subjects.

It is cold comfort to realize that we are not alone in such forgetting; a great deal of scholarship on computers and writing presupposes the importance of new media for the production and assessment of 21st Century learning and laboring. Such exciting high-tech prospects, we recognize in hindsight, are always near to hand, whether in the form of graduate seminars on "gamifying the composition classroom," curriculum proposals built around the use of Adobe Creative Cloud to teach digital writing, or teaching transdisciplinary collaborative competence with virtual and augmented reality systems. Enframed by deep-seated conventions about learning, cognition, and technological novelty, it turned out, made moving our students "forward" next to impossible.

2.3. Backward

> "Imagine two first-year General Education classrooms. In each classroom, students are asked to respond to the following prompt: "Brainstorm ideas for Assignment #1." In one classroom, students hunker over their desks with pens, paper, and laptops, most of them working hard to stave off a sudden case of writer's block as they begin to write conventional outlines and word clusters. In the other classroom, something quite different happens: students pull out pens, paper, laptops, and their smart phones, along with a curious cardboard device that you discover is a low-cost personal virtual reality viewer. As you observe the students in this second class, you note that they work with the VR viewer in different ways, some concentrating exclusively on the immersive experience it presents, some writing even as they interact with the VR world, and some interspersing their viewing with energetic note taking. But no matter the style of interaction with the VR device, the halting work so prevalent in the first classroom is largely replaced in the second by a rapid engagement with ideas and connections, a fact observable by the students' proliferation of words, drawings, join lines, and tentative organizational structures. These students, you are told, are using FAT-VR."

The above description was extracted from the FAT-VR project grant application, and specifically responded to a prompt in the grant's guidelines: "Describe the technology you would like to incorporate into this course or learning environment and why this enhancement will be beneficial to learning." This section sketches, in retrospect, the thresholds of our team's optimism for the FAT-VR project, critically examining how we developed, shared, and at times even policed it. Without question, our grant application rang with a rhetoric infused with modernist ideas of progress, of "moving forward" in exactly the way Heidegger critiqued in "The Question Concerning Technology." We explained that we would use cutting-edge technologies to solve a problem we had discerned not only in our classrooms, but in higher education generally, and suggested that the research inroads that FAT-VR seemed primed to make would lay the foundation for more ambitious projects and scaled up grants—magic words, we surmised, to proposal reviewers.

We detail below ways that the FAT-VR project actually took us in another direction altogether, one that allowed and necessitated us to move *away* from our original vision, abandon our high tech tools, and engage in a series of low tech and low fidelity means of cultivating Focused Associational Thinking. We document here, in other words, how our technological choices—and the enframing that shaped them—forced us to go backward.

In order to explain our "backward" momentum, which was disconcerting in the moment, we draw from lesson plans in the two writing courses where FAT-VR was employed. To facilitate this analysis, we call upon Berlant's (2011) theory of "cruel optimism" to elucidate how (1) our team's desire to move forward with integrating VR into the classroom, and (2) our reluctance to depart from its use once we realized how pedagogically challenging it was, yielded a series of teaching and learning accidents that were, at turns, enervating and productive. In many ways, the inevitability of these accidents was primed when, despite some early concern over how well our optimistic vision for the project (i.e., *telos*) aligned with our shared pedagogical philosophy to prioritize the needs of students over those of the project, we forged ahead with developing the VR environment instead of our curricular plan as soon as we received the award. To be candid, we saw the latter as relatively uncomplicated, and it thus became a secondary priority.

Berlant describes well what, in retrospect, we see was operative in our early development phase: "A relation of cruel optimism exists when something you desire is actually an obstacle to your flourishing…. They become cruel only when the object that draws your attachment actively impedes the aim that brought you to it initially" (2011). Although we were clear in early planning meetings that we didn't want the technological tail to wag the pedagogical dog, the sheer complexity of the project we had been funded to undertake made it nearly impossible to not put most of our time and energy into getting the technology ready for deployment in the pilot courses. We provide below three lesson plans and activities that were developed for the pilot courses, each of which conveys the high level of optimism we shared that our VR environment would be developed in a timely fashion, thus allowing us plenty of time to assemble a set of effective curricula around it. Before looking more closely at these lesson plans, however, a bit more contextualization is necessary, particularly about the relationship between our initial objectives and how the project ultimately fared. This is where Berlant's theory about why people exhibit a powerful reluctance to retreat from an established goal (in our case, away from deploying VR in the classroom) is especially salient.

2.4. From Experimentation to Exhibition

Even though our team was well-versed in critical theories of technology and pedagogy, the research we had conducted prior to writing our grant application got us excited. In particular, it convinced us that the combination of a low-cost stereoscopic display technology (e.g., Google Cardboard), ubiquitous computing devices (i.e., smartphones), collaboratively developed VR environments (i.e., the 3D space we would develop), and careful preliminary research (i.e., the

scholarship justifying the project), would enable us to undertake FAT-VR with open minds, few predispositions for the outcome, and with relatively few technical obstacles. We felt, in other words, optimistic about our ability to plan and execute the research and accept whatever results emerged.

