Undergraduate Writing Pedagogy in an Era of Digital Ubiquity

by

Addison Eldin

B.S. Mathematics and English Literature, St. Lawrence University, 2014

M.A. English Rhetoric and Composition, University of Pittsburgh, 2021

Submitted to the Graduate Faculty of the

Dietrich School of Arts and Sciences in partial fulfillment

of the requirements for the degree of

Doctor of Philosophy

University of Pittsburgh

2024

UNIVERSITY OF PITTSBURGH

DIETRICH SCHOOL OF ARTS AND SCIENCES

This dissertation was presented

by

Addison Eldin

It was defended on

February 12, 2024

and approved by

Alison Langmead, Clinical Professor and Director of Visual Media Workshop, Department of History of Art and Architecture (Dietrich School of Arts and Sciences) and Department of Information Culture and Data Stewardship (School of Computing and Information), University of Pittsburgh

Elizabeth Pitts, Assistant Professor, Pitt English Composition

Benjamin Miller, Associate Professor, Pitt English Composition

Dissertation Director: Annette Vee, Associate Professor, Pitt English Composition

Copyright © by Addison Eldin

2024

Undergraduate Writing Pedagogy in an Era of Digital Ubiquity

Addison Eldin, PhD

University of Pittsburgh, 2024

In academia, there remains a broad cultural divide between STEM and the humanities that was identified over half a century ago by C.P. Snow. However, the nature of this divide has changed in recent years as a scientific tool, the digital computer, has become ubiquitous in daily life. The humanities must now contend with how to account for this specialized-yet-ubiquitous technology within its various disciplines, and it is in this contention that I believe composition pedagogy is well-situated to support undergraduate education and bridge the cultural divide. The use of digital technology can be taught via concepts from composition pedagogy to undergraduates at sufficient levels of generality to support their use of the technology in their home disciplines and post-college work.

This approach is an extension of how composition studies has dealt with the incorporation of writing technology into the classroom. In doing so, it attempts to account for perspectives from both STEM and humanities cultures, considering not only what composition pedagogy and humanities perspectives might bring to the teaching of computing, but also how to effectively engage students in technical learning as they familiarize themselves with how to make use of a specialist technology in their lives and work.

Table of Contents

List of Figures

Acknowledgements

Thank you first to Annette Vee, who made this process not just tolerable but even, sometimes, kind of fun. Thank you to Alison Langmead, who inspired much of the theoretical work of this dissertation through suggestions and just being endlessly interesting to talk to. Thank you to Ben Miller and Elizabeth Pitts, who not only provided the right mix of feedback and support, but helped me think about something called "employment," which was useful to learn about.

And finally, thank you to my wife, Colleen—for everything, for everything, for everything.

0.0 Understanding the "Two Cultures" Problem

In 1959, C.P. Snow delivered a lecture describing a conflict between two cultures, one literary and one scientific, each with their own dispositions constituted by "common attitudes, common standards and patterns of behavior, common approaches and assumptions" (9). Plenty has changed since his time of writing that I'll talk about shortly, but I want to start with what is still deeply relevant about his distinction from my perspective today, over half a century later.

My academic work has continually bumped into the distinctions and boundaries that Snow discusses, such as when dealing with questions of meaning in scientific and adjacent domains such as mathematics. For example, consider when Snow compares asking scientists a question like, "What do you mean by mass?" to "the scientific equivalent of saying, *Can you read?*" (15, emphasis in original). He's describing a communication gap created by a question about mass and meaning being heard as a request for recall of an elementary definition or fact. The initial question begs for foundational or philosophical reflection about the meaning of a term or concept, reflecting the literary disposition, while the question that's heard reshapes it into being about rote recall. This mis-hearing stems from the question entering the rhetorical context of the scientific disposition, where it more closely resembles a high school or early undergraduate student's quiz than it does a probing question about philosophical foundations of science. As this introduction and the next chapter will discuss in detail, these conversations are not foreign to scientific fields, so this isn't a matter of scientists being ignorant or hard-headed. The issue is a cultural gap that makes the question come across differently to two different audiences, rather than a difference in what people from one culture or the other are able to understand or discuss.

Snow's analogy describes quite well experiences I had as an undergraduate. For example, in a mathematics course about ring theory—a subject that, to oversimplify, attempts to generalize our intuitive understandings of addition and multiplication to sets of things that might not be numbers at all—my professor playfully treated me with suspicion for asking why rings were important or interesting as algebraic structures. After all, algebraic structures are defined by a specific set of axioms—essential, unprovable assumptions upon which claims and proofs are built—and are distinguished from other structures by what axioms they do and do not include. So why did people care about *this* set of axioms over other sets? Why is *this* structure important in the "real world"?

Unfortunately, my question sounded less like a question about history and context and more like the high school refrain of the subject lacking clear personal utility to me and my future. The problem was not that my professor wouldn't or couldn't hear what I was asking; he also taught, from my understanding, great courses in the history of mathematics, and I imagine that if I reworked and asked the question now that I'd get an answer much more in line with what I was looking for. The problem was in the cultural gap between us, where my question was intended to deal with the *meaning* of rings as understood over time by mathematicians, but was heard as dealing with "real-world" applications as found in textbooks—even more of a cultural *faux pas* given ring theory's placement in *pure mathematics*, as distinguished from *applied mathematics* which contains fields such as statistics and deals more squarely with real-world applications. To tap into the potentially rich conversation my question could've started, I needed to better

understand this difference, but I did not yet have the language to name precisely what I was looking for.[1]

My perspective was informed by the fact that I was a mathematics and English literature major. The meaning of rings was essential to me because I needed to know why people came to care about this structure at all, as I figured the department required math majors to take a ring theory or group theory class for a reason that resembled a process more sophisticated than throwing darts at a list of axioms. I wanted to understand, from a mathematical *and* historical context, why the discipline cares about rings at all. Without this, I felt like I was an outsider studying alien concepts rather than a real member of the community.[2] I was taking an approach to learning about

---

1 Admittedly, my professor provided a useful analogy to linear algebra and its later application to non-communicative matrix multiplication in subatomic physics, but that was more about how the ideas were applied after the fact rather than why the ideas seemed worth pursuing to mathematicians in the first place. Nowadays, I understand rings as the abstraction of our ideas about what multiplication and addition are/do, removed from the direct context of number systems like the integers. This understanding itself points to several sites for historical analysis, namely attempts to formalize and make rigorous the algebraic tools used in mathematics over the early twentieth century. These attempts came about not as a teleological process of discovering mathematics as it objectively or truly is, but instead as the result of crises in understanding of the nature of our mathematical abstractions. As Ernst Snapper opens with in his paper on various schools in mathematics attempting to address these crises, "The three schools, [logicism, intuitionism, and formalism], all tried to give a firm foundation to mathematics. The three crises are the failures of these schools to complete their tasks" (207). Rings arose in a certain context as part of an ongoing conversation in mathematics that was not just technical, but philosophical.

2 This issue is not exclusive to me, obviously. Sara N. Hottinger, who similarly majored in mathematics and a humanities discipline, notes that she and others have been dissuaded from pursuing mathematics at higher levels because they could not see themselves as mathematicians (2-3), as people who did what mathematicians

a subject that served me well in literature courses—asking questions and writing about not only what something *is*, but in what context it developed and how it has been taken up by human beings—and trying to apply it in a different domain without consideration of the distinctions between those domains. While the distinctions between my majors was felt in several ways, I think this example reflects how the problem Snow identifies is still present, and how his insights into the nature of the problem remain salient.

My example does not stand on its own, though. Two scholars whose work is essential to this dissertation, Brian Cantwell Smith and N. Katherine Hayles, have both related similar experiences. Smith's work deals squarely with questions of meaning in fields traditionally

---

do. I didn't see myself as a mathematician because, while I understood what a ring was defined as and various propositions about it, I didn't understand the inquiries and discoveries within mathematics that made rings relevant. This understanding contrasted with my lit classes, where I could see resemblance between the work of my professors and the work we were being taught to do. Historian of mathematics Judith V. Grabiner, implicitly dealing with elements of both cultures, describes possibilities for learning that address such a gap: "Knowledge of the history of the relevant mathematical concepts can help the teacher understand what is troubling the student" ("Introduction" xii). She adds that that doing so can help students understand the work done by mathematicians as a community more broadly.

We don't need more opportunities to teach mathematics as a rote learning process, continuing the kind of mathematics many students will have encountered in high school; we need to address the lack of focus on meaning in mathematics and how the discipline has changed over time. Even in John Stillwell's celebrated history of mathematics, he notes that math students are often chiefly disappointed by the fact "that they never get a course on mathematics" ("Introduction" xi), taking several courses that cover mathematical topics but lacking an introductory or later class that unifies the subjects. The need to speak to the intersections of these cultures is not just to the benefit of the humanities, but also to more traditionally "scientific" cultures like the study of mathematics.

considered the realm of the sciences—what, from my perspective, is now more accurately reflected in the term *STEM*, which groups the sciences, technology, engineering, and mathematics together based on a perceived cultural affinity—and he relates a similar albeit more antagonistic example of this communication gap from a 1990s conference about the concept of *information* in computer science:

> I put up my hand and said, … 'What are you going to say about what information is about?' And the speaker came to a complete halt. Someone in the audience stood up and said, '*About*? That's a word for philosophers. Information is a scientific notion. It has nothing to do with *aboutness*.' And there was a huge cheer in the audience. ("Brian" 24:53)

The response contrasts a hope Smith describes having had at the start of his academic career about investigating "whether the computer could play a role in healing this gap between the part of me that was interested in complexity, and politics, and religion, and so on, on the one hand, and the kind of power and elegance and so on and so forth that I saw in physics" ("Brian" 1:08). Smith's desire to think of a technological object—the study of which is mostly formalized within STEM departments—from a "literary" perspective leads to conflict with those who might have the most insight into the ideas underpinning the conversation—in this case computer scientists with specialized understanding of their field's approach to the idea of *information*. The cultural differences Snow highlights lead to real blocks in important work, like asking for reflection on foundational concepts in a field, be it the meaning of mass or the aboutness of information. Smith's work, as I will expand on in sections 0.2 and 1.0, has a lot to offer toward bridging the cultural gap and creating an opportunity for valuable work at the intersections of the scientific and literary cultures. However, it can be hard to see its value when his approach does not fit comfortably within the dispositions of either culture, the divides of which are partially formalized in university

departments and programs, which are far more likely to see collaboration between departments like biology and chemistry than chemistry and history.

Hayles has also spent a lifetime dealing with questions of meaning and technology, and describes a similar problem through a semi-fictionalized autobiographical account of her academic work and career via her avatar, Kaye, in 2002's *Writing Machines*. Despite her affinity for scientific cultures, "when she asked [her colleagues] the questions that were bothering her—why was it important? what does it mean?—they laughed or shrugged them off, looking at her as if she had committed a breach of decorum" (13-4). Note the overlap between the stories from Snow, Smith, and Hayles: in each, a question intended to prompt insight or reflection is dismissed as somehow inappropriate for the context. The cultural gap is what makes the question inappropriate and demarcated as irrelevant or uninteresting; the "common attitudes, common standards and patterns of behavior, common approaches and assumptions" cause an inability for two people to converse, despite the potential richness of their interdisciplinary interaction.

Despite this, there are many people who enjoy working at those intersections, and I increasingly became one of those people over my college and, later, graduate career. As a student of English literature, I was interested in science fiction and work dealing with technology, reflecting Sheryl Vint's description of science fiction as a corrective to the two cultures problem: "Snow also argued that this segregation of knowledge was a hindrance to solving humanity's most pressing problems. The strength of the best sf [science fiction] is that it keeps one foot in each of these worlds" (164). My position in mathematics and English literature, which largely arose out of an interest in both while treating them as separable for most of my time as an undergraduate student, helped me draw connections between the two places I stood, a foot planted in each—

analogous to how science fiction, in dealing with science and technology through narrative, does through its dual focus.

In my senior year of undergrad, though, I worked with a professor of mathematics and another of English, the latter having strong programming knowledge, on a project that interlaced questions of authorship, statistical analysis of style, and the writing of code that could facilitate our statistical and historical analysis of texts. The interweaving of these cultures would continue in my graduate work via my use of computers and code; in coursework, I did projects using network analysis to understand political biases in YouTube's recommendation algorithm; created lesson plans for teaching about early digital computer technology in humanities classes; and wrote code that compared print and digital-born texts to facilitate analysis of cultural shifts in fictional depictions of lesbian culture. The interweaving of technology and meaning are, for me, rich sites of analysis, and thus are the basis of my interests in addressing the two cultures gap. Although my graduate work is not taking place in a literature program, it's still interested in these questions of meaning which travel outside of literature departments, reflected in the fact that contemporary scholarship tends to discuss Snow's distinction as between that of the sciences and humanities, rather than the sciences and literature departments (see Vint 164; Vee 42; Guzdial 39; and Massey 69).[3]

While the work I've just described does not even begin to scratch the surface of interdisciplinary work, specifically interdisciplinary *cross-cultural* work in the Snow sense of *two*

---

3 For my part, I will generally distinguish STEM and the humanities in keeping with the phrasing I hear most often, particularly given that I come out of the culture of the "sciences" with a particular interest in technology and mathematics, which STEM includes more directly. When I say the sciences from here on, I am generally referring to how it's used in the acronym STEM, rather than the broader usage from Snow.

cultures, it does reflect how my slightly atypical undergraduate education and resultant graduate work has set me up well to understand and build on scholarship that looks at the intersection of these cultures. Further, I cannot help but relate my experiences to the role of undergraduate pedagogy, where STEM and humanities departments not only foster work amongst experts, but also contribute to the specialization process through undergraduate pedagogy. Before I began specializing in composition as a graduate student—which has only reinforced the relevance of undergraduate pedagogical solutions, as I'll discuss at length in Chapter 2—I had a host of experiences where I saw opportunities to draw connections between these two cultures. As said above, some of my more negative experiences arose from dissonance, but some of my most positive experiences arose from when those connections were encouraged. As undergraduate students begin to understand the depth of their respective fields, they should be encouraged to draw connections even as they learn about the boundaries and contours of their field. Similarly, Snow argues that the only solution to the cultural divide is "rethinking our education" (18). He is focused on English secondary school rather than general undergraduate education, but not due to universal norms around secondary school compared to college, which indicates that his point is still relevant. He argues that specialization is much more prominent at the secondary level in England compared to the U.S. (18), and the resultant inflexibility is the concern to address (19). Given the prominence of specialization as Snow describes in today's U.S. undergraduate programs, I think his pedagogical solution is thus still worth focusing on.

Snow's insights, then, are still relevant and useful for considering how to address this ongoing problem that is rooted in two cultural dispositions at odds. Just this month at the time of my writing, an article in *The Atlantic* proposes in its title that "The College Essay Is Dead" in recognition of recent developments in machine learning-based writing software, a subject of

discussion within my own home department. The author, Stephen Marche, directly relates Snow's description of the cultural divide when describing how, "[i]n the modern tech world, the value of a humanistic education shows up in evidence of its absence." While the modern tech world hardly encompasses all of STEM, in Marche's argument in favor of cross-disciplinary work, the lack of engagement with humanistic modes of inquiry and thought are direct contributors to the at-times dystopic developments in contemporary computer technology.

Yet there are also gulfs in context between Snow's work and the context I find myself writing in as a graduate student in the United States over sixty years on. So before considering how to further map out what role undergraduate pedagogy might play in addressing the two cultures divide, let's consider what problems have changed or been introduced since.

0.1 "The Two Cultures," Six Decades Later

0.1.1 Generalization and Interdisciplinarity

While I can't speak from direct personal experience, my understanding is that much can change in six decades. While the core of Snow's commentary is still relevant, there are some deltas to consider, and a good starting place is in Stefan Collini's 2012 introduction to a collection including Snow's 1959 lecture and 1963 revisiting of the subject. He emphasizes two major changes: an increase in public understanding and awareness of scientific concepts (lxi), and the "micro-electronic revolution" that brought applied scientific objects more directly into the average person's home (lxii). The former, I think, reflects Vint's ideas about science fiction as particularly valuable for bridging the two cultures gap (164), and additionally recognizes the general

proliferation of fictional and non-fictional media about science paired with increased spending in STEM education. Two years prior to Snow's initial lecture, the Soviet Union had launched Sputnik, leading to calls to reshape American education in what would now be recognized as STEM fields as high up as President Dwight D. Eisenhower (Watters 95-6), and further leading to substantial increases in funding to science education (Rankin 114). The then-recently founded National Science Foundation, which had begun funding educational programs in 1954, had its appropriation doubled by Congress, and the organization tripled their funding directed toward education (National Science Foundation). Media, culture, and education all had their part to play.

In this sense, the domain of STEM fields has been *generalized*, which is to say taken up outside of the domains of STEM professionals, experts, and scholars. The general public now has more access to the ideas at play in, say, the sciences. The "micro-electronic revolution," which has resulted in the proliferation of computers in daily life, has also required people to become more comfortable with everyday use of the technological results of scientific pursuits (Collini lxii). Walter Massey, former head of the NSF, also emphasizes this point in his 2018 reflection on the continued legacy of Snow's work by noting the increased accessibility of the sciences to "general audiences, including scholars in the humanities" (69).

While I think what has been made more accessible is scientific *information* more so than an understanding of the aspects of disposition Snow describes—"common attitudes, common standards, and patterns of behavior, common approaches and assumptions" (9)—I do think that work by humanists indicates an appreciation of those cultural norms in a way that Snow identifies as lacking at his time of writing. He argues there is a kind of apathy amongst those in the humanities culture toward the meaning of important historical epochs like the industrial and scientific revolutions in a way that, to me, no longer resonates: "If we forget the scientific culture,"

he says, "then the rest of western intellectuals have never tried, wanted, or been able to understand the industrial revolution, much less accept it. Intellectuals, in particular literary intellectuals, are natural Luddites" (22). The meaning of these revolutions, and their social consequences, has been the focus of —to name two major examples that are different in kind—books like Thomas Kuhn's 1962 *The Structure of Scientific Revolutions* and the rise of science and technology studies since the 1970s, a field that necessarily engages with the social roots and consequences of the development of science and technology (Blume 349-50). Both reflect the work by humanists to understand the sciences and technology as technical objects without forsaking a focus on meaning, addressing the exact issue Snow describes.

Interdisciplinary work reaching toward the STEM culture from a humanities perspective goes far beyond the scope of the industrial revolution. From literature, to history, to philosophy, to more recent academic disciplines such as cultural studies and feminist theory, there is an abundance of scholarship that can serve as examples. Hayles, a scholar of literature, combines technical and historical analysis with an emphasis on meaning in her 1999 *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics*, where she considers the ideological basis for Claude Shannon and Norbert Wiener's theories of information and the rise of a new conceptualization of what it means to be human as interrelated processes (53-4). She further engages deeply with the content of scientific works like Stephen Wolfram's *A New Kind of Science* and Harold Morowitz's *The Emergence of Everything* in *My Mother Was a Computer: Digital Subjects and Literary Texts* (18-30).[4] In philosophy, Smith interrogates ideas underwriting the rise

4 Several of Hayles' books will appear in this dissertation, so I will use an acronym for each title after it's been introduced. Here's a guide for this chapter:

of computing and AI, arguing they are "likely to be as consequential as the Scientific Revolution—an upheaval that will profoundly alter our understanding of the world, ourselves, and our (and our AI's) place in that world" (*Promise* xiii-iv). The impact and role of human beings in the Scientific Revolution, and what has come after, have had unprecedented consideration by a range of humanists since 1959.

Within mathematics, a subject of particular interest to me, there are scholars like historian Judith V. Grabiner with articles on the central role of mathematics in defining a specifically Western tradition of thought ("Centrality"), or one titled with the probing question, "Is Mathematical Truth Time-Dependent"? Sara N. Hottinger, who herself describes a sense of being between the cultures of mathematics and feminist studies (1), centers her book on the work she did as a graduate student in the latter field to help understand the former, bringing together "cultural studies, postmodern theory, and mathematics" (11). More humanists than could possibly be discussed here have since Snow's time challenged the criticism that they are uninterested in the topics that he ascribes to the traditional domain of the sciences and other subjects in STEM.

The interdisciplinarity is, of course, not unidirectional. As Massey also points out, scientists are now more inclined toward interdisciplinary work, contributing to the narrowing of the cultural gap (69). Within mathematics, there are several examples of such interdisciplinary approaches: mathematicians like Morris Kline have written rich historical texts oriented around interpretive questions like the role of certainty in the history of mathematics across time and

---

How We Became Posthuman: *HWBP*

My Mother Was a Computer: *MMWAC*

Writing Machines: *WM*.

I'll simplify *Postprint* by using just that word instead of the book's full title and subtitle.

cultures (6-7). John Stillwell's *Mathematics and Its History* attempts to address a gap between understanding ideas within mathematics and understanding the more general meaning of what it is to *do* mathematics (xi), a gap that I see reflected in my undergraduate lack of understanding the role of ring theory within mathematics. Mathematician Luke Hodgkin's *A History of Mathematics: From Mesopotamia to Modernity* considers not just historical developments in mathematics, but different ways of understanding what mathematics is and how it develops, centering ways to evaluate *meaning* in said histories (3-4); he directly relates his textbook to Kuhn's aforementioned seminal text on understanding the meaning of scientific revolutions (8-9). The more recent *Six Septembers: Mathematics for Humanists* is co-authored by Patrick Juola, a professor of computer science, and Stephen Ramsay, a professor of English. Scholars in mathematics and computer science are taking seriously questions of meaning in their fields, and considering how to make technical aspects of their fields more accessible to people in the humanities, which are interdisciplinary projects by virtue of their attempts to speak across the cultural gap.

So on the one hand we have increased generalization and interdisciplinarity, which signals a decrease in distance of the cultural gap. But there's an apparent contradiction here when considering that Collini also emphasizes the increase in specialization reflected by the various sub-disciplines across universities, which he attributes to a break-up of monolithic cultures like "the sciences" into a variety of highly networked sub-cultures (xliv). There is an increased amount of work at the intersections of the two cultures, yet academic work is increasingly siloed not just in terms of STEM and the humanities, but within the disciplines, sub-disciplines, and specializations that comprise them.

While Collini's insights are relevant, I think there's a more systematic way to understand this apparent contradiction between increased generalization and specialization, which leads us to

focusing on the second major change: the increasing ubiquity of "micro-electronic" technology, or the more useful term that Collini employs, *computers* (lxii). The computer, which will be defined more rigorously in section 0.2 but for now will serve as a metonym for micro-electronic and digital technologies, proves essential for understanding the twin roles of specialization and generalization in affecting the relevance of the two cultures problem today.

0.1.2 Specialization

Computers and their history in the United States reveal how the increases in specialization and generalization are two sides of the same coin, the coin being changes brought on by the rise of digital technology and its proliferation into public infrastructure and use. These sides correspond to the role of the computer as an information processing machine and *universal solvent*—a coinage I borrow from Paul E. Ceruzzi and Thomas Haigh, as explained below— respectively. The role of the computer will be central to this dissertation as a whole in terms of understanding and attempting to address the two cultures problem via undergraduate pedagogy, and so this section aims to start defining and contextualizing what the computer is more rigorously as a historically-situated technological object in service of better understanding the changing dynamics of the cultural divide since Snow's initial lecture. While the understanding of a computer set up here will be built on in the next section, 0.2, the computer-as-information processor and the computer-as-universal solvent will help begin the conversation and clarify the twin nature of specialization and generalization as changes of note over the past half-century for understanding the two cultures problem.

The computer-as-information processor illuminates the increase in specialization in American universities by bringing into frame the early developments in digital electronic

computers, a more specific predecessor to the digital technological objects we generally call "computers" today.

To start, it's important to understand the basic technologies that led into digital electronic computers, and then what led to the funding and infrastructure that enabled the creation of the expensive machines that can be tied to the proliferation of digital technology over the second half of the twentieth century. Computers arose in a context of military, governmental, and commercial needs for information processing; Martin Campbell-Kelly et al., in their seminal and fittingly-titled computer history book, *Computer: A History of the Information Machine*, situate the computer as stemming from "giant office-machine firms of the 1890s" (19), the Hollerith tabulation machine for the 1890 census (18), and the "need for mathematical computation" during World War II that led to the creation of the ENIAC and other influential early digital electronic computers (65), not to mention pre-war predecessors like the electromechanical Harvard Mark I and IBM Automatic Sequence Controlled Calculator (54). Herman H. Goldstine, reflecting on his own work in the ENIAC and later machines from the standpoint of the 1970s, reflects Campbell-Kelly's emphasis: "In sum," he writes at the end of his book, "the importance of the computer to society lies not only in its superb ability to do very complex tasks of an abstruse mathematical nature but also in its ability to alter profoundly the communication and transformation of all sorts of information. It is the latter capacity that has been so useful to the humanist and the sociologist as well as to the businessman" (345). Note the connection that is already being drawn between the specialized role of the computer as an information processor, and the generalization of the technology's usefulness that results, reaching across the cultures toward humanists and sociologists.

World War II is also relevant in this history as that war demanded a staggering amount of information processing, which included a substantial amount of *computation*, a process that even

throughout the war was primarily the domain of human computers (Campbell-Kelly et al. 3). The volume of computation needed during World War II, much like the Hollerith tabulation machine's origin in the need to count census details of a large population, created a need for a more efficient, reliable technological solution (Campbell-Kelly et al. 65; de Mol & Premiero 199). The unprecedented interconnections between government, military, industry, and academia—what Haigh et al. call the "emerging military-industrial-academic complex" (5)—enabled the funding and depth of research required for the digital electronic computer to get its footing in service of meeting an information processing need that would not subside after World War II (Haigh et al. 4). Vannevar Bush, head of the Office of Scientific Research and Development during the war, wrote toward its end an article oriented toward the general American public that there was a need for increasingly sophisticated technology as a means to address "specialization," which was "increasingly necessary for progress" (37). To parse through the kind of specialized information that humans needed to now deal with, a means for performing "complex computations" was essential but at the time "still in embryo" (Bush 41). Writing in 1962, Douglas Engelbart places his work as an extension of Bush's in considering the possibility of computer augmentation for human intellectual work, i.e. a technology for managing more information than a human could reasonably handle on their own (98-9). The increased need to process information in a variety of contexts was a problem that the digital computer was designed to solve both at its origin and throughout its history. The proliferation of what could be understood as information and processed accordingly had spread across several specialized domains, across the government, military, academic, and commercial sectors. Again, the technology became generalized in service of supporting specialist work across a variety of contexts.

The computer's development was an expensive and complex enterprise that reflects the changing dynamic of scientific research and technological development in the United States following World War II. Its ability to store and compute at scale with great speed represented a seismic shift in the possibilities scientists now had in front of them, represented most terrifyingly by the computer's role in performing complex calculations needed for the ongoing development of nuclear weaponry (Haigh et al. 5). The computer's legacy as an information processing machine relates it to the increasing prominence of specialization in society by recognizing the specialized work it enabled, whether it be nuclear research in the sciences or sophisticated information processing needs by firms and institutions dealing with data about a rapidly expanding population. The computer as a technological object is inseparable from the rise of specialization in a modern context, the historical processes that enabled it, the basis of the computer's initial funding and development, and its sustained use over the coming decades amongst the military-industrial-academic complex. An explosion of needs across a variety of sectors represented an immediate problem, and the shift from the computer as a specialized scientific tool to being a general solution to the needs of disparate domains is the legacy that leads to digital ubiquity in the present.

Generalization, then, reflects how the evolving design of the digital electronic computer sought generality of representation in service of meeting specialized need, in effect dissolving the operations of those specialized domains and their unique needs into a form that could be consistently addressed with a single class of technological object. This understanding of the computer as dissolving different domains is the basis of Haigh and Ceruzzi's term *universal solvent*, which they use to describe computers in *A New History of Modern Computing*, their 2021 reworking of Ceruzzi's essential contribution to computer history that was first released in 1998. They argue that the computer has become a "universal solvent, … making an astounding variety

of other technologies vanish into itself" (3). With much less depth, Ceruzzi first mentioned the idea in the 1998 edition (309), and Hayles wrote on the same concept in 2004: she describes a "current tendency to regard the computer as the ultimate solvent that is dissolving all other media into itself" (*MMWAC* 31).

Her concern is that this approach flattens several complex, interweaving processes into a uniform medium, but as I hope to demonstrate here, I think understanding the computer as a solvent can help to enrich our understanding of how technology interweaves with the "social and cultural processes" that Hayles worries about eliding (*MMWAC* 31). The computer is a universal solvent not only in terms of dissolving other media into itself, but also in partially dissolving communal practice through use of that technology. Because the computer made the jump from use in scientific computing to use across scientific, commercial, governmental, personal, and military domains, a variety of communities had to consider how to shape their needs and understandings/representations of the world into the logic of the computer, one of digital representation and computation.

Thus, a technology designed to support specialized information processing needs also became a technology of generalization, in terms of both dissolving different media into itself and unifying use through the object of the computer. As Haigh and Ceruzzi add, "Whenever the computer became a new thing it did not stop being everything it had been before" (5), which reflects that the technology was both general enough for widespread use while retaining its technological specificity as an information processing machine. Digital ubiquity—which is no doubt the current situation in most American universities; even considering disparities in access, interest, and funding, a university with no digital technology is necessarily standing out from the overwhelming norm—has created the conditions for the changes to the two cultures divide that I

find most important when looking at Snow's work and Collini's updated reflections on it. That is, the computer's shared use across several specialized disciplines can provide opportunities for collaboration. Whether it's computer scientists and mathematicians working with scientists to model complex phenomena, or philosophers asking fundamental questions about the assumptions driving AI research, the computer functions as a tool to do specialized work while also enabling collaborative or cross-cultural work through shared familiarity with and use of a generalized technology. The specialist spaces can communicate with a greater number and variety of groups through digital technology, as the computer can serve as a basis for interdisciplinary work by revealing different skills held by different groups using the same technology, or by providing new perspectives on that use. Further, the specialized work across STEM, the humanities, and the social sciences must regularly consider the role the computer plays in their object of study, e.g. how smartphones have been taken up and used by different social communities. The specialist role the computer initially had has increased the specialized domains of study that are possible by enabling substantial information processing that would have disabled or prevented the growth of several fields, but its design for general use across domains has enabled interdisciplinarity and pushed scholars of all sorts to have to consider how this technology has been taken up across contexts.

0.2 The Computer, Computing, and Computation

The computer is essential for understanding the differences in context between my focus on contemporary American universities and Snow's perspective, which comes from an English context with a broader educational focus. As argued in section 0.1, the computer has introduced new problems of generalization and specialization arising from the computer's origins in

specialized information processing and the dissolution of other technologies and community practices stemming from generalized use of the computer. While the computer-as-information processor and computer-as-solvent pairing helps to illuminate these changes, I think it's important to clarify how I'm using *computer* and how it contrasts *computation* and *computing*. Doing so will build on the previous definition(s) of *computer* and further relate how the understanding of this triad of terms as used in this dissertation contextualizes digital technology as a way to understand the current landscape of the two cultures divide and, hopefully, address it. The choice of these terms and how they're defined is itself meant to enact a cross-cultural understanding, recognizing how the two general cultural dispositions can be utilized to perform a more unified, sophisticated, and useful analysis of not only digital technology, but the contemporary university paradigm that an effective pedagogy must understand and address. Smith's work will not only help parse these three terms; it will also serve as an example of how a specialized approach to understanding computers—in Smith's case, from the standpoint of philosophy—can perform cross-cultural work by taking seriously the specialist understanding of another domain—in this case, computer science and artificial intelligence research—and then applying the lens of one discipline to the work of another.

A computer is a digital electronic technological object; while *computer* generally indicates digital technology that relies on an operating system and screen-based interface, it can also describe technology that has become digital through incorporation of digital computer technology, e.g. microwaves, cash registers, and television antennas. Frankly, it's the least interesting of the terms for our purposes.

Computing and *computation* respectively extend our ideas of the computer as a universal solvent and an information processor. My description of the computer as *a solvent dissolving both*

technologies and community practice reflects Haigh and Ceruzzi's use of the latter term; they invoke *computing* as initially defined by Michael Sean Mahoney (Haigh and Ceruzzi 5), who describes "the process of different communities trying to incorporate the computer into their practices and goals" as creating "different … computings" (64). *Computing*, then, describes the use of the computer by different groups of people, who had to mediate between their goals, desires, and practices on the one hand, and the computer as a technological object on the other. This human-centered definition pairs nicely with both Haigh and Ceruzzi's history as reflected in their title, as well as Joy Lisi Rankin's 2018 re-telling of computer history in a way that de-emphasizes more mainstream and traditional cultural and corporate narratives, or what she calls the "Silicon Valley mythology" (2). She argues, "We need histories not of computers but of the *act of computing*" (11, emphasis added), reflecting that computing is a process taken up by people and that the ways in which the technology interfaces with these communities is, as Bush argued, not simply the domain of specialists but of people coming to terms with a society in which digital technology is now ubiquitous.

Computation describes the technical aspects of the computer, the "everything it had been before" that Haigh and Ceruzzi allude to as informing the process of incorporation of digital technology by various communities (5). More specifically it describes the process that enables information processing, i.e. the computation of discrete values in programmed sequence. Smith's work is once again useful for theoretically understanding computation due to his depth of work on theories *of* computation from a philosophical perspective. In both a talk cited already in this

dissertation and the introduction to a never-finished project called *The Age of Significance*,[5] Smith defines major theories of computation, particularly those used as a basis for equating computing to the human mind. He settles on roughly five non-mutually exclusive theories or "construals":

---

5 The incomplete *Age* and the talk included here are relatively informal as sources, but I've chosen to include them for a handful of reasons. First, while his *Promise of Artificial Intelligence* is a useful book and will be referenced here, it does not cover the same material with the same depth as his talk and the now de-listed introduction. He does point to an upcoming work*, Computational Reflections* (*Promise* 4n2), that would seemingly be all someone writing about meaning and computation could ask for, but I don't see any indication that it's on the horizon. Much of the material in *Age* is covered in a chapter from Matthias Scheutz's collection, *Computationalism: New Directions* from 2002, but given that Smith says the chapter is "distilled from" work being done for *Age* ("The Foundations" 53n1)—the introduction to which is dated eight years later—and given the lack of emphasis on the meaning-mechanism dialectic, I think *Age* is the more relevant text. The talk is included due to it covering much of the same material with additional insights, and being more recent by a few years. The cited material from the video included so far, for example, do not show up in *Age*.

Related to my focus on *Age*, although my re-use of Smith's approach to meaning, mechanism, and computation serve as the basis for how I understand computation and computing, it's briefly worth noting how Smith describes the distinction between computation, computer, and computing in the *Age* introduction. He's more focused on the distinction between the first two terms, noting the common understandings of computation as an abstract concept enacted in the physical computer, while computing is a more general term to describe "active processing" (11n18). My use of the terms might seem out of place then, especially given my partial roots in his work, but it's worth noting that he intends to challenge this abstract/concrete distinction in a future moment that, as far as I can tell, has not yet happened. I believe that my work does build on his concepts and rejects the abstract/concrete distinction between computation and computer that he's concerned with here. I have reworked the focus to be between computation/computing, with the mechanism/meaning distinction initially paralleling those terms but eventually revealing how the two ideas are at play in both computation and computing.

"formal symbol manipulation, effective computability, Turing machines, information processing, and digitality" (*Age* 13). Notably, Smith describes these theories not just in terms of their self-described insights into the nature of computation and computers, but in terms of how they balance a consideration of the computer's *mechanistic* and *meaningful* qualities.

Smith's use of *meaning* and *mechanism* is important to understand, as the terms capture the difference in cultural disposition reflected in the above definitions of *computing* and *computation*; this will allow us to see the computer not as something technological on the one hand and social/interpretive on the other, but as at once incorporating these concepts and recognizing that they are both always in play. The meaning/mechanism pairing gives us a way to continue to understand the computer through *computing* and *computation*, continues to recognize the general distinction in cultural dispositions outlined in the previous sections, and—most importantly—gives us a dialectical framework with which to understand the co-presence and mutual influence of these two concepts.

0.3 Looking Forward

In the next chapter, I will set up the theoretical foundations for this dissertation by relating these terms and their dialectical relationship as Smith describes them, and then show how they help to understand Smith's analysis of theories of computation, which in turns rounds out this introduction's definition of the computer through *computing* and *computation* as terms corresponding to *meaning* and *mechanism* in the meaning/mechanism dialectic. I will then explore the utility of this dialectic further to show how it helps address cultural divides in understanding contemporary topics relevant to STEM and the humanities, as well as extant or potential work at

their intersections. With this developed understanding of the computer and the meaning/mechanism dialectic, the ability to see the computer through a cross-cultural lens will provide insight into how to make use of it in addressing the current state of the two cultures divide in U.S. academia, with a focus on an undergraduate pedagogical solution. From there, the rest of the dissertation will look toward how the framework developed in the next chapter can be further developed by connecting it to undergraduate pedagogy via composition studies and its focus on the teaching of writing, which will then become the basis for considering other parts of undergraduate education and how to address the two cultures gap in a variety of undergraduate contexts.

While the next chapter will set up much of the remaining theoretical groundwork for the dissertation, the chapters following will be focused on developing a specific inflection on digital pedagogy rooted in the meaning/mechanism dialectic, because I believe it can help to address the two cultures problem. I think that it can help frame the computer in its historical and technical context with consideration of how it has contributed to the problems of generalization and specialization as discussed in section 0.1. Composition studies has had to consider these generalization/specialization questions before with the teaching of writing, namely in teaching first-year writing courses taken by the majority of students at a given university, or teaching other writing-intensive courses that fulfill degree requirements. As I will demonstrate in the literature review for Chapter 2, section 2.1, key concepts from composition studies such as *transfer*, *discourse communities*, and *rhetorical genre theory* will be invaluable in enacting the digital pedagogy that serves as the focus of this dissertation.

1.0 Meaningful Mechanisms

Let's revisit the two examples of cultural division from the introduction, the first being Snow's scientists who take some degree of insult at being asked about the meaning of mass, and the second being Smith's light chastisement for his questions on the aboutness of information. What these examples reveal is how scientific dispositions can privilege mechanism at the cost of meaning and lead to miscommunication.

In Snow's example, note what is being *said* compared to what is being *heard*. Snow's question asks about the meaning of *mass* as a concept, but is heard as soliciting a rote definition—an elision of how even "simple" scientific terms hold in them a history of theory, research, discussion, and experimentation, paired with a myopic focus on understanding *mass* as a well-defined concept that is useful in so far as it enables more complex scientific inquiry. That is, *mass*'s definition from Snow's perspective is a site for understanding the meaning inherent in the term as something defined and understood by different cultures over time, but the definition from the scientific perspective is a tool for achieving higher-level meaning. The Smith example is similar. Undoubtedly, there is much meaning to be found in understanding the definition of *information*, be it Hayles' *HWBP* or Smith's uptake of the concept through his evaluation of construals of computation. But for the audience Smith spoke to, *information*'s definition is mechanistic, lacking meaning outside of what it enables in computer science more broadly.