In the beginning, this broad optimism was genuine: we really were interested in testing the hypothesis that a VR environment could be constructed where people could train to become more effective associational thinkers and, consequently, become more adept transdisciplinary collaborators. Looking back over the entire project, however, it's clear that cruel optimism took hold of us all—including many of our students—almost immediately upon experiencing a series of inconvenient setbacks. These obstacles subtly nudged us to blend our collective pedagogical aspirations—namely, to help students become more effective transdisciplinary communicators—with our experientially and research-derived understanding that virtual reality has the capacity to shape how people relate to objects and space. Thus, even when our technologies failed repeatedly and we missed milestone after milestone, we were unswerving in our commitment to continue. As the semester progressed and the VR-driven assignments scheduled in our syllabi were postponed one after another, we framed this unraveling as "glitches" and the result of the "steep learning curve" on this new way of teaching. If anyone saw signs of a deeper technological or pedagogical problematic, such thoughts were not voiced in our regular meetings, at least not until much later.

Such optimistic adaptations, Berlant suggests, are powerful signs, not of willful blindness to a wicked problem (see box [3]), but of the strengthening presence of an "object of desire":

> To phrase "the object of desire" as a cluster of promises is to allow us to encounter what's incoherent or enigmatic in our attachments, not as confirmation of our irrationality but as an explanation of our sense of our *endurance in the object,* insofar as proximity to that object means proximity to the cluster of things that the object promises, some of which may be clear to us and good for us while others, not so much. (2011)

[3] We invoke here Rittel and Webber's (1973) idea of a "wicked problem," a type of social policy issue that has no correct answer and thus can only be endlessly solved and resolved based on (among other factors) a community's emerging needs, recent technological innovations, and pressing political exigencies.

As a project team, satisfying the course learning objectives in the classes where we were deploying FAT-VR was paramount, but we wanted to do so in a way that allowed students to engage with the curricula in innovative, meaningful, and memorable ways. Integrating VR into the traditional classroom allowed us to augment it, make it more dynamic and less mundane. The physical classroom could be changed only minimally, for example by moving chairs and desks around. VR, on the other hand, gave us a way to dramatically alter the learning space—and arguably the learning experiences occurring within it—with little more than a smartphone and a folded cardboard viewer with plastic lenses and a popsicle stick for a selection button.

Thus, while we initially framed our project as investigative, aiming to determine if VR could usefully destabilize the expectations and rote behavior that conventional classrooms often place on students, as technical obstacles mounted we began to lose sight of the investigation and found ourselves consumed with making any part of the VR environment work consistently at all. As the following case studies reveal, cruel optimism soon captured the entire team, pulling us out of researcher mode and turning us into troubleshooters hell-bent on exhibiting our successful machinery. From a Heideggerian perspective, we were exchanging one form of enframing for another. And while both experimentation and exhibition are constituents of the "essence of technology," we experienced the latter as far more parochial.

3. Case Study One: FAT on Paper

In large part because of the steep learning curve associated with generating 3D models, and to a lesser degree due to scope creep, we found ourselves at the beginning of the semester without a working FAT-VR environment. Although we pressed during every available off-hour to finish, test, and debug our models and code, there came a point when we realized that we needed an alternative first assignment. To our considerable relief, what started as the seeming ironic pinnacle of a VR-based course gone off the rails—an assignment using pen and paper—turned out to be a very accessible introduction to the course's central concept, namely, focused associational thinking. By putting aside the "VR" for the first assignment, we gave the students a chance to wrap their minds around the idea that the most agile mind is able to connect anything to anything else, whatever the context or medium of conveyance.

In the lo-fi version of what had originally been designed for the FAT-VR environment, students were given sheets of paper covered in images of miscellaneous objects. The course was introductory Honors Composition with the theme "Media and Citizenship," and used mass media as entry points for interrogating the politics of nationhood and citizenship in the United States. The FAT activity took place early in the semester, as students were beginning to more meaningfully understand the theme and better appreciate the ways that seemingly trivial popular culture artifacts carry deeply charged ideological subtexts. The FAT-Paper "National Imaginaries" Assignment (Figure 5) was described as follows:

> For this assignment, you and your team members must make associations (in other words, find the relationships) among three seemingly disparate objects and the concept of "nationhood," broadly conceived. Making these connections will probably take creative, associational, and dare I say "weird" thinking—not "right/wrong" or "good/bad" thinking. Anything goes!
>
> Each team will be assigned a page with five sets of three objects. The formula that you will consider is:
>
> OBJECT + OBJECT + OBJECT = "NATIONHOOD."
>
> Ask yourselves: How can all of these things connect? I encourage you to think solo and then jump back in to share your connections with your team.
>
> Next, collaboratively come to a consensus about two of your team's formulae: (1) Which of the relationships is most plausible or most easily substantiated? (2) Which of the relationships is the most provocative? Write these two connectional sets next to their objects. In articulating your responses, make sure that you briefly touch upon the "what," "how," and "why" of your connections.

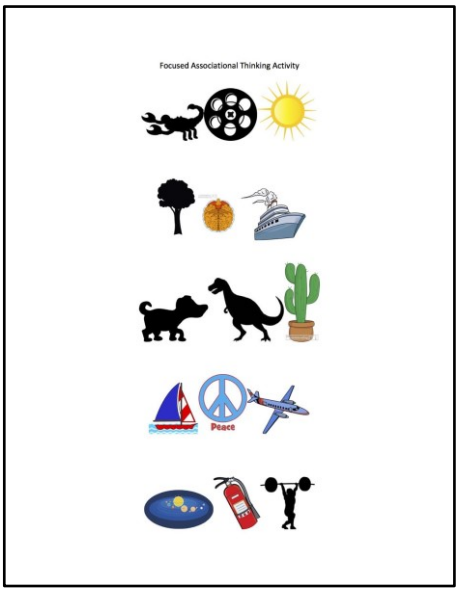


Figure 5: FAT-Paper "National Imaginaries" Assignment

There were two goals for the FAT-Paper "National Imaginaries" assignment. First, it was intended to help strengthen students' abilities to analyze popular cultural artifacts, a skill that was to be increasingly developed for analytical projects later in the semester involving non-alphanumeric texts. A key element of learning artifactual analysis is teaching students to stretch their claim-making capacities and degauss their attraction to labeling certain kinds of thinking as "good," "bad," "right," "wrong," "logical," "absurd," and so on. To do this, we developed assignments that encouraged students to generate defensible, even surprising associative arguments ranging from "plausible" to "provocative." In short, we aimed to make the classroom safe for expansive thinking.

The second objective of the FAT-Paper "National Imaginaries" assignment was to complement a theory-heavy class reading: Gramsci's (1972) "Critical Notes on an Attempt at Popular Sociology." In this essay, Gramsci explains his "philosophy of common sense," which he defines as "the conception of the world which is uncritically absorbed by the various social and cultural environments in which the moral individuality of the average man is developed" (1972). According to Gramsci, the most fundamental characteristic of common sense is "that it is a conception which, even in the brain of one individual, is fragmentary, incoherent and inconsequential, in conformity with the social and cultural position of those masses whose philosophy it is" (1972). In the class discussion of this essay, students were encouraged to reflect on and discuss the "common sense" ideologies that seemed to be emerging from their FAT-generated claims. To our delight and relief, the FAT-Paper "National Imaginaries" assignment largely succeeded, not only in orienting students to the basic principles of focused associational thinking sans VR, but also in familiarizing students with how to read complex cultural theory. Once they had practiced making their own ranging arguments about seemingly disparate objects, making sense of the link between a pop song and the rise of fascism, for example, became relatively easy, if not always agreeable.

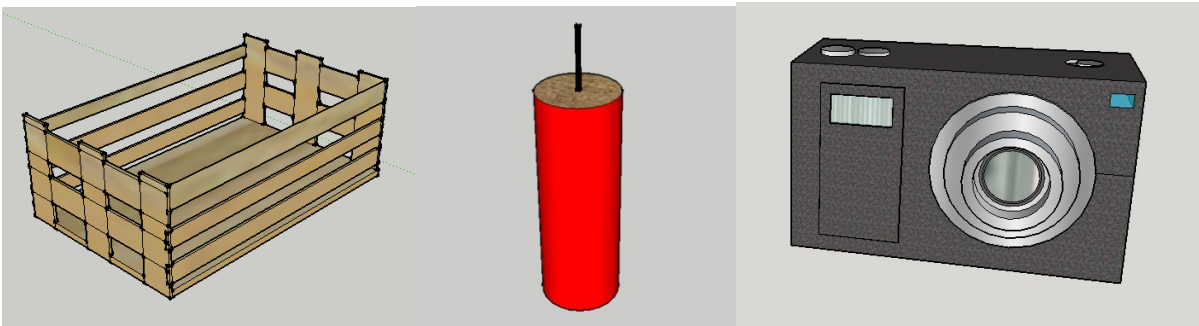
4. Case Study Two: Writing VR Instruction Manuals

FAT-VR was also designed into a small group of Business and Technical Communication courses. This curriculum was a natural fit for our project because such courses often already have an element of interdisciplinary collaboration built in, not only because they tend to draw students from a variety of academic units, but also because of their focus on group projects. The combination of interdisciplinarity and collaboration promised to provide our team with a highly generative context for the FAT-VR environment, especially given that here at the University of Arizona, these courses blend instruction on data visualization and document design with professional development: resumes, cover letters, interview strategies, and so on. Thus, the Business and Technical Communication courses were seen as excellent contexts in which to provide students with the loci and personal exigences to practice interdisciplinary (and sometimes transdisciplinary) communication, particularly in the form of project pitches, mock job interviews, and small talk scenarios.