Mechanism, then, contrasts *meaning*, and emphasizes what I've been calling *technical* features or forms of thinking—that is, aspects of functioning that appear closer to the "natural way of things" or some objective process outside of human desire and perception. For example, if a heavy boulder falls from high up and lands on soft ground below, it will impact that ground

regardless of whether a human wills it or witnesses it, because the mechanisms of the appropriately titled *mechanics* do not require human subjectivity to function. Smith describes the term as reflective of the fact that his audience will "recognize computers as subject to substantial and fundamental constraints of effectiveness or mechanical potency" (Smith, *Age* 17). The term exists not simply in opposition to meaning, but in a dialectical relationship with it. That is, there is not an *a priori* mechanical function to a piece of technology; the way the technology is designed and used is informed by questions of meaning and human perception.

When I say *mechanism*, then, or describe something's *mechanistic* or *mechanical* qualities/functioning, I'm describing what appears to operate based on cause-and-effect processes outside of direct human control, while recognizing that the human influence is present in different degrees. For example, a machine might add 2 to 1 and produce an output of 3, but the coldly mechanical nature of it and lack of human decision-making will seem very different if the 2 and 1 represent the dollars someone owes to a cashier for coffee plus a tip, compared to the number of felony crimes they have committed, which with a Three Strikes law could put them in prison for life. The process is roughly the same, but what it does cannot be fully separated from who designed the mechanism or how it's used. If there were qualifications on what kinds of felonies counted as part of this law, the mechanism would need to change accordingly, because now a simple counting of the number of felonies is insufficient for the human goal it fulfills.

Computation is a way to emphasize the mechanistic qualities of the computer. As illustrated in section 0.2, the computer's role as an information processor—which describes its mechanical functioning and purpose—is important to understand for contextualizing its present use. But what the *meaning*/*mechanism* dialectic reveals is that despite such a definition of *computation*-as-mechanism, it still cannot be separated from the other half of the coin, *computing*-

as-meaning. Here, Smith's contributions to the study of computation are invaluable. I won't review all of the construals and his commentary, but instead focus on the one that Smith identifies as both the basis of most computer science departments and the most mechanistic theory of the ones listed: the theory of effective computability ("Brian" 5:30; *Age* 22). In such theories, rooted in the work of Alan Turing, computers are instantiations of abstract machines that can theoretically perform all possible computations based on assumptions like the ability to read and write information, e.g. a binary digit, and containing as much memory/storage as needed (Turing, "Computing Machinery" 52-3). Here, we have mechanism taken to a logical extreme, where the rules and functioning are themselves abstracted out of the material world. The beauty of this abstraction is that it makes all technologies that might function like such a machine essentially equivalent, demonstrating a universality to computational methods that follow such a form.

Smith challenges this claim to universality/equivalence between all technologies that can enact computation in the way Turing described by highlighting not simply the lack of physical considerations, but the fact that the programs by which different abstract technological designs can perform the same computations as the others is itself meaningful. To demonstrate the point, Smith points out the absurdity of saying a motor is equivalent to some other machine like an MRI if some number of parts and methods allow the former to function like the latter (*Age* 32-3). Surely the motor, even with a variety of parts arranged in "Rube Goldberg[-like] complexity" (*Age* 33), could not meaningfully be called equivalent to an MRI machine. Smith's words for the problem are strong: "this equivalence metric is a terrible idea: tremendously misleading, the historical progenitor of fifty years of intellectual misadventure, and a continuing distraction to our ability to understand the powers and limitations of meaningful mechanisms" (*Age* 33). Thus, even the most

mechanistically-oriented theory of computation necessitates a consideration of meaning, of the *aboutness* that Smith was chastised for asking about in a room full of scientists.

Smith's application of the meaning/mechanism dialectic to the theory of effective computability reveals that while computers clearly function based on mechanical processes, it is not possible to define them fully mechanistically:

> Computers, in the end, turn out to be rather like cars: objects of inestimable social, political, and economic significance, but not destined, per se, to be the subject matter of deep, generative, intellectually satisfying explanation. The reason is simple. Beyond manifesting a dialectical interplay of meaning and mechanism, computers per se do not have what I earlier said they must have, in order to constitute a genuine subject matter: they are not sufficiently special. (*Age* 38)

I agree with his conclusions that there is no one obvious theory of computability that can define the computer purely in terms of mechanism, and that the computer is, like a car, not meaningful in and of itself as a unique form of technology. But to me, the fact that they do "manifest[ ]a dialectical interplay of meaning and mechanism" is what makes them so theoretically rich through the lens of computation and computing, or mechanism and meaning, or the cultures of STEM and the humanities. They are rich not necessarily as the basis for reshaping theories of mind, or economics, or the universe, but for serving as what Smith calls a site: "an historical occasion on which to see general, unrestricted issues of meaning and mechanism play out" (*Age* 40).

The roots of such misunderstanding through the removal of questions of meaning run deep in the history of computers. Consider, in addition to Turing's work, the contributions of Claude Shannon to information theory in "A Mathematical Theory of Communication." In his introduction, he outlines the problem with defining and working with communication in a way that echoes what Smith identified as problematic in Turing's work:

> The fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point. Frequently the messages have *meaning*; that is they refer to or are correlated according to some system with certain physical or conceptual entities. These semantic aspects of communication are irrelevant to the engineering problem. The significant aspect is that the actual message is one *selected from a set* of possible messages. (379, emphasis in original)

Shannon abstracts the meaning of messages out of the equation as the basis for his theory of communication so that it can fit in with the mechanical capabilities of engineering at the time. Such a theory of information is limited and specific to a certain technological context, which Hayles notes was a common criticism even at the time of Shannon's theory and one that Shannon seemed aware of, recognizing that his theory could not serve as a full, general theory of communication (*HWBP* 19). In fact, Hayles argues that the technological context and information processing needs at the time is what made Shannon's theory of disembodied, immaterial information so plausible. She provides language that helps to understand the issues this move creates, what she calls the *Platonic backhand* and *forehand*. The *backhand* refers to the general work of theory, where a simplified model with explanatory power is abstracted from a messy reality (*HWBP* 12-3). Shannon's theory of information performs the backhand, providing explanatory power through the ability to understand communication and information in a way that can enable engineering in service of the communication of that information as bits, i.e. as something that can be represented as combinations of two discrete numbers, 0 and 1. Clearly, such a theory has had substantial success, as I write this paragraph on a computer and prepare to upload it to a cloud service for access on another device, unworried that the information here on my laptop will be meaningfully different from the information when I look at it on my home computer.

The issue comes with the *forehand*, where the model is assumed to represent the fundamental workings of the universe, expressed imperfectly in the material world (*HWBP* 12-3). In the case of Shannon's work, a mechanistic backhand move of defining information as removed

from meaning becomes a forehand move by assuming this theory represents the fundamental reality of the material world, leading to the mis-perceptions and "fifty years of intellectual misadventure" that Smith describes (*Age* 33), along with misplaced science fiction-like dreams that Hayles identifies as arising from Shannon's theory. "Marvin Minsky," she writes, "precisely expressed this dream when, in a recent lecture, he suggested it will soon be possible to extract human memories from the brain and import them, intact and unchanged, to computer disks. The clear implication is that if we can become the information we have constructed, we can achieve effective immortality" (*HWBP* 13). Shannon may have been aware of the limitations of his theory-as-Platonic backhand, but the consequences are countless instances of the Platonic forehand wherein the removal of meaning from information and communication becomes not simply a useful model, but reality itself. Similarly, when historical figures in the downstream conversation of artificial intelligence like Joseph Weizenbaum and Hubert Dreyfus critique the theories of mind, communication, and information of their contemporaries, they are making philosophical critiques; that is, they reject the forehand move as misunderstanding a model for reality, noting instead other theories that challenge the theories used in the development of artificial intelligence at the level of meaning (Weizenbaum 13; Dreyfus 65).

Thus we have the various pillars of this dissertation's understanding of the two cultures problem and what to do about it. There is a cultural gap that is particularly pronounced when the meaning/mechanism dialectic is ignored, assuming the meaningful act of theorization—Hayles' Platonic backhand—is mistaken for a purely mechanistic explanation of reality—Hayles' Platonic forehand. And it is this gap that I think should be addressed; scholars in both cultures can benefit from seeing how both use mechanism and meaning in tandem, creating abstracted models of the world that do capture mechanistic traits outside of human subjectivity, while being formed by

people in certain cultural and historical contexts that can help understand the mechanisms' development, application, and limitations.

As noted in the introduction to this dissertation, while the cultural divide broadly remains, there has been an increase in interdisciplinary work, generalized use of specialist technology, and increased specialization. These increases stem from the changing climate at the time of Snow's writing rooted in information processing and the development of the digital electronic computer, which has only continued into today's context of digital ubiquity. To understand how the computer is at play requires an understanding that interweaves the general cultural dispositions' viewpoints through understanding the paired concepts of *computing* and *computation*, corresponding to STEM and humanities cultures. To understand the interrelation of these concepts and possibilities for further interrelating the cultures despite their divisions, Smith's *meaning*/*mechanism* dialectic can enable a cross-cultural mode of analysis that recognizes the differences between emphases in meaning and mechanism without drawing a binary distinction between them, which would only reinforce the difference in dispositions and perspectives seen as dividing STEM and humanities.

The solution requires a focus on undergraduate pedagogy, an argument I make as an extension of conversations around the two cultures as discussed in section 0.0, as well as in recognition of how questions of generalization and specialization are at play in composition studies, which has had to consider these questions in terms of undergraduate writing pedagogy. I will begin to draw out the role of pedagogy further in section 1.2, after which it will become a primary focus of the thesis throughout the remaining chapters.

1.1 Applying the Meaning/Mechanism Dialectic

Before exploring work that considers the analogy between computer and writing technology, which will round out applying the theoretical terrain covered in this chapter and the introduction, I want to explore the meaning/mechanism dialectic as a useful tool for cross-cultural analysis through a set of examples. The examples will demonstrate the utility of the dialectic by looking at two objects of analysis in STEM and two in the humanities. For the former, I'll discuss two examples about mathematics, one involving the role of mechanistic viewpoints in the history of mathematics as clarified by humanist inquiry into that history, and the other on recent attempts to purposefully contextualize mathematical concepts and methods as meaningful through public-facing videos and writings that engage directly with mathematics and the value of mathematicians' work. With these two examples, I hope to demonstrate not only what humanists can bring to STEM topics, but also what those in STEM are doing and can do to make the meaning of their work clear for a non-specialist audience.

Following these examples, I turn toward the purview of the humanities as a way to look at how the meaning/mechanism dialectic has contributed or could contribute to the study of certain subjects from a humanities perspective, or to methods employed by humanists, which often differ from those in STEM. First, I will focus on the question of method and the utility of the meaning/mechanism dialectic in understanding humanities methods by looking at the conversation around *distant reading*, which contrasts *close reading* by focusing on the (often machine-assisted) practice of reading large corpora of texts. Then, I will apply the dialectic to a humanities subject by looking at how scholars and cultural critics have navigated the application of mechanistic ideas to narrative in today's era of ubiquitous digital computing. In this final example, I hope to reveal how the dialectical approach can illuminate the impact of mechanistic digital technology on

culture, particularly through a focus on a subject that seems to emphasize meaning more than any other: storytelling.

After going through these examples, I will turn to one last example that is particularly salient as a hybrid of STEM and humanities subjects that can be understood via the meaning/mechanism dialectic directly: a connection between writing technology and digital technology as explored in the works of Hayles and Annette Vee.

1.1.1 Meaningful Mechanisms in Mathematics: Humanists Look In

In the first example I focus on mathematics, a STEM field that is both of interest to me and, I argue, particularly rich with mechanistic viewpoints. In this example, I will relate mechanistic viewpoints in the history of mathematics, how these viewpoints were challenged through crises in the study of the foundations of mathematics, and the way these perspectives led into the theories of effective computability underpinning contemporary computer science. The goal is to demonstrate how the meaning/mechanism dialectic enables cross-cultural analysis by considering how even a mechanistically framed subject is shot through with meaning, and to simultaneously add more context to the history leading directly into the proliferation of computers at the academic, institutional level. That is, this section reframes mathematics as not purely mechanistic, but as a field of *meaningful mechanisms*, a coinage I borrow from Smith to describe an approach to studying an object or subject that treats mechanism and meaning in dialectical terms.

Mechanistic viewpoints in the history of mathematics are plentiful, but upon further examination reveal the co-presence of meaning in the historical development of these viewpoints. Looking back at the scale of millennia, Grabiner relates Plato's vision to the Biblical creation story

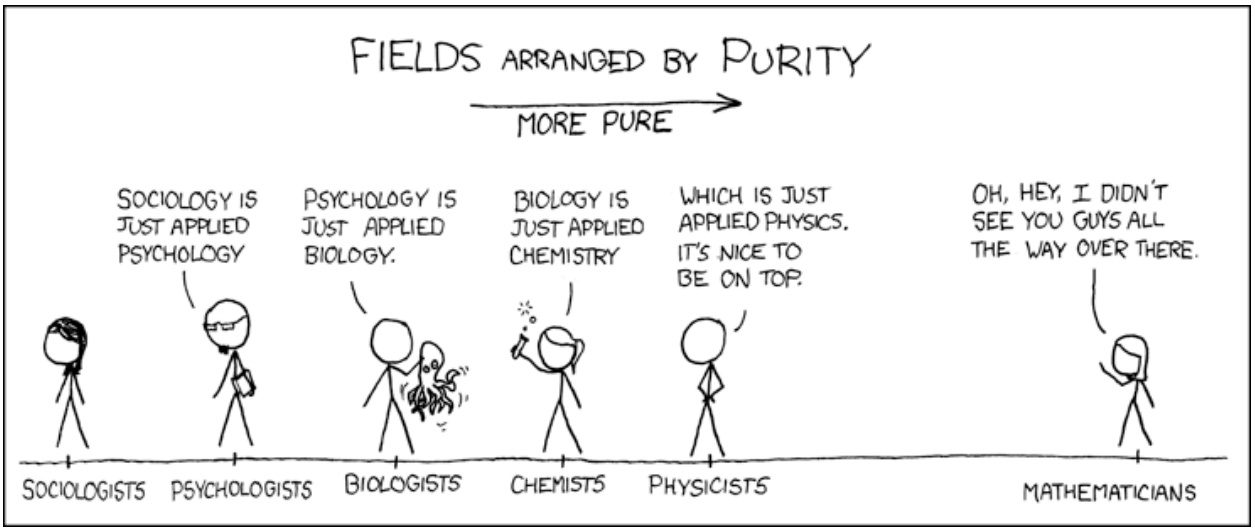
of the universe as instances of a perfect mathematical model being replicated in the physical universe ("Centrality" 221). Perspectives on mathematics that treat it as the laws of nature or design of God are mechanistic in that they are focused on how the mechanics of mathematics directly represent the fundamental nature of reality, and thus exist and can be understood outside of human interpretation and context. The meaning is placed outside of human intention and instead abstracted to a third party, be it God or nature.

Such a perspective is hardly limited to the views of a few mathematicians; Grabiner argues that mathematics in this vein held "a crucial role … in shaping views of man and the world held not just by scientists, but by everyone educated in the Western tradition" ("Centrality" 220). This mechanistic view of mathematics and its relationship to the world was essential and long-lasting. It also impacts the way mathematics is understood as less human- or materially-mediated than other parts of STEM, in particular the sciences. To appeal to two wildly different sources: in Hodgkin's historically-oriented mathematics textbook, he notes that mathematics is often argued to be unique among the sciences by virtue of lacking what Thomas S. Kuhn described as *revolutions* (9), or fundamental paradigm shifts in methods, tools, and ways of understanding (8). Here, mathematics is viewed as dealing with more fundamental, rigorously defined truths, ones that are applied in the material world but no less transcend it.

In the widely read webcomic *xkcd* by Randall Monroe, a single-panel comic called "Purity" communicates a similar concept (see Figure 1). The panel depicts a graph titled "FIELDS ARRANGED BY PURITY," increasing left to right. The reader sees a figure labeled "SOCIOLOGISTS" followed by a labeled psychologist stating, "SOCIOLOGY IS JUST APPLIED PSYCHOLOGY," echoed in turn by the biologist behind him saying, "PSYCHOLOGY IS JUST APPLIED BIOLOGY." The biologist is similarly followed by the chemist, who is

followed by the physicist, seeing no one in as near a proximity and feeling quite good about it. But even *further* away, to the far-right end of the graph, stands the mathematician, breaking the cycle in words but not in spirit: "OH, HEY, I DIDN'T SEE YOU GUYS ALL THE WAY OVER THERE." Monroe's comic is different in tone than Hodgkin's book, maybe, but it communicates the same idea: mathematics just seems less messy and confounded by materiality and human application than the rest of the sciences.

Figure 1: "Purity" from *xkcd* by Randall Monroe, licensed under CC BY-NC 2.5.



The history of how mathematics was understood from the late medieval period to the early twentieth century gives us substantial insight into the meaning of mathematics itself in regard to human interpretation and use, which in turn demonstrates the way human beings engaged in discourse about meaning in mathematics in ways that cannot be neatly separated from their historical, cultural, and social contexts. That is, the mechanistic viewpoint of mathematics gives us a great opportunity to discuss meaning in the field and perspectives thereof, demonstrating how this dialectic enables cross-cultural analysis of even the most apparently mechanistic science.

I do not intend to communicate that mathematics is purely a human-constructed subject, that the truths it describes are only true in so far as a human perceives it to be so. Mathematics does describe phenomena of the material world outside of human construction and perception. Even something as fancifully-named as imaginary numbers can be used to predict the behavior of real-world phenomena, e.g. alternating current and electricity. However, I think it's important to note that mathematics *describes*. The field itself is how human beings apply Hayles' Platonic backhand to the material world. The model that results can describe the material world as it behaves outside of our will and perception, and if the model fails to correspond to the world it describes, then it is an insufficient model. But mathematics, the field itself, cannot be removed from the human context, from the process of abstracting the world into a representative model. Mathematics was developed by people to understand the world; the foci of mathematicians in their various specialties and the nature of the field itself are human activities and conversations, itself a dialectic between human desires, understandings, and decisions on the one hand, and the mechanistic processes those activities and conversations center around on the other. As a result, understanding mathematics requires looking at the dialectical nature of it; the work of mathematicians cannot be removed from questions of meaning, which means that mathematics is not a purely mechanistic field. It is open to questions of meaning both by the people in it, who shape what mathematics is, and people outside of it, who can understand the way the field relates to the human beings that have defined it. This opens the field up to philosophers, historians, theologians, and more. It is in this understanding, I argue, that the cultural gap can begin to be bridged, as it does not forsake a meaningful or mechanistic perspective, but instead uses both to better understand the subject in all of its complexity.