Unfortunately, when the FAT-VR environment could be only partially deployed at the scheduled time on the syllabus, the Business and Technical Communication Courses—students and teachers alike—experienced an aggravating setback. Predictably, our 300-level students were more forthright and detailed than our first-years in their critiques of FAT-VR: it used too much storage space on their phones, caused VR sickness, and seemed like a "bizarrely unnecessary exercise," as one student complained in a mid-term course assessment. We recognized that these perceptual problems needed to be addressed immediately if FAT-VR was ever going to become a stable testbed for classroom-based focused associational thinking.

Driven by the same ideological enframing of technological success (Heidegger, 1977) and cruel optimism (Berlant, 2011) that propelled us forward in the Honors Composition course, we did our best in this course too to turn lemons into lemonade. By the end of the semester, there had been two clear successes, at least from the conventional standpoint of course outcomes. The first was the development

of assembly instructions for the cardboard VR viewing devices that students needed to experience FAT-VR. The second was a guide for navigating the FAT-VR interface, including an explanation of why the environment was replete with the strangest assortment of 3D models (Figures 6, 7 and 8).



Figures 6, 7, and 8: Examples of 3D Objects used to spur FAT

Because student critiques seemed mainly to focus on our artless introduction of the VR equipment and environment, we generated two activities to directly address these problems, even as we continued to familiarize students with the rudiments of VR-deficient focused associational thinking. In short, we recast the problems as opportunities to advance our curriculum from an alternate starting point.

The first new lesson was co-developed by the students and instructors, all of whom had experienced frustration with the purported "easy assembly" of the cardboard virtual reality viewers. Before students were guided into FAT-VR's object storehouse, they were grouped in teams to make the cardboard viewers. They had already learned that our shipment of viewers had not come with assembly instructions, so after locating and watching a step-by-step video of the construction process online (https://www.youtube.com/watch?v=-KqJAUIG5M8), the students began a collaborative build session (Figures 9 and 10). Unfortunately, the video proved to be insufficient—it was for a different model of viewer than we had—and confusion soon gave way to annoyance.

Figures 9 and 10: Students constructing the cardboard virtual reality viewers

Given that this was a technical communication class, it made sense for the students themselves to address our pressing problem by creating a new assembly guide, one that merged the strengths of the video and written instructions they'd found online, but that they customized for the off-brand devices they had before them. This assignment turned out to be especially generative because, as several students noted, it was inspired by their first-hand frustration with an object that they needed for future class assignments. This produced among many students—though not all—a sense of empowerment within the class, one derived from the experience of analyzing a problem, planning a solution, then collaboratively putting that plan into action. Students exercised ownership over their

learning experience by re-writing a set of assembly guides that they were having issues with. Once their modified instructions were completed, students were eager to share their revised instructions to showcase how better organized, accessible, and relevant the new instructions were. Moreover, after the students' new assembly guide was complete, they were able to share it with—and receive feedback from—a business communication class that also needed to build their cardboard VR viewers. Through this unexpected yet highly productive collaboration, our students were able to strengthen their technical analysis and communication skills in response to an exigence and subsequent usability testing. In turn, students were, if not happy about the curricular hiccup that gave rise to the assembly guide assignment, at least grudgingly appreciative of the fact that they had just collaboratively solved a real-world technical communication problem.

It is tempting in moments like these—when, by some unrepeatable alchemical miracle, pedagogical lead transmutes into gold—to feel a sense of vindication in one's commitment to advancing the role of educational technology. And to be sure, we all got a little better at thinking on our feet when we suddenly had to find a way for our students to learn something after our lesson plans broke down. In hindsight, though, our lesson plans didn't "suddenly" collapse—we'd known trouble was ahead for days, if not weeks. The truth is that we were so invested in the classroom deployment of FAT-VR that even when it failed us time and again—stereo display problems, memory allocation failures, misaligned collision detection systems, asset management complications, and model production backlogs, among others—we refused to step back from it, refused to collectively wonder if perhaps the "VR" in "FAT-VR" wasn't all that important. We had identified a problem in the world—students need a way to consistently practice highly focused associational thinking in order to become more efficient interdisciplinary collaborators—and had identified a technological solution: virtual reality. Our technological enframing fixed just so, we had set ourselves up for weeks of cruel optimism, pressing forward only to be pushed back just far enough that our disappointment was always tempered by the proximity of success.

4.1. In Circles

Three-quarters of the way through the semester, we began to discuss in our development meetings the fact that we seemed to be going in circles. FAT-VR had become a locus for disorienting instructional circumstances that routinely took us off the path we had marked out for ourselves early in the project. It did this even as it enabled us to recognize and ultimately challenge some of the foundational assumptions we had invested in the project from the start.

In *Queer Phenomenology*, Ahmed explored the world-making capacities of "disorientation"—which she described as "bodily experiences that throw the world up, or throw the body from its ground" (2006). Ahmed later noted that while the experience of disorientation is not inherently radical, such moments can "impact…the orientation of bodies and spaces" and in so doing "offer us the hope of new directions" (2006) In this final section, we offer a kind of meditation on the dizzying and disorienting experience of teaching with just-in-time virtual reality, attending in particular to how such environments compose users as much as users compose with and in them.

Significantly, and on the most literal level, navigating in virtual reality made some of our students dizzy and sick. These students—clearly not as enframed as their instructors—asked to opt out of the VR exercises, preferring instead extra pen and paper exercises. While we had tried to consider our students' different environmental preferences in creating FAT-VR—designing, among others, several virtual variants such as a cozy study, a scientific lab, and a sterile office where students could reflect on their chosen objects—we had not fully anticipated the ways their differently embodied and abled selves might interact with the virtual spaces we had provided. Some students actively challenged our "freeing" and "de-limiting" understandings of virtual reality's potential in the classroom, arguing

that while VR might have the potential to transport users elsewhere, not all students can or want to be so moved.

Such retroactive insights align with the critiques of Yergeau et al.'s "Disability & Kairotic Spaces" (2013), a webtext in which they challenged the assumption that there exists a constructed "default user" whose imagined characteristics too often underpin the pedagogical assumptions of multimodal composition. As they argued: "Multimodality has been discussed at length as a means to enhance access to the public and private spaces through which we and our writing move. However…multimodality, as it is commonly used implies an ableist understanding of the human composer" (Yergeau et al., 2013). Writing in the same webtext, Kerschbaum explained that this phenomenon—which they termed "multimodal inhospitality"—"occurs when the design and production of multimodal texts and environments persistently ignore access except as a retrofit" (Yergeau et al., 2013). Without a doubt, the FAT-VR environment "fit" some bodies better than others. Such important and destabilizing insights set us and our courses on paths different from what we had anticipated, even as they led us to consider how we might retain—and differently express—other multimodal options for inspiring FAT in lieu of those driven by the modality of a digital virtual world. This re-vision of our project helped us discern three precepts of VR pedagogy that, had we been guided by them from the beginning, would certainly have mitigated the deleterious effects of our technological enframing and cruel optimism. The following precepts are:

1. Learning complex tools (e.g., Unity 3D, Blender, Audacity) is not easy, no matter what the company websites tell you.
2. Students need priming for transdisciplinary thinking.
3. VR hardware is not yet ready for wide use in educational settings.

These precepts are neither subtle nor hermetic. On the contrary, they are disappointingly mundane. It is their very banality, however, that enables them to go unattended, thus *enhancing* the sensory power of VR and other cutting-edge technologies.

4.2. Circular Lessons

As we noted earlier, our first phantasy of a virtual learning environment for teaching-focused associational thinking drew on the ancient concept of the memory palace (https://viviennemorrell.files.wordpress.com/2015/03/wunderkammer.png). As we imagined it, students would enter the virtual memory palace, select a random set of objects, and begin to link them in as many ways as possible. In our enthusiasm for developing the project, however—and especially its VR component—we neglected to deal honestly with the fact that, while everyone on the team was very tech savvy, we largely shared a gap in our understanding of some of the most essential tools of VR development. This led to our first Precept:

1. Learning complex tools (e.g., Unity 3D, Blender, Audacity) is not easy, no matter what the company websites tell you.

We knew that we would need to do some learning about these tools. What we did not account for, however, was that in addition to becoming adept with the software, we had to plan every detail of the environment itself, plus develop pedagogically sound courses within which FAT-VR would be used. Trying to be autodidactic about the languages, skillsets, and workflows required for the efficient use of VR development tools proved unrealistic, especially with a looming deadline. The Unity 3D game engine, for instance, was particularly challenging, despite the company website's enunciations to the contrary:

> You can create any 2D or 3D game with Unity. You can make it with ease, you can make it highly-optimized and beautiful, and you can deploy it with a click to more platforms than you

> have fingers and toes. What's more, you can use Unity's integrated services to speed up your development process, optimize your game, connect with an audience, and achieve success. (Unity 2017)

In fact, accomplishing even basic tasks in Unity is challenging, not necessarily because the application is poorly designed but because it is so powerfully complex; the user interface has dozens of options available onscreen at any given moment, and it nearly always requires coding to get one's desired interactions to work properly. By no means is this a criticism of Unity—in fact, we think it's incredible. But like a great Russian novel, dropping into Unity casually is a sure path to frustration. With 100+ 3D objects to create, script, and situate in the FAT-VR environment, time management problems quickly cascaded, the quality of our objects and scripts began to suffer, and a variety of shortcuts we opted to take turned out to be significant contributors to the higher-than-usual rates of VR sickness that the environment's users had begun to experience. Had we held Precept 1—"Learning complex tools is not easy"—before us from the start of the project, we would have managed our time differently and been less susceptible to cruel optimism.