Of particular use here is Grabiner's work and that of Morris Kline, a celebrated historian of mathematics. Later in his career, he wrote the 1980 book, *Mathematics: The Loss of Certainty*, to rebuke the notion that mathematics is "a universally accepted, infallible body of reasoning—the majestic mathematics of 1800 and the pride of man," calling the viewpoint "a grand illusion" (5). Kline draws a line from ancient Greek emphases on mathematics as the laws of the natural world, to how a similarly mechanistic idea was brought into medieval Catholic and orthodox Christian perspectives and then continued through the Renaissance and following centuries; Christians, in this view, adapted the Greek perspective upon the rediscovery of ancient works via Arabic translations in the late medieval period, which informed the medieval understanding of the mathematical principles at play in several natural processes (37). Rather than viewing mathematical design as underpinning and defining natural order, the medieval tendency to place the Christian God as the root of all things meant ascribing mathematical order to His will, moving the relationship between mathematics and nature from one of Platonic idealism to one rooted in the generative and universal power of God (Kline 38). The belief in mathematics as representing the true functioning of the universe remained, however, defined at root as separate from human beings but discoverable by them. In this case, the role of meaning in mathematics is removed from human intentionality and action, deferring questions of significance or purpose to something fundamentally outside of human intent and, ultimately, outside of mathematics itself.

As the medieval period shifted into the Renaissance, these ideas remained in play. Catholic and orthodox Christian perspectives had both absorbed God-based understandings of the mathematical design of nature and thus saw the seeking of mathematical knowledge as a means of understanding God's design (Kline 38). Grabiner affirms the prominence of this perspective by describing the emphasis on results over rigorous proof in the Renaissance, relating the beginning

of the Scientific Revolution and the discovery of materially applicable mathematical methods in 1545.[6] Both led to a sustained belief that "increasing mathematical knowledge had meant finding new results" over rigorously demonstrated certainty of the soundness of those results and methods of reasoning employed ("Is Mathematical" 356). She argues that the invention(s) of (the) calculus at the end of the seventeenth century was part of and contributed to this legacy because it was an incredibly powerful method for discovering mathematical truths ("Is Mathematical" 356). Kline, summarizing the work of seventeenth century Western mathematicians, argues that they "built up a *mechanical* world picture, a world operating like a *machine*" (66, emphasis added), and it's important to keep in mind this is in the broader arc of the sixteenth, seventeenth, and eighteenth century, where the pursuit for mathematical knowledge was "a religious quest," "an act of devotion which would reveal the glory and grandeur of His handiwork" (Kline 39).

One of the biggest attacks on calculus in these centuries came in 1734 from a religious figure, Bishop George Berkeley, who defended the Church against claims of irrationality and unreasonableness by accurately arguing that the prized science of mathematics, through calculus, had produced accurate results with invalid methods (Grabiner, "Is Mathematical" 359). He attacks calculus methods by relating them not to the logically intuited aspects of God's design expressed in nature, but instead the *super*natural. In describing the use of vanishing increments—or values that are both greater than zero yet become increasingly small as to become irrelevant, which are essential to calculus—he critiques the lack of rigor in contemporary definitions of the term, arguing they are "neither finite quantities, nor quantities infinitely small, nor yet nothing. May we not call them the ghosts of departed quantities?" (199). Mathematicians were dealing with methods outside

6 Specifically, a method for solving cubic equations.

of God and nature's mechanisms, and studying subjects that befit the spiritual more than the rational and material, even if mathematical truths were discovered using this process.

Because, as Grabiner puts it, "the subject of foundations was still not considered serious mathematics" ("Is Mathematical" 359), Berkeley's critiques did not lead to substantial changes in the field. Even though he'd accurately critiqued the mechanisms employed in mathematicians' use of calculus, which was meant to reveal truths of a mechanistic universe, mathematicians were not in the main interested in his critique because it lacked meaning in their virtual perception of what it meant to do mathematics. Clearly, there are degrees of human influence and meaning at play in privileging results or foundations, not to mention how seriously a critique of method should be taken even in a field dedicated to understanding God's design.

Important mathematicians of the day, from Isaac Newton to Gottfried Leibniz and others, were employing calculus as part of an explosion of exciting new results that could finally deal with continuous change and infinite processes. Yet "they perpetrated all sorts of blunders, made false proofs, and drew incorrect conclusions; they even gave arguments that now with hindsight we are obliged to call ludicrous" (Kline 169). Looking back, as Kline does here, there's a budding contradiction: mathematicians were apparently uncovering godly universal truths, but they were sometimes wrong or used fallacious reasoning in their correct discoveries. Here we see the role of meaning in mathematics: just as there was a human purpose to relating mathematics and God's will—for how else could one study mathematics in medieval Europe?—there was a human desire for results and success within the mathematical communities that informed the seemingly objective practice. To push for results over irreproachable rigor was influenced by the cultural context and understanding of what mathematics was and should be, even as it was understood to be discovering

divine truths about the world and its design. The mechanistic viewpoints and mechanistic methods those holding the viewpoints employed reveal that meaning has been in play from the start.

To add another interpretive possibility to looking at this era in mathematics, consider that from today's standpoint, approaches such as those used by Newton and Leibniz seem decidedly *anti*-mathematical in terms of present-day norms in the field. Given the contemporary emphasis in mathematics on rigor in proofs and definitions, the results-driven and error-prone approach of those studying God's design is fundamentally against the norms of the discipline as it exists today, which employs much stricter standards of rigor—generally understood through the lens of communal agreement or peer review confirming the logical necessity of claims given the starting axioms and assumptions. The meaning of mathematics, and what it means to *do* mathematics, has certainly changed in ways influenced by human desires and context, even as the tools enable inarguably useful and accurate ways to navigate and act in the material world.

Even ignoring today's differently-mechanistic perspective of mathematics, which reflect a difference in values and how mathematicians identify what's meaningful to study in the field, it's worth noting that the old mechanistic vision experienced crises and changed as a result, leading into the contemporary perspective. In the eighteenth century, problems of rigor and foundations came to a head. The changes that followed ended up pushing mathematics even further into mechanistic territory by trying to remove intuitions or conclusions overly rooted in human experience and perception of the world. But the philosophical content of these changes reflect attempts to grapple with the fundamental meaning of mathematics and people's relationship to it, resulting in field-defining crises. While it is difficult to argue if these crises resulted in so substantial a change as to be called a revolution in the Kuhnian sense, they certainly meet some basic criteria such as involving a "major change in the way mathematics is done and looked at,"

which Grabiner roots in the work of nineteenth century mathematical analysts that emphasized rigorous proofs of theorems ("Is Mathematical" 358).[7]

She gives several reasons: the diminishing returns on results achievable via the new method of calculus ("Is Mathematical" 359); ongoing attacks on calculus for its lack of rigor by non-mathematicians like Bishop Berkeley ("Is Mathematical" 359); and the movement of mathematicians from royal courts to the role of teaching in post-revolutionary France, a profession requiring the ability to justify that which is being taught ("Is Mathematical" 360). For all these reasons, there was a shift in understanding of what mathematics is and should be, a re-emphasis on the mathematical systems themselves and the demonstrable validity of those systems to ensure the validity of results acquired therefrom. The fact that understandings of what mathematics *is* changed in response to cultural shifts demonstrates that the mechanistic perspective of mathematics itself takes shape in cultural context for certain purposes, reflecting that meaning in terms of human understanding and social contexts are at play in the framing of a mechanism.

Were mathematics able to be straightforwardly formalized—that is, defined via clearcut assumptions that could be built upon to explain the whole of mathematics without inconsistency—if it were a correctable historical blip addressed by brilliant mathematicians, the notion that mathematics is purely mechanistic might carry more weight. Yet the push to formalize the field not only reveals further meaningful, human-centered questions within mathematics, it also helps to contextualize what aspect(s) of mathematics led into the development of digital computers. Moving into the nineteenth century and continuing into the twentieth, the need to formalize

7 Grabiner's key figures here are Augustin-Louis Cauchy and Bernard Bolzano.

mathematics and ensure rigorous standards of proof became increasingly essential for mathematicians (Grabiner, "Is Mathematical" 358; Kline 218).

There was not a single, unified attempt to address concerns about a lack of rigor in mathematical proofs and concerns about poorly defined foundations. Ernst Snapper describes three schools of thought that attempted to provide "a firm foundation to mathematics" in the nineteenth and twentieth centuries, resulting in three crises as each failed (207). One that he discusses is relevant for capping this examination of mathematics as demonstrating the role of meaning in even the most mechanistically defined discipline. Further, it leads into the concepts from mathematics that informed the initial development of digital technology: the logicist program, which includes the late nineteenth century mathematician Gottlob Frege and, more relevantly here, early twentieth century mathematicians Bertrand Russell and Alfred North Whitehead. Smith rightly describes the "logicist background" as the basis "out of which Turing's conception of computing arose" (*Age* 18). When paired with his aforementioned comments about the emphasis on mechanism to the exclusion of meaning in this presently dominant conception amongst computer scientists, it's useful for us to understand the logicist context because it shows the historical processes contextualizing the exclusive emphasis on mechanism in the dominant academic field for the study of computers: computer science. The removal of meaning at the level of mathematical or computational theory is thus a meaningful act from the perspective of understanding meaning and mechanism as a dialectic, enabling humanistic inquiry into STEM disciplines.

Logicists such as Russell and Whitehead, to demonstrate the lack of error and contradiction in the assumptions underpinning mathematical theory and practice, attempted to demonstrate that the fundamental rules and assumptions of arithmetic could be stated as a finite set of logical propositions. This would mean that the validity of arithmetic was demonstrated by restating it in

terms of logic, the validity of which was already established (Snapper 208). Notably, logic's validity and discussions thereof were the domain of philosophy, meaning philosophical questions about mathematics were obviated by relying on philosophers' answers to such questions about logic. Note the following from Snapper on the logicist program, which he explicitly relates to the philosophy of realism: "It is important to realize that logicism is founded in philosophy. For example, when the logicists tell us what they mean by a logical proposition …, they use philosophical and not mathematical language. They have to use philosophical language for that purpose since mathematics simply cannot handle definitions of so wide a scope" (209). Meaning was deferred in this case to the domain of philosophy despite the previous connection between the mathematical and philosophical representations, treating mathematics as only the set of abstract logical statements whose validity or meaning were considered outside of the domain of mathematics itself. Mathematics was in essence born-again as mechanistic, but now with meaning placed in abstract notions of objective reasoning instead of God.

It's worth noting that the removal of meaning for the logicists does not simply come from the presence of formal logic; Smith discusses another construal of computing, theories of formal symbol manipulation, which are also rooted in this tradition of formal logic (*Age* 28). However, he argues, this construal does not fully remove meaning in the same way that the effective computability construal does because it deals with the manipulation of symbols, which in formal logic still represent meaningful statements and relations. For example, the formal logic statement "p v q" deals with symbols, but those symbols have meaning: the statement effectively translates as, "if statement p or statement q is true, then the statement 'p or q' is true." Note that the symbols relate directly to our ideas of *or*-ness—the sense that if I tell someone, "either me or my friend will come to pick you up from the airport," then I didn't lie to them just because only I or only my

friend showed up. Moreover, the fact that the content of formal logic and discussions of the validity of that content both take place in philosophy means that a construal rooted in this approach to symbol manipulation is still considering the relationship between the mechanism, or the rules and theorems of formal logic, and their meaning, or what those mechanistic statements reflect in terms of human understanding. In this construal, the Platonic backhand still occurs, but there is no Platonic forehand to confuse the abstraction for reality itself.

By contrast, the logicist program treats its axioms as necessarily lacking meaning or validity within mathematics, meaning the foundations on which mathematics is built lacks meaning within mathematics, making the field a purely abstract study of symbols that can be treated as at best isomorphic to aspects of our world. *This* tradition is the one Smith relates to Turing's work and the removal of meaning it represents. Because the effective computability construal represents a mechanism as a purely abstract mathematical concept (see section 1.0 on Smith and the motor theorem), it serves as an exclusively mechanistic perspective of what computing is. Essential to note here is that while this perspective on computing is entirely mechanistic, it is still rooted in a meaningful conversation around what domain mathematics belongs to, how it relates to the real world, and what it means to do mathematics at all. There is a reason *aboutness* was, per Smith's anecdote relayed in section 0.0, understood as separate from the domain of computer scientists. The reason itself involves understanding human decisions about what their theories and practices mean, and how those decisions are rooted in historically contextualized moments.

The analysis in this section, I think, demonstrates the utility of the meaning/mechanism dialectic: it provides a way to understand not only the content of various disciplines within STEM, but also the structure, history, and meaning of that content, even when the discipline argues that

aboutness is outside of its domain. It both accepts the role of mechanisms in the field and attempts to contextually frame them, giving humanists a way to understand the culture of STEM disciplines without forsaking their own analytic strengths. It grounds our understanding in both the field's content and its historical formation(s), allowing for interpretation at the level of meaning and mechanism as they influence each other.

1.1.1.1 The Role of Logicism in Computer Science

To speak more to the logicist program and its role in computer science history, I want to elaborate on how it's at play in the works of Turing, Norbert Wiener, and Shannon. All three in some way extend the logicist program, furthering the removal of meaning in computer science as a means to understand the computer as purely mechanistic. Usefully, both Smith and Hayles provide insight into how this process happened from a humanities, meaning-oriented perspective.

For his part, Turing relates his work to that of Kurt Gödel ("On Computable" 259), who provided a watershed proof in the history of mathematics that fundamentally undermined logicist programs like that of Russell and Whitehead's. Turing describes the consequences of Gödel's work as relating to questions of consistency in Russell and Whitehead's foundational logicist work ("On Computable" 259). Shannon's essential contribution to information theory in his master's thesis relates George Boole's "algebra of logic" to an abstraction of electricity via electronic circuits ("A Symbolic" 714), where rapid shifts in voltage become represented as "on" and "off" states that in turn can be represented as binary digits *1* or *0* ("A Symbolic" 713). The physical electrical processes become abstractly represented as binary electronic signals that isomorphically represent logical statements as binary computations, abstracting out both physical reality and the content of the logical statements, reflecting Smith's differentiating of the effective computability construal and formal symbol manipulation construal.

Wiener's similarly important work on *cybernetics*—a reframing of both biological and mechanical processes so as to enable the drawing of analogies between them—emphasizes "the influence of mathematical logic" as "an element which occurs repeatedly in the history of cybernetics" (19), noting his role as a "former student of [Bertrand] Russell" and referencing Shannon's aforementioned work (20). The logicist tradition was essential to the foundational theories of computing that would dominate computer science as a field, but the questions of *aboutness* and meaning in mathematics that the logicists were necessarily dealing with as practicing mathematicians were elided in favor of absorbing their abstracted vision of mathematics without that essential context. This in turn enabled interpretations of man and machine that saw them as fundamentally similar in terms of *homeostasis*, or responding to external information and stimuli such that the internal system maintains balance (Hayles, *HWBP* 8).

Hayles' work in *HWBP*, which interrogates the philosophical underpinnings of theories of computing and mind that have enabled analogies between the two, reflects the utility of applying a meaning-oriented approach to understanding what has been claimed as the domain of mechanism through her examination of cybernetics and the separation of information from its material substrate (2). The processes of abstraction and elision of materiality in mathematics and then early theories of computing were not a recognition of mathematics or computers as purely mechanistic, but rather a decision about how to frame both as removed from their historical and material context, a sleight of hand that when unchallenged exacerbates the two cultures problem by signaling that questions of *aboutness* or meaning are not only secondary, but irrelevant for those who formally study, design, and program on computers. Such a perspective is deeply flawed but arises from a specific historical context. Hayles's and Smith's work reflects and influences my argument that examining STEM through the interrelated consideration of meaning and mechanism provides

valuable opportunities for understanding the role of meaning in what can seem to be and is often presented as pure mechanism.

1.1.2 Meaningful Mechanisms in Mathematics: Mathematicians Look Out

The example(s) from mathematics in section 1.1.1 demonstrate the utility of the meaning/mechanism dialectic for cross-cultural analysis by showing how, from a humanities perspective focused on meaning, even the most mechanistic-seeming subject within STEM can yield rich analysis without forsaking meaning or mechanism. In this section, I want to further demonstrate the utility of this approach within the same domain—STEM, but more specifically mathematics—by looking at how those in a STEM culture have treated their own subjects with a focus on meaning.

The historical work described in section 1.1.1, namely that of Grabiner, Kline, and Hodgkin, is done by mathematicians but still falls closer to the perspective and approach of, well, *history*—a humanities discipline. A different kind of example can be seen in a collaborative project, the Summer of Math Exposition, organized by a mathematics-oriented YouTube channel called 3Blue1Brown. Grant Sanderson, who holds a bachelor of science in mathematics and runs the channel, and James Schloss, a physics PhD, work together on the project (Sanderson, "About"), which seeks explanatory content on mathematical subjects with an emphasis on compelling, effective expression of the ideas, contrasting a more bland textbook approach that explains the subject in as plain terms as possible. The call for projects emphasizes a desire for clarity of language and content, motivation for the reader/viewer, novel value for the reader/viewer, and some combination of memorable design, delivery, or content revelation (Sanderson, "The Summer"). In a video relating the five winners for the 2021 iteration of the project, Sanderson

narrates the value he sees in the honorees, which is neither the complexity or mathematical depth of the subject, nor the aesthetics. For one visually stunning submission, he notes that it won specifically because of its value as exposition:

> I do want to be clear. The reason I'm choosing [this video] is not because of the smooth graphics. It's that, here we have someone who uses a certain mathematical tool regularly in her work, and she has the ability to clearly motivate why you should care too, and to go into the details of how it works, the many different facets of how she uses it, how she thinks about it. And what makes it *visually* great is not so much the smoothness of the graphics or the aesthetic appeal. It's that they're clean and to the point, serving to aid what's the core value in the whole piece: a series of well-chosen intuitions and applications of a topic in math that deserves to be known by more people. ("2021 Summer" 5:03)

While the subjects of contributions to the exposition are decidedly mechanistic, the approach is focused on the meaning inherent in that mechanism, which Sanderson and Schloss solicit through their call for work that makes clear the meaning and value of work being done in mathematics for non-specialist audiences. The term *exposition* itself indicates the emphasis on explanation for an audience, in considering the way the subject might be understood as not just a mechanism but as a mechanism that has meaning in a certain context. While the contents of section 1.1.1 focus on the work of scholars from a humanities standpoint providing insight into the field of mathematics a whole, the focus of this section is on how those within mathematics and related disciplines bring a focus on meaning to their own work or areas of interest. It is in this section's examples that I hope to demonstrate that crossing the cultural gap can be of benefit to scholars in the humanities and STEM, rather than only providing a way for those in the humanities to reframe the traditional domains of STEM for our own purposes.

One video submitted for this project, "Fast Inverse Square Root — A Quake III Algorithm" by user Nemean, provides an example of this kind of work. Nemean introduces the titular algorithm as being an "ingenious" part of the source code for a game engine designed by John

Carmack at id Software (0:06), undoubtedly one of the major figures in gaming given projects like *Wolfenstein 3D*, *Doom*, and *Quake* over the 1990s, when personal computer gaming took hold in the United States. He explains the fundamental mathematics being performed—for any number *n*, calculating the value of one divided by the square root of *n*, i.e. the inverse square root[8]—and shows how rather than writing the intuitive, single line of code calculating the value, the source code instead has fourteen lines of code determining the value over several steps that escape intuition even for those of us comfortable with basic programming syntax (1:12).

Before running through this code line by line, Nemean explains why such a value would be interesting for calculation in the first place, which has to do with how game engines model the physics of reflection (1:28). He then contextualizes the core mathematics through appeals to viewer knowledge of simpler concepts from algebra like Pythagoras's theorem (1:56). Once the understanding of the core mathematical purpose has been established, Nemean not only goes through the code line by line, but also goes through the programmer comments, which are human-written and intended to improve readability for the code by other humans, a communication mediated by the machine but never acted upon or mechanized by it in the same way that it would act in response to, say, being told to calculate the sum 2+2. He not only explains the comments, but incorporates them into the logic of the video, with comments like "evil floating point bit hack" and "what the fuck?" becoming the basis of the video's structure, reflected in its chapter titles.

8 For those interested in an example, consider the inverse-square root value of the number 5. The inverse of 5 is 1/5, and the square of that inverse is $(1/5)^2$, or $1^2/5^2$. Simplifying both parts of the fraction gives the inverse-square root of 5: 1/25.

Nemean's video, I argue, is an effective example of what the Summer of Math Exposition encourages—not to mention a particularly successful one, at 3.5 million views at the time of writing. His work presents a mathematical concept, explains how that concept is made use of by people in a professional context, explores a non-intuitive implementation of the mathematics by speaking to the technical needs and specificity of the computer,[9] and highlights the human element of creating the algorithm through strong engagement with the interpretable human marks in the code comments. Further, it reflects and adds to cultural understandings of id Software's early contributions to gaming and the culture of that team, where clever use of available tools enabled memorable gaming experiences that are still discussed in gaming communities. The video serves as a strong example of the overall goal of the project: to make meaningful the mechanisms employed within mathematics. Such an approach, I think, reflects the utility of interrelating meaning and mechanism, in this case from a STEM perspective and oriented toward STEM subject matter.

The creation of popular-oriented content about mathematics is far from niche, though, especially in online spaces. The YouTube channel Numberphile, for instance, has produced hundreds of videos over the past decade that features interviews with a variety of mathematicians, each attempting to make approachable to the public some interesting concept from mathematics, be it a number, a sequence of numbers, a formula, a person, or more. Several of their videos have millions of views—an impressive feat for any YouTube channel, no less one about many people's

9 The algorithm's relative length arises from the fact that it directly addresses computer memory to store and load values as part of the calculation, speeding up the process by ensuring optimal calculation rather than relying on the consistent and effective but non-optimal default mode of determining an inverse square root in the C programming language.

least favorite subject—and two of their most popular videos demonstrate the channel's approach. In "The Scientific Way to Cut a Cake," channel host Brady Haran speaks to Alex Bellos, who opens by noting the common joy of eating cake as a means to introduce mathematical principles for cutting cake that maximize, say, "the amount of gastronomic pleasure that you can make from this cake" (1:10). In another video on the channel, "Zeno's Paradox," Haran interviews James Grime, who establishes that the problem is of interest to not only mathematicians, but also physicists and philosophers (0:00). Grimes explains the famous paradox, which seems to draw out a contradiction between a mathematical understanding of distance traveled—where half the distance is covered, then half the remaining distance is covered, and so on ad infinitum, implying you approach your target but never quite reach it—and material reality, where walking from point A to B succeeds regardless. In both videos, the mathematical principles underpinning some real-world experience are drawn out as a basis for understanding the mathematical ideas or tools at hand, centering the meaning of the mathematics in a way that can appeal to an audience that includes more than just mathematicians.

I find these kinds of projects important because they demonstrate attempts to bridge the cultural divide from within mathematics, and the prominence of such projects indicates to me that there is not only a value in such work, but a demand for and interest in it. The weekly PBS program *Closer to Truth*, which has been on the air for over two decades, engages philosophers, scientists, and mathematicians on the intersection of those subjects, and some of their uploaded segments are as popular as the Numberphile videos, e.g. an interview with mathematical physicist Roger Penrose titled, "Roger Penrose - Is Mathematics Invented or Discovered?" (Robert Lawrence Kuhn).

In the realm of journalism, *Quanta Magazine* sets as its mission statement, "Illuminating basic science and math research through public service journalism" ("About"). In his introduction to a book collecting articles from the magazine focused on mathematics, editor-in-chief Thomas Lin writes that he "wanted a science magazine that helps us achieve escape velocity beyond our own small worlds"—that is, reaching across disciplinary boundaries and even across the cultural divide—and that while the magazine "avoid[s] jargon," they also "don't protect readers from the science itself. We trust readers, whether they have a science background or not, to be intellectually curious enough to want to know more, so we give you more" (xix). To me, this statement makes clear the value that not only I and people discussing Snow identify in reaching across cultural lines, but that people in a variety of spheres have identified as a relevant problem for the present day. Our understanding of the world and the technology we use to navigate it is rooted in the work of scientists, mathematicians, engineers, and technologists, and the value to the public of making the mechanisms underpinning that work meaningful and comprehensible at the level of human need and interest has only increased as digital technology has become ubiquitous in contemporary society.

1.1.3 Meaningful Mechanisms in Humanities Methods

The previous two sections have focused on identifying meaning in areas traditionally understood mechanistically, computer science and mathematics. However, the dialectic can also help to understand the role of mechanism in the humanities at the levels of method and theory, which is the focus of this and the next section. Whereas sections 1.1.1 and 1.1.2 focus on the work of humanists about STEM subjects and the work of those in STEM itself, respectively, this section focuses on the work of humanists in the humanities at the level of method and theory to understand

how the meaning/mechanism dialectic is at play and can help understand ongoing conversations in that space. I focus on conversations around the method of distant reading as an example, as it focuses on mechanistic approaches to reading that are enabled by digital technology.

Distant reading contrasts *close reading*, or the act of rhetorical examination of concentrated parts of a text to illuminate it as a whole. Johanna Drucker defines *distant reading* as "the computational processing of textual information in digital form" (629), and she notes that the way distant reading enables quantitative evidence collection does have real advantages that can address problems in close reading, such as a biased focus on a subset of relevant texts that then get treated as representative (632). Franco Moretti, who coined the term, has more generally argued for the need for greater empiricism, belying a greater sense of valid mechanistic approaches to meaning-making in literary studies. In an article on operationalizing methods in the humanities, he writes:

> Now, I don't know whether scientific theories really have so few points of contact with nature; for literary theories, though, this is certainly the case, and it is also why measurement matters so much: it makes some concepts 'actual' in the strong sense of the word; it takes character-space, and proves that there is something in the real world (the real world of fictions) that corresponds to it. Not all concepts are born equal, some are better than others, and operationalization, though not the only test of a theory, is an important one. It shows that, by following a series of steps, you can turn abstractions into a clear and, hopefully, unexpected elaboration of reality.

This is an appeal to more effective mechanisms for the meaning-making and interpretive practices of literary theorists, which is to say methods that go beyond what seems right to an individual scholar and that instead can be measured and used in a predictive capacity, modeling the methods of scientists and mathematicians. In a sense, Moretti attacks literary theory for having insufficiently justified mechanisms, mechanisms that devalue a process that checks its findings in accordance with the external world in favor of overly-liberal interpretive tools. In this light, *distant*

reading can bring greater empiricism to the humanities. However, the role of this method in the field is not as simple as bringing more rigor and empiricism to it; there are questions about the nature of literary theory and reading itself that arise from suggesting approaches that defer reading, in part, to a computer.

Drucker's critique of distant reading, as reflected in her pithy title, "Why Distant Reading Isn't," focuses on the idea that distant reading is reading at all, describing the practice as the processing of information by machines rather than reading them as interpretable marks (630), echoing the discussion of removing meaning from marks in section 1.1.1. To use Drucker's phrasing, distant reading *isn't*, because it isn't reading at all, even considering notions of machine reading as those generally involved reading by human operators (628). Empirical or not, the phrase smuggles in assumptions about the notion of reading that can be challenged, a critique at the level of meaning focused at a conversation around method and mechanism.

Drucker is right to critique attempts to treat the results or process of distant reading as meaningful in and of themselves. The results and process take on meaning through how they're defined to capture a certain human goal for looking at a set of texts at the level of algorithm/program design, with a project focused on spelling changes requiring different kinds of distant reading methods than, say, trying to understand "social relations in a narrative"—the former benefiting from attention to spacing and letter placement, and the latter, from identifying names and nouns (629). The results similarly only bear meaning when taken up by the person producing and using them, serving as opportunities to return to the text. The Platonic backhand that distant reading methods rely on should not be mistaken for the forehand, where we assume that operationalization is more effective at revealing realities of the text and the world it exists in.

For a quick example from my own work, years ago I was working on a project where I was writing about an autobiography. I wanted more details on the main character's relationship to her family, and while I had read the book, I did not remember which chapters featured which family members the most. I created a list of words associating a name or names and the familial role of a character, divided the text by chapters, and then looked at which list appeared most in each section. Importantly though, this was only part of the overall *reading* process; when writing the paper itself, if I found myself writing about a certain familial relationship and needed more textual evidence than I'd found in my first reading of the book, I knew which chapter to turn to and closely read again. I was choosing how to make use of the mechanistic processes of digital technology to capture some part of the text and then return to the text myself.

Ted Underwood, in his "Genealogy of Distant Reading," seems to split the difference between Drucker's and Moretti's perspectives on empirical method and distant reading in the humanities. He recognizes the utility in greater empiricism, writing that "[l]iterary historians can minimize misleading confirmations, for instance, by framing testable hypotheses about a sample of texts that are selected before the researcher settles on a conclusion." However, in identifying potential concern at employing what he calls a "minimally 'scientific'" approach as removing the imaginative power of literature and the study thereof, he suggests a cautious middle ground: "Literary historians who use numbers will have to somehow combine rigor with simplicity, and prune back a thicket of fiddly details that would be fatal to our reason for caring about the subject. But within those rhetorical limits, distant reading can, let us say, *aspire* to the methods of social science: it is defined not only by a commitment to historical breadth, but by a version of the scientific method appropriate for a historical discipline" (emphasis in original). He recognizes the utility of critiques of the mechanisms used in literature and how more "scientific" methods can

foster exemplary scholarship in the field, while also recognizing that the application of those methods will have to be well-chosen and employed in such a way that the author keeps in view the meaningful purpose of applying a given mechanism.

In my reading, then, Drucker and Underwood look at a mechanistic method in the contemporary humanities and critique how it's formulated by emphasizing the way distant reading techniques integrate meaning and mechanism. Neither forsake the mechanistic aspects of textual analysis enacted in code, nor do they consider such analysis outside of the humanities. Instead, they situate the mechanism in the context of reading as a meaning-making process, recognizing how both traits are in play and interwoven in the methods of literary scholars. Further, their analyses of both distant and close reading reveal limitations in the latter, which is traditionally the domain of literary studies and the humanities. The cross-cultural analysis keeps in close proximity the mechanisms at play and the meaning of those mechanisms, not to mention the use thereof, as an important conversation for furthering literary scholarship. With or without the digital computer, such conversations demonstrate the utility of a dialectic approach to meaning and mechanism in the humanities.

1.1.4 Meaningful Mechanisms in Humanities Subjects

For this section, I want to further look at conversations around mechanism in the humanities, and particularly in literary studies, by looking at how an integrated dialectical consideration of meaning and mechanism can help understand subjects of study for literary theorists as they have been impacted by digital technology. First, I will look at Hiroki Azuma's analysis of how audiences engage with narratives in mechanistic, meaning-deprived ways in Japan, which I will extend to audience practices online and in the United States. Then, I will turn toward

an approach to designing narrative that appears purely mechanistic but actually reveals the new possibilities for meaning-making that digital technology enable, as a contrast to the focus on mechanistic interpretive practices by audiences. Together, I think the examples in this section show how humanities scholars, particularly in literary studies, can employ the meaning/mechanism dialectic in their analysis of their chosen groups or texts of focus.

Hiroki Azuma's *Otaku: Japan's Database Animals* focuses on Japanese culture, but much of his commentary is relevant here given the resonance of Japanese cultural output, generally in the form of animated media and video games, in Western culture broadly.[10] This is especially true in Western technology subcultures, to the point that Japanese science fiction is often designed to speak to both Japanese and Western audiences (Bolton et al. vii). Azuma's translators, Jonathan E. Abel and Shion Kono, emphasize that such work enables analysis of technology and science fiction cultures in the United States, e.g. analyzing Star Trek fanatics (xix). Thus I turn to his work, which provides a useful starting point for understanding a particularly mechanistic approach to a traditionally humanities-based, meaning-packed subject: the interpretation of narrative by audiences.

In referring to certain Japanese consumers of media as "database animals," Azuma highlights their media engagement with narrative texts as being less interested in human questions of meaning or interpretation, and more interested in "the combination of elements extracted from the database" (92), the database here indicating that the text is understood less as narrative and more as "the data and facts of the fictional worlds" (36). In this mode of cultural engagement, the

10 Consider, for example, of the general public's awareness of Pokemon, Godzilla, Nintendo mascot character Mario, and Pac-Man, just to name a small handful.

text is a mechanism and the way to understand it is similarly mechanistic, despite narrative's traditional emphasis on the meaning of events via representation. Think of it as Hayles' Platonic forehand once again inappropriately following the Platonic backhand; readers identify aspects of the text that seem to function like data, such as character names, biographical information, and historical details revealed in the text, and collect such data as a means to understand the backstory and main story of the text, but then assume that such an approach is the way narratives are *meant* to be understood, that narratives *are* collections of such data.

Azuma successfully relates the mechanistic method to a broader social condition, which he associates with postmodernism (92). Said another way, he identifies a mechanistic approach within the consumption of culture and relates it to broader ideological currents. Abel and Kono identify mechanistic aspects of the problem Azuma identifies—namely by drawing out the clear connection between *database* as used by Azuma and the storage design made use of in computer programs and website information storage and retrieval—and relate this connection to a broader world-view wherein meaning and narrative take a backseat to the processing of decontextualized information (xvi).[11] The mechanistic behaviors reflect meaningful cultural shifts in interpretation of meaning-

11 There's plenty to be said about how this issue is at play in American culture. First to consider is the rise of massive databases for nearly any media franchise, generally hosted on the website fandom.com; as of the time of writing, their site states there are more than 385,000 fandom wikis with over 50 million pages between them ("Explore"). A well-articulated expression of this problem comes from a popular culture critic on YouTube, Dan Olson, who opens his critique of a film that reflects the database narrative problem at the design level with two sentences: "There is no meaning. There is only lore" ("Glass Isn't" 0:00). "Lore"—a catchall term for what might be called narrative information, or Azuma's "data and facts of the fictional worlds" (36)— in certain texts supplants the meaningful aspect of narrative in favor of treating it as decontextualizable

oriented narrative texts. Azuma, by my reading, is employing an understanding of digital technology as encouraging mechanistic perspectives of a traditional domain of the humanities: cultural engagement with narrative.

Azuma's insights paired with the meaning/mechanism dialectic can enable further analysis in this vein. If we look to video games, where mechanistic aspects are even more apparent due to video games' reliance on the underlying limitations and affordances of digital technology, the database features stand out. At a core level, game rules—often, appropriately, called game *mechanics*—are manipulations of internal states and user input to produce mechanically determined outputs. Yet the design of these rules itself has a rhetorical dimension, as argued by Ian Bogost in his defining of *procedural rhetoric* as the rhetorical dimension of processes (*Persuasive Games* 28-9), e.g. how a city-building simulator *Sim City* mechanizes zoning, energy production, and infrastructure funding in a way that reflects an urban planning perspective that can be criticized for its contemporary American bias (237-8). Here, the fundamentally mechanistic game mechanics act as representational systems that produce meaningful rhetorical statements about their object of representation.

Even more than mechanics acting as representations and thus bearing meaning that can be analyzed rhetorically, video game mechanics can produce new ways of understanding narrative in a way that seems to extend the problem Azuma identifies, but actually provides new theoretical

---

information, as data for infoboxes on a wiki. In a video analyzing a recent science fiction film, *Annihilation*, Olson similarly targets popular film analysis channels on YouTube that relate details of the film not in terms of their interpretive value, but in terms of the apparent details about the world as a host of science fiction facts and details, even when the film itself clearly signals a piece of information as being about meaning and interpretation ("Annihilation and Decoding" 10:45, 17:18).

possibilities. Namely: what happens when a game provides enough simple systems that what they produce is emergent, in the sense that what arises could not be predicted despite the initial states and transformations being defined in advance? How might such a narrative itself be worthy of literary analysis despite the lack of a single narrative told through the text, in this case a video game?

Both Bogost and Hayles have discussed the notion of emergent patterns and computational systems where complexity arises from initial simplicity. In *Unit Operations: An Approach to Videogame Criticism*, Bogost pulls from computer science to understand meaning in the mechanics through a computational lens, directly stating his intent to develop a bridge between literary theory and computation as practiced by "humanists" and "technologists" (ix-x). He argues that a medium "can be read as a configurative system, an arrangement of discrete, interlocking units of expressive meaning. I call these general instances of procedural expression *unit operations*" (ix, emphasis in original). The units—which he describes as "a material element, a thing" (5)—have expressive meaning, but through their operations can interact with each other, producing a different kind of meaning. For a narrative example, two different characters-as-units might represent two different perspectives on a meaningful issue, but their interaction as represented by an author itself produces a perspective on the issue through representing the interaction of two perspectives. If one perspective is made to sound foolish and under-considered, while the other is presented as convincing, sophisticated, and accurate, then the system of the two units interacting itself produces a rhetorical argument.

Procedural rhetoric, then, can benefit from seeing a procedural system as having mechanics that themselves are representational and thus meaningful, *and* as producing meaning through the interaction of those rules. But what's especially useful here about a computational

focus is the possibility for bringing in a new element of understanding to extant purview of narrative analysis from a humanities perspective: *emergent* narrative. An *emergent system* as defined by Bogost is one where "simple rules combine to lead to consequences unpredictable from those rules" (*Unit Operations* 95), a concept that Hayles defines similarly and engages with as it's at play in STEM disciplines (*MMWAC* 25). Hayles is cautious of using such a framework to argue that computational systems as they exist can readily clear a path to computational models that rival the complexity of our world (*MMWAC* 28), but with a focus on games and narrative systems, I think we can avoid running into these pitfalls by keeping our scope limited.

Dwarf Fortress is a video game that helps demonstrate how the relationship between game mechanics-as-mechanism, the underlying digital technology, and emergent systems enables a new kind of meaningful analysis in the humanities a la Azuma's work. The game has been available in some form since 2002 and worked on consistently over the past two decades. It is a game with minimal designed narrative elements, and thus minimal obviously meaningful elements in a traditional literary sense. You control an expedition of dwarves leaving their home civilization to form a new settlement, with the goal of establishing a new seat of civilization. What stands between the starting point and the goal is a host of systems that allow the player to *create* that civilization: mining rocks and gems; creating farms; forging weaponry, tools, and furniture; managing dwarven leadership roles; considering the emotional state of dwarves and preventing violent outbursts or breakdowns; building out living spaces, offices, and taverns; erecting temples to the various faiths the dwarves might have; building guildhalls to train new members in one of well-over a dozen crafts; training military units to ward off invasions by giant ash monsters and devilish beastmen; and the list goes on. There is no shortage of units and procedures in Bogost's sense of the terms. Yet, interestingly, no single element of the player's narrative experience of their fortress—which

can span hundreds if not thousands of in-game years—is explicitly designed outside of the initial narrative premise. Character names, appearances, personalities, behaviors, religious beliefs, and other traits are generated from different sets of core rules, but they are no less generated and modular. The other civilizations in the living game-world have their own sets of systems that determine behavior, as do monsters, animals, and more. The range and number of relatively simple systems is staggering.