The second Precept we discovered had to do with collaboration and disciplinarity:

2. Students need priming for transdisciplinary thinking.

Not all of our problems arose from technology. To our surprise, a significant number of our upper-division technical communication students expressed skepticism, not with the idea that virtual reality worlds could be learning environments, but with the deeper premise of our courses: that transdisciplinary thinking is the future of problem-solving. The course had been themed around the concept of *disciplinary translation and interpretation*, that is, preparing to translate written materials and interpret disciplinary knowledge for other-disciplinary and non-specialized audiences. Such work, we explained to the class, requires either transdisciplinary intermediaries or transdisciplinary specialists to bridge the inevitable communication divides that occur when, for example, a bio-engineer is collaborating with an applied linguist.

Students' resistance took us by surprise mainly because this technical communication course fulfills an upper-division writing requirement for students in several STEM majors. As a result, these courses routinely have juniors and seniors in fields like biochemistry, environmental science, engineering management, and opto-electronics—all highly transdisciplinary research areas. We could understand why students who had spent years learning in a disciplinary silo would resist the idea that they needed to practice learning other disciplines. As every teacher knows, many students who are nearly finished with their coursework buck assignments and learning materials that are of questionable relevance to their established courses of study. But why, for example, would a mathematical life scientist resist transdisciplinarity?

We discovered an answer through a number of candid conversations we had with our students; it turned out to be simple: even transdisciplinary fields can become flattened into a discipline with a discreet and guarded curriculum. From the outside, such a field can appear new and hybridized, even while internally it's as traditional as can be. Our resistant students had determined, it seemed, that "transdisciplinarity" was code for "hodge-podge," an intellectual, disciplinary, and avoidable quality that had potentially disastrous professional implications for them. The ability to promote oneself on the job market as a specialist was key to their success and they had been encouraged by advisers, job counselors, and recruiters to project a high contrast image of themselves in their resumes and interviews. A transdisciplinary persona, they suggested, would come across as dilettantism and cost them jobs.

Hearing these concerns was enormously helpful to us because it gave us an opportunity to articulate for ourselves and the students why an appreciation for—and a modest skill set in—transdisciplinarity can only be advantageous on the job market. It allows, we proposed, one to clearly

frame one's respect for other fields practiced in the workplace, to serve as a problem-solving mediator on high complexity projects, and demonstrates an ability—when needed—to think beyond the silo in order to overcome the most vexing project impediments. We can't say for sure that our skeptical students were ultimately converted or only humoring us (though several of the student evaluations suggested the latter), but, in any case the anxiety about transdisciplinarity eventually dissipated and we were able to shift the course into a series of projects specifically designed to help students practice this type of thinking.

The first of these assignments, the Disciplinary Journal Analysis, prompted students to write an essay analyzing a respected journal in their major field. This assignment has four goals. It gives students an opportunity to engage with recent scholarship within their fields. It requires students to practice some of the basic forms of academic research. It educates students about the generic writing conventions in their fields, and thus to see how writing constitutes disciplinary boundaries. And finally, through the "What patterns/exceptions to the norm do you notice?" prompt, it teaches students to notice the disciplinary gaps that routinely appear in even the most conventional scholarship. Such disjunctive moments, we show them—when, for instance, a writer veers from convention by using a metaphor, telling a story, pursuing a non-sequitur in a footnote, or drawing an analogy—are often signs that an author has approached the edge of disciplinary knowledge, then needed to reach toward another to fill out the description. Students quickly and surprisingly discover that disciplinary writing of all sorts is replete with such gaps, and discern on their own that, in effect, disciplinary communication is always already transdisciplinary.

With this understanding in hand, students are next prompted to describe their relation to their own disciplinary knowledge, which we help them distinguish from the discourse of their chosen fields. In this assignment, called the Disciplinary Literacy Narrative, students answer a series of questions in three categories: 1.) Disciplinary Knowledge—How is your knowledge formed? 2.) Autobiographical—What is my relation to this knowledge? and 3.) Professional—What can I achieve with this knowledge?

As with similar exercises—personal literacy narratives, media literacy narratives, and so on—this assignment gave students the opportunity to be more reflective about why they know and believe things in the ways they do. The discoveries that such reflection yielded often illustrated for students one of the course's main values: it simultaneously teaches hard and soft skills.

We found that once students were able to weave together their (a) developing awareness of disciplinary conventions generally, their (b) relationship to and fluency in the particular conventions of their own fields, and their (c) professional goals, then their transdisciplinary and associative skills developed quickly. They began to recognize how the ability to understand, explain, and apply another field's knowledge domain had everything to do with one's own personal disciplinary agility. In short, they began to see how self-knowledge optimized their capacity to collaboratively problem-solve with colleagues from very different backgrounds.