In an inflection of Azuma's concerns about turning narratives from meaningful representations to mechanistic ones, we can see how a host of mechanisms can produce new kinds of meaning. Writing in 2013—halfway between when the game's development began and the present—Stephanie Boluk and Patrick LeMieux describe the procedural histories of *Dwarf Fortress* in a collection co-edited by Hayles. They relate the process of initializing the game world— itself full of systems with parameters that can be adjusted by the player for certain kinds of play-experiences—as "everything … emerg[ing] from combinations of simple mechanics" (127). As the game world further integrates with the moment-to-moment decisions by the player as they direct their dwarves to design their civilization via the immense number of mechanics available, the various units, systems of those units, and larger systems that those systems then enter *as* units can create something as complex as what Boluk and LeMieux call a "dwarven culture" (129). This idea scales up to an entire world of civilizations constructed and constantly changed by countless interacting mechanics.

Tarn Adams, the original creator of *Dwarf Fortress* who now co-develops the game as part of a team, clearly envisions this as a primary rather than secondary part of the game; he describes "this whole notion that's at the center of the game" to be "emergent narrative" ("Dwarf Fortress Creator" 10:31). When the human mind meets the storytelling systems built into the game, the

game developers' work becomes "a collaboration with the player to produce a bunch of stories" ("Dwarf Fortress Creator" 11:03), reflecting the game's interrelation of its mechanics and the meaningful use and interpretation of those mechanics. When Hayles critiques the limitations of emergent visions of complexity, as described above, she specifically takes issue with a lack of consideration of the mixing of human and analog feedback—the big and small decisions a person makes, rooted in conscious engagement with the available systems and the variety of contextual factors influencing the human mind, from past experiences to emotions to physical sensations affecting mood—with digital systems, via digital information processing and other ways of representing reality (*MMWAC* 27-9). Adams, it seems, recognizes that the emergence of complex narratives arises not simply from his mechanics, but from how they are used and understood by the player, as well as the human decision-making that acts as part of the feedback loop pushing the narrative possibilities in the world toward greater and greater complexity, with greater and greater room for meaning as experienced by the player.

If the narrative richness of such a world seems hollow due to clear matters of intention in its narrative design, the way *Dwarf Fortress* has been taken up in gaming culture reveals it to be anything but. Boluk and LeMieux relate a collaborative project called "Boatmurdered" (136), the generated name of a civilization that would be run as a saved game file by one user for an in-game year, then passed to another player, and so on. The various players would narrativize their experiences on a web forum, adding narrative elements like intentionality to characters' behaviors based on their interpretation of the events and descriptions. Mad previous leaders and rampant, seemingly vengeful elephants arise as compelling narratives that play off of the game's programming, as "the combination and layering of *Dwarf Fortress's* complex dynamics take on a

life of their own and produce unpredictable effects that do not always align with traditional forms of narrative and psychological casuality" (136).[12]

To take another example related by Adams, he tells the story of a player's civilization that had progressed greatly but was undone by the narrative trope of dwarves digging too deep into the Earth ("Depth of Storytelling" 0:10).[13] One dwarf remained after demons arose from the depths, when all others in their civilization had fallen—which might have included the dwarf's spouse, children, and close friends, all defined explicitly in the game's mechanics. The dwarf won in a pyrrhic victory, being knocked off the bridge to a short, isolated landing below, irreparably hurt.

Here is where the array of interlocking systems come in, building on top of the host of units, operations, and decisions that had enabled the fortress's demise in the first place. "And so the player"—"of course," Adams adds as an aside, "we're leaving the player out of this"—"they decided, you know, how are we gonna cap off this fortress?" ("Depth of Storytelling" 0:44). They decide to command the dwarf to engrave the wall on the short landing, as engravings produce art with generated descriptions. Notably, the descriptions are generated but not random; they can come from a dwarf's memories, which includes what they like, symbols of their civilization, or major

---

12 "Boatmurdered" was the first story I saw mentioned when I looked for narrativized Dwarf Fortress playthroughs, and I would see it recommended again and again as I took interest in the game. Boluk and LeMieux did not cherry-pick a niche example within the community.

13 For what is popular culture's most prominent example of this, see J.R.R. Tolkien's *The Fellowship of the Ring*, where the wizard Gandalf relates the fate of a great kingdom of dwarves destroyed by an ancient, demon-like creature: "they delved too greedily and too deep, and disturbed that from which they fled" (347). Again, the mechanics themselves can reflect meaningful relationships to real-world referents, as popular cultural understandings of dwarves get turned into game mechanics.

events. The last act of the last dwarf of this civilization is to engrave the wall, and as the player scrolls over it, they can read what was produced: a depiction of the dwarf slaying the demon in their final battle.

Such a story is, I think, narratively compelling. Not only does it represent the events in a way that aligns with the experience of the player, it also arises from the interaction of the game world and the player's decisions over time, bringing in stakes and a sense of personalization. The meaning was not designed in advance, nor is it a simple logical consequence of the mechanics. It emerged from the interaction of several units and systems, of several mechanisms.

We might think of *Dwarf Fortress* as bearing minimal consideration of meaning in its representational and narrative elements designed through mechanics, but it does so *toward the production of emergent narrative*, which results in a new way of understanding the generation of meaning. At this level, it's worth wondering if a game in this vein developed at sufficient complexity would not at least resemble the emergence of narrative in reality as experienced by humans, providing subject matter for further analysis using the tools of, say, narrative theory. A narrative is an interpretive act of events, actors, place, and time, with a person drawing them together through arrangement and emphasis to draw out the meaning they identify. If *Dwarf Fortress* or something similar can create a variety of simple and complex interlocking systems that then can form new complex systems—e.g. the ability for a dwarf to engrave art, have memories of important events, sort themselves as part of a fortress and civilization, witness violence caused by an attacking monster with its own host of mechanics, and in their final act as the last member of a now-destroyed civilization create a piece of art reflecting the horror of everything they witnessed—then questions of meaning from a humanities perspective have new terrain to consider

by looking at how it interacts with narrative mechanisms. Further, this new terrain can then enable new insights into narrative theory and the study of narrative in everyday life.

1.2 Relating Computer and Writing Technology

To end this chapter on the meaning/mechanism dialectic as a tool for doing cross-cultural analysis, I want to look at humanities-based approaches to digital technology that focus on its relationship to writing technology, with technology being a key part of the connection. This connection, I argue, is a rich site of analysis for the dialectical approach, and is exemplified by several of Hayles' works and Annette Vee's *Coding Literacy: How Computer Programming Is Changing Writing*. Hayles' work has been covered already throughout this introduction, so her relevance should not be surprising. Vee's work—which rhetorically analyzes the calls for treating use of the computer, in particular code, as a literacy akin to reading and writing (51)—is relevant not only due to its connections to Hayles' work and emphasis on computers, but also because she situates her project as addressing the still-extant "conceptual gap between the sciences and humanities" as described by Snow (42). Her work reflects other work that fills this gap; affirms the existence of the cultural gap in the present; and relates computer and writing technology as part of a broader effort in the humanities to address it (42).

Hayles' bibliography similarly points us to the value of considering the relationship between computers and writing. Hayles, again through Kaye, describes the power of this intersection and its influence on her: "When she first encountered the desktop computer and understood it could be used to create literary texts, she realized that everything important to her met in the nexus of this material-semiotic object" (*WM* 15). Recall Smith's similar hopes that the

computer could "heal[ ]this gap between the part of me that was interested" in complex, human domains like politics and the seeming "power and elegance" of physics ("Smith"). *Writing Machines* itself is part of a self-described "trilogy" of Hayles' work, along with *How We Became Posthuman* and *My Mother Was a Computer*, that engages with "the materiality of literary texts" as a basis for relating "computation and textuality" (*My Mother* 2-3). Nearly 20 years later, Hayles' *Postprint: Books and Becoming Computational* builds on her career-long emphasis on the materiality of information/communication technology by considering how digital technology has transformed literature, not just in the generation of electronic literature but also in terms of the more traditional terrain of print and the technologies underwriting the medium, creating a "new state of affairs" called *postprint* (2).

Why is this connection useful for understanding meaning and mechanism? First, the work of Vee and Hayles helps us further consider *computation* as the mechanistic aspects of the computer, and how that mechanism is essentially meaningful *and* technological. Second, I think the connection works because it recognizes how writing and computer technologies are uniquely potent as hybrids of mechanistic technology and human meaning by virtue of how they inscribe meaningful marks that are interpreted by people.

In Vee's work, she highlights computation as a process because, given the now infrastructural role of digital technology, that technical functioning is a part of non-specialist daily life (140). Hayles similarly is interested in the process of computation as a site of analysis from a literary perspective, prompting questions like, what is the *meaning* of computation, and how does that inform how we frame it as humanists? This question is even more important now that it's a foundational process to contemporary society. In *HWBP* she argues that "the posthuman appears when computation rather than possessive individualism is taken as the ground of being" (34), the

mistaking of the Platonic backhand for the forehand again, and in *MMWAC* she connects "speech, writing, and code" via what she calls the "Regime of Computation."

This regime arises in the context of digital technology but is not simply descriptive of how digital technology functions, instead considering the history of computation as a practice that has now become infrastructural (17-8). In Hayles' own words, it "continues in the tradition of Turing's work by considering computation to be a process that starts with a parsimonious set of elements and a relatively small set of logical operations" (18). The worldview that this regime represents is rooted in the mechanistic perspective outlined in section 1.1.1, extended into "a narrative that accounts for the evolution of the universe, life, mind, and mind reflecting on mind" (27). It stems from treating the meaning part of the dialectic as downstream from the mechanistic part. Vee reaffirms the concern inherent in calling such a worldview a regime, noting that "computation is ascendant" as seen in how human life is converted into data and essential decisions regarding human life are often made by or via computers (177). Vee emphasizes that she wants a more humane vision of computation, rather than writing it off entirely (177), indicating the value of more cross-pollination between those working in the two cultures. The meaning-oriented approaches and viewpoints of those in the humanities could help achieve such a cross-cultural goal, as I think work like Hayles' and Vee's both does and enables.

Vee and Hayles use different categorizations of writing and computer technologies to relate the two, but from the perspective of this dissertation, the concepts—*material intelligence* and *inscription technologies*, respectively—are synchronous. Before defining them, though, I want to focus on the notion of *materiality*, which is obviously a concept at play in Vee's categorization but is also relevant to Hayles'.

Hayles defines *materiality* as that which "emerges from the dynamic interplay between the richness of a physically robust world and human intelligence as it crafts this physicality to create meaning" (*WM* 33). Print and the computer—technologies mechanizing writing and computation, respectively—are both rich sites of meaning-oriented analysis of technology for Hayles because the material changes they make in the world are inscriptions, or marks that can be read as meaningful; thus, she calls them *inscription technologies* (*WM* 24). She demonstrates the utility of the concept by using it to circumvent a debate around the terms *hypertext* and *cybertext*, the former associated with a literary perspective and the latter, a computational one; to her, neither suffices for her analysis because neither "pays particular attention to interactions between the materiality of inscription technologies and the inscriptions they produce" (28). That is, analysis of hypertexts or cybertexts should consider the interrelating of meaning and mechanism as they are at play in these technologies to understand them more completely as literature. The computer as an inscription technology embodies meaning and mechanism through its pairing of computation and material representation of symbols via electronic circuitry, which parallels how writing technologies enable the material representations of symbols through written or printed symbolic marks. Smith echoes this point in the introduction to *Age of Significance*, where he argues that the computer is at once essentially non-distinct from all other technologies, and yet significant to study no less: "we will arrive at a point," he foreshadows, "from which the following is clear: computers are intentionally significant physical artifacts—the best we know how to build" (39). The computer is not fundamentally different from everything that has become before, but it is exceptional as, to use Hayles' terminology, an inscription technology—or, much like writing, a technology designed to facilitate the production and interpretation of representational marks.

Vee's work, I argue, is similarly interested in the analogy between writing and computing as technologies embodying tensions in the meaning/mechanism dialectic via her study of writing and programming through the framework of literacy, analogous to Hayles' consideration of print and the computer through the framework of literature. Similarly, Hayles' *inscription technologies* rhymes with Vee's use of *material intelligence*. The concept, which comes from Andrea DiSessa, parallels the idea of an inscription technology by describing material objects that are changed to create interpretable marks (96). The material constraints are real—be they a slab and etching device, pencil and paper, or word processing software—but they exist to enable necessarily human activity, i.e. the creation and interpretation of meaningful marks.

To speak more to the writing/programming analogy, programming is mechanistically limited by contemporary digital technology through needing to operate procedurally, but this mode of thought and action "builds knowledge," which is a necessarily human domain (96). Again, the computer-as-technology is related to writing through how they interrelate meaning and mechanism via code or otherwise meaningful language, this time through programming and writing as similar kinds of interactions between human thought and the material world using technology.

While Vee and Hayles are hardly the only scholars in their respective fields to consider the effects of writing on computers and vice versa, their work is exemplary because of how it deals with the meaning/mechanism dialectic in terms of the technological objects and people taking those objects up at the levels of the individual, community, and broader society. Their work is important because they both reconsider the nature of writing through the computer with an increased emphasis on questions of mechanism and technology, while also reconsidering the nature of the computer through a humanities lens interested in the meaning of the technology. The focus of both on computation, I think, reflects Smith's emphasis on the computer as essential to

understanding the meaning/mechanism dialectic, as both use computation as a process to understand the interrelation of digital technology and human intentionality. Fittingly, both authors have also produced work that bridges the two cultures gap in these terms.

Both scholars are dealing with writing, one from the perspective of literacy and the other, literature. My focus is centered more in composition studies and how it can flesh out the application of this problem toward potential solutions through a focus on undergraduate pedagogy. Literary and literacy studies both have overlap with composition through a focus on writing, but there's a major aspect of the field that I think could deepen the computer-writing connection: the emphasis within composition studies on undergraduate pedagogy as a means to address the role of writing in universities.

The role of education is never far from discussions of the two cultures problem. Vee describes the intensity of this problem at the college and university level (42); Snow himself strongly emphasizes the need for an educational means of addressing the problem (18), which Massey reinforces decades later albeit with more emphasis on education writ large (72). In Mark Guzdial's insightful *Learner-Centered Design of Computing Education: Research on Computing for Everyone*, which is about how undergraduate pedagogy can serve a diverse range of students' computing needs, he argues for "the importance of understanding computing for every citizen," a project he directly ties into the legacy of Snow's work (39). The undergraduate level is notable here: it is in these spaces that students generally develop a specialization through their majors, while also taking classes outside of those majors and with students who are likely to intersect with different communities. He explains the prescience of Snow's calls to reshape education to counteract specialization by appealing to aforementioned public call for computing literacy, a combined humanities- and STEM-oriented understanding that can empower people living in a

pervasively digital world. Clearly, the computer has brought on real changes in attempts to bridge the two cultures, yet implicit in Guzdial's emphasis that computing should be made open to the broader citizenry is the notion that it isn't already, and that there is a real barrier between the specialist technology of the computer—even more closely tied to the sciences through the idea of STEM as a collective that contrasts the humanities—and use by non-specialists. He has suggestions that I'll look at more closely throughout this dissertation, e.g. how he uses *transfer* in section 2.1, but I think his emphasis on the computer is useful pedagogically and enriched by the connections to writing that Vee and Hayles draw out.

Guzdial here is speaking to a problem that Rankin places as early as 1961, as "[John] Kemeny and [Thomas] Kurtz believed that computers would soon become a part of daily work life, possibly even a part of personal life. ... This conviction, combined with their students' prowess on the LGP-30, propelled them to consider making computing accessible to many more students" (21). Vee similarly relates the largely un-followed upon call by Kemeny for a Computing Across the Curriculum movement in the 1980s, building on this vision with a critical eye toward the role of the computer within the disciplines it now occupies (72-3). The computer, in not just Collini's analysis of Snow but in Vee's, Hayles', Guzdial's, and Rankin's analyses of digital technology, has helped cross the gap between the two cultures.

Understanding the potential of undergraduate pedagogy from a writing-oriented perspective can help extend some of Guzdial's ideas for pedagogy. Vee pinpoints a limitation in how Guzdial understands the utility of programming outside of computer science, noting that programming is taught in many places outside of such departments already (18). Just as composition studies approaches the teaching of writing in a way that recognizes it as a specialized practice that can no less be taught to a general student body, programming can also be taught at

sufficient levels of generality to be relevant to non-computer science students. In Chapter 3, I will discuss an example of teaching programming concepts to students in a class that was available to undergraduates at the University of Pittsburgh and met a philosophy general education requirement. While it was focused on computers, it was not a computer science class and did not assume any programming familiarity. Yet, principles from writing pedagogy enabled me to engage students by considering the various meaningful contexts the mechanism of programming is taken up in.

1.3 Looking Backward and Forward

To summarize and signpost: this dissertation develops a digital pedagogy that focuses on digital technology as reflecting the exemplary way in which the computer takes up the dialectic between mechanism and meaning, with computation and computing as—at least initially—respectively paired terms. The focus provides two benefits: first, it helps to understand the cultural distinctions Snow and others have identified between the sciences and humanities and then challenge those distinctions through the meaning/mechanism dialectic; second, it recognizes the limitations that specialization places on interdisciplinary work while still finding ways to encourage work at the intersections. To take this theoretical framework for understanding digital technology and the two cultures problem, and enact it pedagogically, I look to work in composition studies to consider what transfers from the teaching of writing to the teaching of computing, what work has already been done to account for the role of the computer in the teaching of writing, and what work from other areas dealing with the meaning/mechanism dialectic in digital technology might contribute.

However, I do not intend for the focus of this dissertation to remain limited to writing classes. While undergraduate writing pedagogy and composition studies are important for developing a digital pedagogy that can be enacted within the current academic paradigm, the effective teaching of digital technology to facilitate interdisciplinary work cannot happen only in writing classes, much like the effective teaching of writing cannot happen only in a first-year writing course led by a composition instructor. Thus, this dissertation will attempt to apply such a digital pedagogy in three contexts: writing classes, non-writing humanities classes, and programs/curricula.

The introduction to this dissertation and this chapter have set up the parts and structure of a theoretical framework that can support such a digital pedagogy. I started with the two cultures problem and what has changed in sections 0.0 and 0.1, namely how the computer has introduced new problems of *specialization* and *generalization*. To understand and address how these problems are at play, and how they're rooted in the computer as a historically situated technology, I looked at how computer historians have understood the computer and two closely related concepts, *computation* and *computing*, which emphasize the technical aspects of the computer and the historical/cultural/social contexts in which the computer is taken up. To ensure these concepts are understood in tandem rather than as distinct, I employed Smith's meaning/mechanism dialectic, which illuminates the relationship between the computer, computation, and computing. Further, it parallels the cultural norms and world-views of STEM—an extension of Snow's *scientific culture* and generally more associated with the mechanism side of the dialectic—and the humanities—an extension of Snow's *literary culture* and generally more associated with the meaning side. After examining how the meaning/mechanism dialectic can enable cross-cultural analysis of subjects in both STEM and the humanities, I discussed how the analogy between computer and writing

technology discussed in Vee and Hayles' work can round out the framework by illuminating further pedagogical solutions, namely by looking to composition studies and how it has handled questions of interdisciplinarity and generalization in undergraduate pedagogy.

Chapter 2 will directly build on that last example, the analogy between computer and writing technology. First, I will look at how Guzdial uses the concept *transfer*, which has a lot of traction in composition pedagogy, and from there build out what other pedagogical concepts composition studies can offer to this dissertation's approach to digital pedagogy—namely *rhetorical theories of genre* and *discourse communities*. I will then look at scholarship in composition studies that focuses on digital pedagogy to relate my work more closely to that being done in the field already, and lastly draw conclusions about how to employ digital pedagogy in specifically first-year composition classrooms in a way that makes use of the meaning/mechanism dialectic and thus can help address the two cultures gap.

Chapter 3 will look at my own teaching beyond first-year composition, focusing on work I've done in three different courses that either did or could benefit from the use of the three central composition concepts in this dissertation's approach to digital pedagogy discussed in the previous paragraph. Lastly, Chapter 4 will relate solutions at the level of the curriculum/program. I will speak to my own work as the Program Assistant for Pitt's own major, Digital Narrative and Interactive Design, which navigates questions of meaning and mechanism through the interrelation of computer science and English departments. My work in the major, which includes the assistant position and teaching threshold courses for it, will be paired with interviews of others in the program to contextualize and add depth to the curricular and programming suggestions this dissertation's digital pedagogy can foster.

By the end of this dissertation, I will have developed a theoretical framework underpinning a digital pedagogy that can enable cross-cultural connections and analysis in the Snow sense of *culture*; demonstrated its utility in applying the framework toward a pedagogical solution rooted in composition studies; extended the pedagogical possibilities into a variety of writing-intensive and non-writing-intensive courses; designed pedagogical materials to support teachers trying to incorporate more digital pedagogical work into their courses; and examined how programs can enable and are already enabling cross-cultural work. The result will be a robust digital pedagogy that speaks to the specific interpretive questions that have been generated, expanded, changed, or exploded due to the rise of digital technology from the mid-twentieth century up to the present.

2.0 Comp Digital Pedagogy

Chapters 0 and 1 set up the theoretical framework underpinning this dissertation—identifying the two cultures problem as it's at play in the present; relating that problem to digital technology; defining digital technology from a perspective that considers technical and interpretive elements as dialectically related in order to address the cultural problem; and connecting computer technology to writing technology in order to develop a pedagogical solution. This chapter continues the focus on writing and its technological analogy to computers by developing a composition-rooted pedagogical approach to addressing the two cultures problem. Further, it will apply the pedagogical framework and solutions it can provide in an immediately appropriate context: first-year writing courses, which have had to consider problems of specialization and generalization.[14] There will be applications of these ideas to courses outside of this very specific context in following chapters, but for now I am staying in that context to keep the emphasis on the crossover between writing and computing, which will then reach further outside of that context.

First, I will look at a pedagogical concept discussed in Mark Guzdial's *Learner-Centered Design*, which is discussed in section 1.2: *transfer*. I will demonstrate how this concept can be further developed by looking at how it has been used in composition scholarship. From there, I will bring in two other essential concepts from composition studies and its twin field of rhetoric—*genre* and *discourse communities*—to flesh out the theoretical concepts underpinning this dissertation's approach to digital pedagogy. After the pedagogical aspect of the dissertation's

14 See section 0.1 for more on how specialization and generalization are contemporary problems that inform the contemporary state of the two cultures problem.

theoretical framework is developed, I will look at scholarship in composition studies focused on digital technology and pedagogy in writing classes to better demonstrate how the field approaches similar subjects in the discipline.

Before getting started, a note on terminology: I have no interest in coming up with an awkward neologism that differentiates this dissertation's approach to digital pedagogy from others. But "this dissertation's approach to digital pedagogy" doesn't exactly roll off the tongue. Given the focus on computers through the lens of computation and computing to understand the two cultures problem in the present, and the role of composition studies in providing essential insights for pedagogical interventions toward addressing the problem, I'll use *comp digital pedagogy*, with *digital pedagogy* referring to the broader field. The *comp* part, if it's not obvious, is meant to refer to *computer*, *computation*, *computing*, and *composition* all at once, and clarifies when I'm using a shorthand for "this dissertation's approach to digital pedagogy." The approach is not intended to shake the foundations of several disciplines through revolutionary reframing, but instead to build on conversations in digital pedagogy, composition and rhetoric, and the study of computers in service of understanding and addressing the two cultures problem with a focus on pedagogy and instruction in the humanities. That is, comp digital pedagogy is an extension of digital pedagogy that accounts for the idiosyncrasies of this dissertation.

2.1 Concepts from Composition

2.1.1 Transfer

I want to further look at the computing and writing connection by looking to the teaching of writing for key concepts that can help facilitate the effective teaching of computer technology from a comp digital pedagogy perspective. As noted in section 1.2, N. Katherine Hayles' *inscription technology* in *WM* and Annette Vee's use of Andrea DiSessa's *material intelligence* speak to the theoretical overlap in computer and writing technologies, where the mechanistic features of each are leveraged to create meaningful marks, whether they be letters strung into words or bits strung into legible text and images. There's another layer of connection, though, at the level of pedagogy and universities, also discussed in section 1.2: both writing and computers deal with problems of *specialization* and *generalization*, reflecting skills that are used to solve highly specialized problems that must also be taught at a sufficient level of generality to set students up for that specialized work early in their undergraduate careers.

One concept that I think is useful for demonstrating the utility of composition concepts for the teaching of computing shows up in Guzdial's work: *transfer*. Recall that Guzdial focuses on how undergraduate pedagogy can serve a diverse range of students in the teaching of computers, with his title referring to "Computing for Everyone" in a way that reflects the calls for a Computing Across the Curriculum movement as referenced in Vee (72-3). Guzdial frames transfer not via writing, but instead via a concept from A.N. Whitehead, a mathematician mentioned briefly in section 1.1.1: *inert knowledge*, or knowledge that someone has but cannot make use of in a new challenge or context (29). In such a case, knowledge does not *transfer*. Guzdial emphasizes that traditional computer science knowledge is not likely to transfer to use in daily life (40).

The reason he gives is important: for transfer of knowledge to occur, the knowledge to be transferred and how it can be transferred should be *taught* (48). When talking about the lack of transfer of problem-solving skills learned in computer science classes, he provides a counterexample from professor Sharon Carver. In her class, she did not focus the lessons on a certain programming language or computer science concept; instead, she focused on specific problem-solving skills by looking at a set of related examples, with the programming language Logo being a means to solve these problems (47). I argue that this approach is useful because it does not privilege the mechanism of applied use of a specific programming language, but instead what the mechanism enables— the human cognitive process that the programming language can facilitate—and thus relates the meaning of use of a specific programming language to solving a human-defined problem.

Guzdial's use of transfer is useful for defining how to teach computing in a way that is more generally useful to undergraduates in- and outside of computer science programs. I think that the term could be even further theorized and understood as a pedagogical tool by understanding how the concept has been taken up in the study of writing. In this section, I will turn to composition studies to further theorize transfer as an avenue for addressing the two cultures problem, relating the term as used in composition to the broader solutions it can enable, e.g. as demonstrated in Guzdial's work. There are two key issues in addressing the two cultures problem that I think *transfer* can help to address: how to bridge gaps in context and culture, and how to teach computer technology in a way that accounts for and manages the hybrid problem of specialization and generalization. After explaining the utility of the concept and its uptake in comp/rhet in further depth and bringing in the related concepts *genre* and *discourse communities* in sections 2.1.2 and

2.1.3, I will then apply these concepts to the teaching of computing in first-year writing courses before turning to other composition courses and then courses in other fields in the next chapter.

Transfer is, at core, a way to understand how similarity and difference can operate dialectically at the level of cognition. It requires an ability to find connections in what one recognizes as different contexts. The ability to identify similarities in different contexts reflects a flexible ability to apply knowledge, and given the variety of knowledge and ways of understanding students will encounter in college, the ability to draw these connections is important. Students need to see the potential bridges between general knowledge and skills they're learning in, say, a first-year writing class, and the more expertise-defined domains of their majors, be they in STEM or the humanities.

First-year writing courses are a relevant site for considering transfer for two reasons: first, most colleges in the U.S. have some kind of first-year writing course to acculturate students to college writing;[15] and second, those courses are intended for a wide student body that will include students well outside of English departments, and must therefore speak to diverse writing needs. As a result, first-year writing courses that fail to teach transferable skills can fail to serve students' work once the term has ended, and writing instructors have had to deal with this theoretical problem due to the institutional context. Further, such an understanding of transfer must necessarily deal with the meaning/mechanism dialectic as it is at play in writing and recognize the

15 See, for example, Sharon Crowley's explanation of the rise in prominence of introductory composition courses in American colleges starting in the late nineteenth century (1), or the 2009 American Council of Trustees and Alumni report that found introductory composition to be the most commonly taught general course at a sample of 100 major American colleges (Diaz and Kempson 22). More recently, a 2017 survey of hundreds of first-year institutions found that 96% had a first-year writing requirement (Gladstein and Fralix).

relationship between general and specialized learning in college, which can help navigate the two cultures divide by helping students see the relationship between specialized subjects like computer science and general issues like the role of the computer in their lives and work.

Important to note is that transfer is not, at least in writing classes, something that students will leave any halfway-decent writing class knowing how to apply in future contexts. In fact, when a course is not designed to facilitate or teach transfer, students often leave the course with few tools for understanding how to relate the work of a composition course to work in other courses (Yancey et al. 5, 101; Whicker 299). By contrast, first-year writing courses that contextualize such writing as a specific kind of writing practice in the broader context of college and other kinds of writing can set students up for more successful application of their learned writing skills to new contexts (Beaufort 7; Whicker 299; Yancey et al. 5). To teach effective first-year writing in terms of the broader college context, with *effective* meaning here that the skills and knowledge learned in the writing course can be made use of in later courses, requires teaching the specialized understanding of writing practice from composition in a way that enables the more general aspects of writing practice to be made use of in the new, more specialized contexts student will encounter as they advance in their undergraduate career. For example, Joanna Wolfe et al. argue that for students to understand how to structure a piece of writing, they should not only learn how to write a thesis-first essay, which is particularly prominent in literary fields; they should also understand the different kinds of structures such as thesis-last or IMRD (introduction, methods, research, discussion) and when they are employed depending on discipline and context (54-6). In the suggested example, students learn not just a means of structuring their writing, but how to identify structures in use and determine the contexts in which a structure might be appropriate as they advance in their undergraduate careers.

Guzdial is considering a similar problem in terms of computing when he discusses transfer: what specialized knowledge or skills from computer science might be teachable as general skills that can transfer to new contexts? The relatively well-theorized and -studied understanding of transfer in the teaching of writing, I argue, is useful for exploring in greater depth what transfers to the teaching of computing.

How do we teach for transfer in the teaching of writing? Two major aspects have been discussed so far that deserve more attention: instructors should recognize that the teaching and learning of writing practice is itself a specialized domain of skills and knowledge that writing courses can help students understand to enable transfer; and instructors should give students time and space as part of a course to consider how to apply the specialized understanding across contexts. In this sense, the specialized learning is in service of generalization, a seeming contradiction that reflects the difficult role of instructors trying to teach sophisticated material intelligences or inscription technologies to generally non-expert students for use in different kinds of specialized contexts.

Kathleen Yancey et al. and Anne Beaufort emphasize the need for students to understand what it means to study and then practice writing, to develop a language for understanding writing that enables students to understand the kind of work compositionists do and the kinds of perspectives they bring to understanding writing. Yancey et al write that, "Without a curriculum explicitly based on a writing vocabulary or set of key terms, students often leave the classroom unsure of what they did learn; they then leapfrog to earlier knowledge and practice that may be more or less helpful, rather than employing a writing-rich language model of curriculum as an approach to understanding and responding to new writing situations" (102). The lack of language and methods that reflect how compositionists think about writing leaves the students unable to

transfer knowledge to later contexts. Beaufort provides an example when framing how to teach students about audience and writing context, starting by introducing the concept *discourse community* (179), a term that as will be discussed in section 2.1.3 is well-theorized in composition literature. Yancey et al. and Beaufort's approaches, which make the language used by the instructor known to students, encourages them to understand the humanities side of the two cultures not simply by focusing on a more humanistic activity—writing—but instead by showing what it means to study writing as a humanist or, more specifically, a compositionist. In the above example from Wolfe et al., the ability to identify a structure and where the argumentative work falls within that structure is closer to the work of a compositionist than, say, knowing that a thesis-first structure is "good writing" in some general sense.

Consider writing an introduction. There are several approaches that could be relayed to students: summarize the topic, like in an abstract; introduce the basic concept that will be built on over the rest of the paper; or have a short, pithy scene or statement that immediately gets the reader's attention. While these methods can all be effective, and are useful to be aware of, there's still a gap between the approaches to writing an introduction and identifying what methods might best set up what is to come. To teach how to write an effective introduction in a way that facilitates transfer, it's not enough to look at several kinds of introductions to see what techniques exist. Rather, what's relevant is the way the introduction mediates audience interest and expectations and the purpose of the text as a whole. In this light, writing an introduction is a process meant to address a certain problem, analogous to how Carver identified a recurrent problem type that could be addressed through computer programming. When students understand what an introduction *does*, they can see how various techniques accomplish that goal in different ways, giving them a way to understand the process of writing an introduction. Then, when reading introductions in their

own discipline, they can understand what approaches are common, and how they mediate the author's disciplinary goals and communication to others within that discipline.

There are a lot of examples of different kinds of introductions, so to narrow my focus, I will start with an interesting but relatively straight-forward example from an academic text, then move into a more complex example from fiction.

The first example is the opening paragraph(s) to the introductory chapter of *Ways of Reading: An Anthology for Writers*, which collects writing from a variety of authors and genres and is regularly used and excerpted by instructors teaching FYC at Pitt. Bartholomae et al. write:

> Reading involves a fair measure of push and shove. You make your mark on a text, and it makes its mark on you. Reading is not simply a matter of hanging back and waiting for a piece, or its author, to tell you what the writing has to say. In fact, one of the difficult things about reading is that the pages before you will begin to speak only when the authors are silent and you begin to speak in their place, sometimes for them — doing their work, continuing their projects — and sometimes for yourself, following your own agenda.
>
> This is an unusual way to talk about reading, we know. We have not mentioned finding information or locating an author's purpose or identifying main ideas, useful though these skills are, because the purpose of our book is to offer you occasions to imagine other ways of reading. (1)

The authors manage to incorporate familiar and relatively atypical elements of composing an introduction here. The familiar: within six sentences, they have made clear what their book is about—teaching the reader a variety of ways of reading—and what it does differently—present ways of reading that may be unfamiliar or atypical but no less productive for the reader. In terms of the atypical, they open with descriptions of reading that are, as the authors themselves note, "unusual." They open with something likely to stick out to the reader as different from their experiences in order to set up the book's role in broadening their experiences to account for a wider range of reading approaches that can benefit them as they read a wide variety of difficult texts.

While it's worth noting that a kind of "thesis" or mission statement is presented early, in keeping with the norms of literary studies and thesis-first structure as discussed above in Wolfe et al., it is even more worth noting how the introduction sets up its thesis. By opening with an atypical set of statements about reading, and noting that the book is about different ways of reading, the reader is encouraged to reflect on their own reading practices and how the book's introduction does or does not align with those practices. For students to make use of such an approach, they would need to consider their own work's purpose and how to not only introduce the key concepts, but make the audience experience in part what the book is about in total, the feeling of reading something differently. With the additional insights of Wolfe et al. about making clear the disciplinary nature of the text, the way the introduction mediates audience and reader in a specific academic context becomes a tool that can more readily transfer out of that initial context.

The second example is from a book that I am teaching in a course called Narrative and Technology, *House of Leaves* by Mark Z. Danielewski. It's a strange book—a print novel with little focus on digital technology, yet one marked by digitality through its unique use of visual layout (Hayles, *EL* 43). Whether it's the large page dimensions of roughly seven by nine and a quarter inches; the mix of pages that are full of text in several fonts along with pages that have fewer than five words on them; or sections of text that are red and struck through—the book will undoubtedly have some unexpected features for people who read novels. Its content is likewise strange: it concerns a house whose internal dimensions exceed its external dimensions and reveal massive dark chasms within, potentially haunted by a minotaur-like monster. Yet, even within the world of the book, the house might not exist; we learn about it as readers through a pseudo-academic write-up on a film documentary that likely does not exist within the diegesis, written by

a blind man in his final years, and annotated by Johnny Truant, a deeply unreliable tattoo artist who finds the man's writing after his death.

How are we introduced to this world? After a brief foreword that describes changes in a recent edition, and before the titled "Introduction" section, there is a single line of text on the right-hand page, the left-hand page being empty: "This is not for you." What is the effect of this introduction to the text? On the one hand, it's unsettling, especially for readers going into it knowing it's a book with strong horror elements. It sets up nothing beyond a sense that the text is not for human consumption, or at least not the reader's, a theme that will be echoed by Truant's decreasing grasp on reality as he works through Zampano's writing (xxiii; 72; 179). But even further, it sets up a metaphysical question at the heart of the book: where is the ground in this text? What is the *this* that is not for me? In a book that we experience through an unreliable narrator's footnotes on a blind man's analysis of a film that doesn't exist, about a house whose internal dimensions are constantly changing, where can we plant our feet on the ground of certainty so that we can understand the "reality" of the story, and then interpret the motivations of the various unreliable narrators in telling that story? For Hayles, *House of Leaves* is an essentially postmodern text, creating several referents but no foundation from which those referents are built (*WM* 110). By starting the story with a word that references *something*, and relates that undefined *something* to our role as readers, Danielewski is setting up the emotional, conceptual, and thematic content of the book to come, even if all of those dimensions might not be clear at first blush. For a dense literary text, such an approach is fitting, but it's hardly an obvious one.

It's hard to teach the idea of writing an introduction without also bringing in ideas of rhetorical context and the host of factors such context brings in for determining effectiveness in writing. If students don't have the language composition scholars would employ for such an

understanding of what makes something like Danielewski's intro effective, how could they think to use such an introduction when it comes time for them to write one? If they do not understand the means by which such an atypical, off-putting, and unclear introduction might be considered effective, how could they identify when to apply it? Teaching this kind of introduction in a composition course would face scheduling limitations due to the length of the text, but having taught this book in a literature class, I can speak to how the general approach I took reflects the approach composition scholars take to writing and re-writing to achieve such a strong rhetorical effect. First, I would ask students what impression the sentence left on them as they began the book. Is it nonsensical? Does it creep you out? Does it inform how you understood Truant's introduction and the opening to Zampano's writing? Later, after students had engaged with the text more and started to piece together some of the dizzying themes like referentiality and the construction of reality, the introduction would be a topic to revisit. Has your impression changed of what the introduction does for the text, what it helps us understand about a book that often resists clear understanding?

For a composition course, such a process of identifying immediate impressions and then revisiting the opening to reconsider its meaning can serve at least two purposes. First, it can show that an introduction might disorient rather than orient a reader to the text, if that disorientation serves a point in the broader context of the narrative. Second, it can show the value of revisiting an introduction as an author; once you understand your goals as an author after you've written more of the text, it can be worthwhile to revise the introduction so that it more effectively sets up what is to come. Something as simple as a five-word introduction can teach students not only how to read effectively, but how to apply what they learn in their own work, assuming the instructor makes this method of reading clear to the students. And again, the instructor can and should note

the disciplinary context; such an approach is appropriate for a novel attempt at narrative presentation, for an audience of fiction readers, whereas this approach might not be appropriate for an engineering paper.

Yancey et al. describe the perspectives of a set of students who did not receive a contextual, transfer-oriented approach to teaching writing, and the effect on their capacity for transfer. The way such students differentiate kinds of writing is telling: they split writing into personal and professional kinds, with the latter being outside of the traditional domain of expertise in English as a discipline (26). Without language and a framework that situates students not merely as novices to writing but as *temporary novices*, students miss the ways their learning is setting them on a path to a more sophisticated understanding of writing as a highly contextual practice (Reiff and Bawarshi 313). The relationship between the instructor and student, in this case, becomes a transparent one where the instructor's experience in identifying relevant parts of rhetorical context provides an avenue for students to learn a contextual approach to solving a problem: introducing a complicated text for a presumed audience.