Put another way, when students reflect on their relationship to the dominant discourses in their lives, they can often discover ways to transect Heideggerian enframing (1977) and Berlant's cruel optimism (2011). And although we didn't recognize it until late in the semester, such reflection is doubly important for teachers whose work is to guide students through an educational process that primes them for so many other kinds of performance beyond their majors and disciplines.

The final Precept in the FAT-VR project was, despite its simple practicality, one of the most liberating for us in terms of understanding how we managed to trap ourselves in an avoidable pedagogical snare:

3. VR hardware is not yet ready for wide use in educational settings.

With students primed to begin practicing FAT, but plagued by problems with the FAT-VR environment, we introduced one analoge FAT exercise after another. We continued to believe that there was an important spatial component to writing and that VR held considerable promise for linking space and FAT using VR. The fact that students had begun to see the value of FAT only whetted our resolve to see the project through. We discussed the situation with our students about a month into the semester, and let them know that we would periodically be bringing prototypes of FAT-VR into the classroom for them to experiment with. It was during these prototype testing sessions, which actually fit perfectly in our units on usability testing, that we began to see a pattern of hardware problems.

The first set of such issues concerned the cardboard viewers themselves. The advantages of these devices were evident to us from the beginning, and certainly played a role in the process of techno-enframing we were experiencing: they worked with our students' ubiquitous smartphones, were cheap and easy to find, and were sophisticated enough to provide a usable virtual reality experience. Their disadvantages, however, became visible soon after we began using them, the worst of which was their limitation to head tracking as opposed to the body tracking capabilities of higher-end devices such as the HTC Vive or Oculus Rift. This limitation proved to be a major drawback when asking students to explore a large and complex virtual room.

The second significant hardware issue we faced was that the FAT-VR app—because of its environmental complexity—required more resources (e.g., memory and bandwidth) than some students' smartphones could accommodate. Even though we had attempted to build FAT-VR with as few polygons as possible, the fact that we had included so many objects—simple as they were—caused the environment to render and update very slowly for some users, which led to student frustration and developer stress.

Additionally, VR sickness—similar to the "simulator sickness" experienced by pilots working in flight simulators—became a regular occurrence in our classes. This temporary illness, which vexes VR developers at all levels of expertise including those who work on consumer grade products like the HTC Vive and higher-end technologies such as the CAVE, is poorly understood even today. Many developers are working on solutions that minimize high latency (i.e., long delays between when, for example, a user turns her head and the environment updates the display to reflect that rotation) and mitigate optical calibration problems related to body tracking sensors, both believed to be leading contributors to VR sickness.

Needless to say, as amateur VR developers, we were at an even greater disadvantage when it came to solving such problems. We had designed the environment, for example, to allow users to walk around the apothecary storeroom, looking at and collecting the objects with which to practice FAT (Figure 11). Because we were not yet familiar with the research related to VR sickness, however, we solved early on the "how will users navigate the VR space" problem in the most expedient way possible: users simply looked at the ground to activate forward movement through the space. Unfortunately, this caused some users to become disoriented, even nauseous: in their need to repeatedly look down for forwarding motion, then look up to see where they were going, users periodically found themselves feeling quite unwell.

Add to these hardware woes the fact that a number of the early FAT-VR prototypes we brought to class had design features that ultimately fell short of delivering a satisfactory user experience—for example, clunky application exit and progress save interfaces—and readers will have a sense of how cruel our optimism truly became.

Taken together, these three precepts of VR pedagogy, mundane as they are, illustrate how compelling new educational technologies can be, as well as how friable are their spells: it takes only attention to the simplest of dicta—not complex arguments—to break their enframing hold. Lose

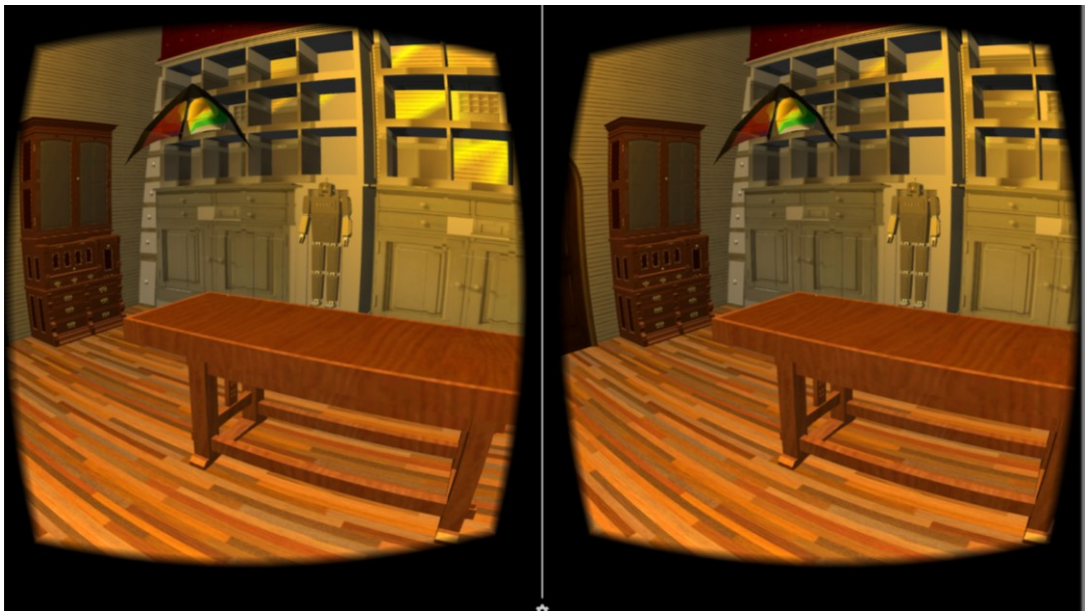


Figure 11: Kite and robot objects in the apothecary

attention on these modest precepts, however, and the drive to solve problems and finish what was started (regardless of the disadvantages of doing so) is likely to quickly gain traction.

5. Conclusion: Failure, Stupidity, and Antidisciplinarity

If digital humanities researcher-teachers are to begin answering the call to develop "new models for invention and pedagogy" as Hawk (2007) encourages, we are well advised to begin by considering the role of failure and stupidity in that work. Without a doubt, the number of disappointments and mistakes we experienced over the course of this project was enough to induce its own kind of motion sickness in us. From the thrill of creating our first 3D objects, then seeing those objects placed in the virtual apothecary we'd created, to the guilt-tinged sympathy we felt when one of our students was stricken with VR sickness and vomited into a nearby wastebasket, the FAT-VR project will, we suspect, long hold an intellectually and emotionally ambiguous place in our minds. To be sure, we often felt discouraged by the lack of VR software and hardware standards, of our students' differentially equipped smartphones, and of our VR development abilities. Yet we are reminded by Halberstam (2011) that failure is not merely a component of thinking differently, it is also likely the very condition of emergence required for this new kind of pedagogy.

In *The Queer Art of Failure*, for example, Halberstam proposes a breakdown of disciplinarity that creates space for "undisciplined knowledge: more questions and fewer answers" (201). Halberstam also characterizes failure "as a refusal of mastery, a critique of the intuitive connections within capitalism between success and profit as a counterhegemonic discourse of losing" (2011, p. 12). Clearly, sustained critical thinking requires that one learn to become comfortable with—or at least able to endure for extended periods—the wild "dance of the dialectic" as Ollman (2003) calls it. Critical thought, however, also necessitates that the dialectic be arrested periodically in order to let praxis flower. Following Halberstam's suggestion to "invest in counterintuitive modes of knowing such as failure and stupidity" (2011), and clearly having become quite skilled at this alternative epistemology ourselves, we cautiously recommend that other digital humanities researcher-teachers take up failure as a professional objective. Note that we don't suggest failure as a goal (*telos*)—the end result of a

project—but rather as an objective throughout one's roving. Without recognizing the vital role of failure in new media-based pedagogy, the likelihood that one will become enframed and guided by cruel optimism is high. To begin a technology-driven project with the expectation that it will almost certainly fail can go a considerable way, we believe, toward helping researchers and teachers disentangle (though not necessarily discard) their futurist, modernist hopes from the infinitely complex dialectical context of their applied scholarship and pedagogy.

This goes double for stupidity. For Halberstam, "stupidity" refers "not simply to a lack of knowledge but to the limits of certain forms of knowledge and certain ways of inhabiting structures of knowing" (2011). Transdisciplinarity, from this perspective, always already originates with stupidity, with the discovery and subsequent exploration and inhabitation of knowledge forms initially beyond one's own. Focused Associational Thinking—and presumably other cognitive activities that play on the mind's plasticity—have the potential to integrate such naïve and nonsensical thinking into university spaces, provoking in turn not transdisciplinarity but what Halberstam terms "antidisciplinarity" (2011). Without minimizing our oversights, fumblings, and mishaps while developing FAT-VR, we appreciate that Halberstam reminds us that failure and stupidity are the fundament for thinking, doing, and communicating differently. Such a reminder goes a considerable way toward annealing our approach to experimentation and failure in the classroom, especially when we undertake these risks in an increasingly vigilant, hyper-professionalized, and product-oriented educational environment.

As we reflect on this project, we can't help but be troubled by the fact that, from the beginning, it was just such a discourse, one that saw the world—and especially our classes—as a sandbox full of problems to be solved: Could VR help people become better transdisciplinary collaborators? Could it get students to think and write in ways that would serve them better as 21st-Century students and workers? Could we harness and leverage for pedagogical purposes the emerging invention and composing practices that our students were developing outside the classroom? And so on. In hindsight, at its most basic level, FAT-VR essentially sought to address the failure of insufficient productivity.

Author Note: This research was supported in part by the University of Arizona's Innovative Learning Project, Catalyst Grant.

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