Yancey et al. more specifically advocate for an approach that they call *teaching for transfer* (TFT) that pulls from some of the curriculum-oriented approaches to first-year writing such as writing in the disciplines and writing about writing. Both of these approaches emphasize writing as a combination of knowledge and skills as described in this section, i.e. as institutionally situated approaches to understanding writing from a compositionist perspective to help students envision their relative novice role in writing as temporary by relating it to a broader, better-defined field of study. Again, the approach treats writing as a specialized domain of study, but the ambition is to encourage better generalization of skills: "Our goal for first-year composition, like the field's collective goal," they write as set up to explaining their TFT course, "is to help writers develop

and prepare students for the writing they will do in other college courses" (139-40). To teach writing in such a way enables general use as students move out of the class and into the rest of their academic work, which will involve more specialized forms of writing appropriate to their future communities.

Two of Yancey et al.'s six general suggestions for a transfer-based approach emphasize their disciplinary approach to the teaching of writing: one is helping students learn processes by "link[ing] them to key terms and a framework" and another, asking students to develop their own frameworks (139). By making visible the mechanisms compositionists make use of for their analysis and framing them as part of a broader meaning-based framework, composition theory, TFT and similar approaches help students better understand the culture of humanities-based inquiry, and what writing looks like as an embodiment of the meaning/mechanism dialectic rather than as pure mechanism.

There is some evidence of the efficacy of transfer in the teaching of college writing. In the *Elon Statement on Writing Transfer*, co-developed by dozens of writing researchers and published in 2015, the researchers relate "high-confidence principles" in teaching for transfer that are rooted in a survey of empirical studies on the subject (6), which in turn allow them to derive three "enabling practices" for teaching for transfer in writing courses. First, instructors should focus on helping students identify concepts that allow them to understand the expectations and norms around writing in a well-defined context using rhetorical concepts such as *genre* and *audience*; second, that instructors should engage students in activities that build metacognitive awareness of how they come to understand and approach writing in a new context; and third, that instructors should make the process in the second principle visible to students, making clear that part of learning and engaging in new contexts is purposefully considering how to approach the new

context and identify past resources that can be made use of (8). These practices, rooted in an examination of a wide body of literature that includes empirical studies applying transfer-based pedagogy in classrooms, reinforce that writing transfer can be taught through rhetorical concepts, and when the process of transfer is given language and made visible to students as a process for making use of prior learning in new contexts. To think about how comp digital pedagogy might make use of the concept of *transfer*, I think the development of the idea through pedagogical theory and empirical studies in composition shows not only that transfer is possible, but that there are established means for enacting it including and beyond Guzdial's use.

The utility of the concept for comp digital pedagogy generally is a direct analogy to its utility in writing courses. First-year writing courses can utilize transfer to teach writing practices as defined from a composition studies perspective—which are necessarily generalized—that might apply in specialized writing contexts later in students' academic careers. Analogously, courses that approach digital technology from a comp digital pedagogy perspective can demonstrate which aspects of digital computers might be taught in courses oriented toward a wide student audience in ways that facilitate purposeful engagement with digital computers as required in their later coursework or research. As scholarship on writing transfer in composition indicates, the problem of teaching in a way that deals with computers as technology used in a variety of specialized contexts—from geographic information systems in a history department to automated writing algorithms in AI research—can be addressed by helping students develop clear language for their object of study, and by an understanding of how that object is understood in its institutional context. These takeaways reflect that transfer occurs when students learn not only a mechanism but the meaningful contexts in which that mechanism is used. While this chapter focuses on

applications of transfer and related concepts in first-year writing contexts, I want to be clear that the utility will expand well beyond that immediate context.

One part of teaching for transfer I want to draw out further is the need not only to make visible the role of transfer in the learning process, but to provide several opportunities for it as the basis for building metacognitive awareness and application. Beaufort, for example, gives three key strategies for teaching for transfer, and one is to "[g]ive students numerous opportunities to apply abstract concepts in different social contexts" (181). If students are to understand how to recognize what kinds of skills can transfer and when to do so, they need to practice it in class, and they need instructors who will help evaluate the effectiveness of the attempted transfer, a role that Rebecca Nowacek calls "instructor-as-handler" (90). Before discussing the instructor more squarely in section 1.1.3 when talking about discourse communities, I want to speak more to Nowacek's work on how students can identify opportunities to transfer, which will introduce another key term for this chapter on composition studies: *genre*.

Nowacek uses the rhetorical concept of *exigence* to describe how to identify opportunities for transfer, with *exigence* defined as "the recurring social situation that calls forth a stabilized-for-now genre" (28). Before turning to *genre* in the next section, it's worth noting that the ability to recognize opportunities for transfer gives a pedagogical in-road for teaching for it, especially considering that the goal is not only the straightforward transfer of skills to superficially similar contexts—or *low-road transfer*, e.g. seeing how the five-paragraph essay format taught in high school might be useful for a short argumentative essay in another class[16]—but also transfer across

16 Or, to apply the concept reflexively to this dissertation, looking to concepts from comp/rhet that can transfer to comp digital pedagogy through an initial focus on the teaching of computing in first-year writing courses,

relatively unlike contexts—or *high-road transfer*, e.g. relating writing and computing through a concept like *material intelligence*. These concepts come from D.N. Perkins and Gavriel Salomon (25), and as Nowacek states, they help to avoid over-generalizing certain skills by recognizing they will need to be applied in different concepts that might differ in likeness (15). To help students understand skills and knowledge in a context that can help them learn mechanistic processes in ways that keep their meaning in view, it's important pedagogically for instructors and students to recognize the exigences for that transfer and differences in kind amongst exigences (*high-road*/*low-road*). To return to *House of Leaves*, teaching the introduction for low-road transfer could involve asking students to propose their own introductions to a horror story or piece of postmodern fiction, while high-road transfer would involve asking students how they might apply the process of understanding the role of the introduction in *House of Leaves* to a dissimilar genre, like an argumentative essay.

I want to emphasize that *transfer* for computing and writing can be best facilitated when meaning and mechanism are framed as inextricable components of how the two should be taught. If writing is taught as a set of rote skills, the ability to recognize unlike contexts falters because the contextual meaning of those skills is invisible to the student. Likewise, were it taught only as theory or explained merely as an object of study rather than understood as a combined study and practice, then the ability to transfer would be hampered by a lack of awareness of what mechanics of writing can and can't be applied in different contexts, or how to differentiate mechanical skills

---

which stays near to the focus within composition studies on first-year writing generally. This chapter applies the concept in a nearby context to set up applications in further away contexts in the chapters to come.

learned in writing from those in a new context to encourage transfer of useful skills for the new context (Whicker 299; Yancey et al. 101).

When it comes to encouraging transfer across STEM and the humanities, which section 1.1 provides several examples of, there is particular need to speak to high-road transfer. The differences between ways of knowing and objects of study between the two cultures, not to mention within them, are substantial, and students aiming to work at these intersections need facility in recognizing them. Such an approach requires consideration of the roles of genre and discourse communities, which can help further contextualize and alleviate the two cultures divide by setting up the contexts across which transfer can occur. Given that the computer-as-universal solvent has changed the nature of the two cultures divide through dissolving traditional boundaries in universities in terms of both disciplines and subject domains, the ability to recognize when and how to draw cross-cultural connections or otherwise hybridize mechanistic and meaningful approaches to understanding is key for undergraduate pedagogy interested in dealing with digital technology.

2.1.2 Genre

Now that *transfer* has been discussed as how students can draw connections across contexts, I want to turn to *genre* as a way to help students identify when and how transfer becomes possible. As related in section 2.1.1 regarding the *Elon Statement*, an essential enabling practice for teaching for transfer includes helping students contextualize writing through rhetorical concepts such as *genre* and *audience* (8). The use of the term in contemporary rhetorical theory is not usually meant to invoke general literary uses of the term, e.g. a novel or a poem, but rather the

notion of recurrent situations in certain social context(s)[17], a means for recognizing likeness across difference by finding common responses in different-yet-similar situations. In this sense, a community or set of interconnected communities function in such a way as to produce recurrent situations, and genres are the categories people make use of to interpret and respond to the situations.

This definition of genre treats categories of writing and the situations that enable or encourage them as emergent, socially situated, and meaningful in the context of a specific community or set of communities. As a result, it gives an inroad for teaching transfer by helping students see, through the lens of a comp/rhet scholar or researcher, how to identify the relevant contextual components of a certain kind of writing so that they can identify what might transfer from prior writing experiences and forms to new ones. The genre of an introduction from this perspective is revealed to be several smaller genres depending on what kind of text is being introduced, and to whom. While teaching students a variety of general methods for introducing a research paper on their own is not effective, teaching them how to identify the contextual norms

---

17 This framing is in line with Nowacek (18), but there are several more comp/rhet scholars who provide variations on this theme. Anis Bawarshi describes the common definition of genres "as typified rhetorical ways communicants come to recognize and act in all kinds of situations, literary and nonliterary" (335). Charles Bazerman describes "typified utterances" that enable the solution of "perceive[d] homologies in circumstances," which solidify into genres (69). Carolyn Miller, reflecting on her 1984 article "Genre as Social Action" three decades on, emphasizes the need she identified at the time to rework genre theory to account for social context ("Genre as Social Action (1984), Revisited"). Such an approach recognizes genres as tools to identify likeness across difference as defined by a person moving across various communities or even within the same community.

and affordances for their research paper's intended audience and effective ways to introduce their topic to that audience is at once a general skill, and a skill that can help them identify the more specialized knowledge they will develop as they write more in their own or future disciplines. If *transfer* sets up a method for bridging gaps between cultures and disciplines that can apply to the teaching of writing and computing, then *genres* are the sites through which opportunities for transfer can be identified at sufficient levels of generality and specificity to speak to a variety of student needs that will later meet more specialized writing contexts.

Consider an example of what such a genre might look like from a comp/rhet perspective, namely that of a follow-up email to discuss something covered in, say, a departmental meeting at a university. This genre arises out of a recurrent situation: something has come up during a meeting that should be discussed further but cannot be at the moment without affecting time constraints or the emphasis on information relevant to all participants in the meeting. The genre could even be invoked inappropriately to the ire of everyone else, e.g. when a manager deflects an important conversation about concerns amongst the people in the meeting by relegating it to an individualized follow-up email. This situation might in turn inspire the utilization of other genres, such as a co-worker meeting at a happy hour to discuss openly the topic that was punted.

Nowacek calls these recurrent situations *exigences*, which as discussed in section 2.1.1 describe "the recurring social situation that calls forth a stabilized-for-now genre" (28). *Genre*, *transfer*, and *exigence* come together in her work as a way to engage students in the writing process in first-year composition by "tak[ing] seriously the imperative to create an institutional context that pulls back the curtain on the formation of disciplinary expertise" (129), a point echoed by the enabling practices in the *Elon Statement* as described in section 2.1.1. In an undergraduate context, students need to be able to identify genres in different academic disciplines and communities so

that they can envision themselves as learning how to be part of such a community. While Nowacek focuses on first-year writing courses, note that the problem she identifies reflects an issue described in the second footnote in section 0.0: when mathematics students cannot see themselves as doing the kind of work or problem-solving that mathematicians do, their work in the field is limited. In the broader context, when students can understand these norms and means of responding to problems, they will have the opportunity to transfer knowledge from different communities and contexts as they can understand what is appropriate and inappropriate for the current issue.

Nowacek's application of these concepts helps address a problem in both composition studies and comp digital pedagogy's attempts at intervening in the two cultures divide. In both cases, the issue is once again the generalization/specialization problem, or the difficulty of dealing with a specialized technology at levels of generality that can support more specialized use of that technology later down the line. From the comp side, a good example of this issue is described in Bartholomae's 1986 "Inventing the University," where he argues that writing instruction can speak to a general undergraduate audience by introducing students to specialized academic discourses, revealing how those communities approach knowledge formation and problem solving so that students can "compromise between idiosyncrasy, a personal history, and the requirements of convention, the history of a discipline" (4-5). To mediate between generalized learning in first-year writing courses and the specialized domains in which writing will be taken up by students later in their undergraduate career, first-year writing can develop an understanding of genre from a rhetorical perspective and then use that understanding to encourage transfer from the various domains students partake and are interested in. And again, this approach models the kind of thinking that will allow students to see their learning as part of a temporary novice role; in a similar interrelation of transfer and genre, Beaufort argues the two enable the kinds of mental schema that

experts make use of: “experts not only have very rich, deep, context-specific knowledge, but they also have mental schema, or heuristics, with which to organize knowledge and aid problem-solving and gaining new knowledge in new situations” (17). By introducing students to these schema and how they develop through the concept of genre, students are prepared to encounter new situations and new genres in the communities they hope to join later in their academic careers and after.

Transfer and *genre* come together in writing pedagogy as ways to deal with the problem of generalization and specialization. Students enter the first-year writing course to learn about writing, but writing is not—or at least should not be—taught as a flat, objective process for disseminating information regardless of context. Rather, composition instructors should introduce students to the kinds of work that writing facilitates in the various communities within academia. *Genres* as recurrent situations enable students to understand how problems are identified, interpreted, and addressed by communities, which helps them understand what prior genre knowledge or other experiences and knowledge can transfer to this new context. In doing so, they not only learn about the practices of an academic community; they also learn how to manage new problems that arise as they continue in their increasingly specialized undergraduate careers and beyond. Note that this solution does not need to be limited to writing as a technology used in specialized work, as it also applies to computer technology. General principles of use can be designed to facilitate later specialized use, and the question then becomes how to reuse or rework the principles and enabling practices learned from writing’s approach to these concepts to computing.

For example, let’s reconsider the example from Brian Cantwell Smith of cross-cultural work that faced some resistance related in the very beginning of this dissertation in section 0.0. The root of the resistance comes into clearer view when transfer and genre are taken into account.

For Smith's part, he was dismissed when asking a question at a conference on the *aboutness* of information in computer science ("Brian" 24:53). Smith's work leads him to consider from the perspective of a philosopher the fundamental ideas at play in the study of computers. These philosophical questions include: what *is* a computer, and how is it similar to or different from other technology? What *is* this notion of information that has been mechanized and appropriated for computer science? And more importantly, what does it *mean*? Certainly these questions can speak to a range of scholars, as indicated by Hayles' literary studies approach to the meaning of information in the history of computers in *HWBP*. And certainly a conference presentation is an appropriate place to consider such difficult questions, as scholars share work in progress that is necessarily exposed to peer critique.

Yet Smith receives pushback for making use of such spaces to ask his questions. Why? His questions, fitting for the genre of conference presentations and conversations in philosophy, seem wholly out of place to an audience of computer scientists, who are less interested in establishing or poking holes in foundational concepts that have been defined for decades. Philip Agre, whose career path took him from being a professor of computer science to one of information studies, gives some context to this problem. He describes "[t]he strategic vagueness of AI vocabulary" which enables "some wildly unreasonable assumptions" by designers of AI and cuts off discussions on those assumptions and potential alternatives (142). Despite being a kind of shared genre, a conference presentation, the approach Smith takes reflects that such a broadly defined genre does not consider the way such a communication event differs based on context and community norms. That said, from another perspective, the fact that Smith used these platforms to provide his ideas to an audience who might not otherwise hear them could also speak to an effective, albeit unpopular, application of transfer.

Transfer and *genre* provide pedagogical tools for understanding and supporting cross-cultural work through theoretically defining how work might cross boundaries, and how to identify opportunities for that boundary crossing. The component that remains undertheorized so far is the notion of *communities* underpinning the idea of differentiable cultures and the contexts that create exigences for transfer. Before turning to how to apply these ideas in the teaching of computing in first-year writing courses, then, I want to describe *communities* in terms of *discourse communities* and some related concepts as they have been written about in comp/rhet.

2.1.3 Discourse Communities

The concept of *discourse communities* comes from linguists, but has been widely taken up in comp/rhet. In this section, I want to relate the concept to *transfer* and *genre* as it's discussed in comp/rhet scholarship, but also use the concept to further theorize the notion of *cultures* discussed by Snow in service of comp digital pedagogy's attempts to build student understandings that might cross those cultural boundaries.

Within comp/rhet, if transfer is the ability to see likeness across difference, and genre provides exigences for enacting transfer through a consideration of rhetorical context, then *discourse community* describes the social context in which genres develop and across which transfer can occur. Beaufort, in her emphasis on pedagogy oriented toward teaching for transfer, describes discourse communities as a theoretical concept that can tie together people across time and space through ongoing inter-community dialogue and norms. "Discourse communities," she writes, "exhibit a particular network of communicative channels, oral and written, whose interplay affects the purposes and meanings of the written texts produced within the community. Based on a set of shared goals and values and certain material/physical conditions, discourse communities

establish norms for genres that may be unique to the community or shared with overlapping communities and roles and tasks for writers are appropriated within this activity system" (18-9). The recurrent situations that create and define genres arise amongst a relatively consistent group of people interacting in a shared context that extends over time, with a "broadly agreed set of common public goals" (Swales, *Genre Analysis* 24).

John Swales introduces, along with the idea of shared goals, two other key aspects of a discourse community that are useful here: first, "[a] discourse community has mechanisms of intercommunication among its members" (*Genre Analysis* 25), and second, it "uses its participatory mechanisms primarily to provide information and feedback" (*Genre Analysis* 26). Hence, discourse communities are particularly relevant to the study and teaching of writing, as well as a more general consideration of computers and writing as *material intelligences* or *inscription technologies*, because they make use of certain communicative mechanisms to facilitate meaningful discourse in pursuit of the somewhat agreed upon set of goals. Composition studies, in acculturating students into the "various discourses of our community" (Bartholomae 4), can contextualize the mechanisms discourse communities use to build, challenge, and distribute knowledge, problems, and accomplishments through study of their meaningful mechanisms, with genre being an essential inroad by highlighting recurrent communicative events in that community.

These understandings of community help clarify what comprises the cultural distinctions that Snow describes. Consider Snow's relating of the question "What do you mean by *mass*?" to "the scientific equivalent of saying, *Can you read?*" (15, emphasis in original), as discussed in section 0.0. From the perspective of the humanities with its increased emphasis on meaning, the initial question is an interesting prompt to consider how the concept of *mass* mediates between physical properties and the perspectives of physicists, with the potential to reveal the assumptions

built into that perspective through close examination of language and thought used to understand mass similar to how section 1.1.1 does with mathematics through consideration of *certainty* and *proof*. From the perspective of scientists, though, where the term has a more mechanistic meaning as a physical measurement used in higher-level concepts within physics, the question does not prompt meta-reflection but instead comes across as patronizing. Similarly, Hayles' reflections on her work and life via the avatar Kaye in *WM* related in section 0.0 describe her questions, rooted in a humanities perspective and a focus on the meaning of terms and technology, facing dismissal amongst those in scientific communities. Her questions seemed outside of the norms and understanding of what a word *means* within those communities.

There are several variations on the concept of *discourse communities* that can help flesh out the idea further, namely: *rhetorical communities*, *communities of practice*, and *activity systems*. The first comes from Carolyn Miller's expansion of Swales' work; along with "material and demographic" dimensions, she considers "virtual" qualities ("Rhetorical Community" 73). Miller's suggestion highlights how communities themselves are rhetorically formed, shaped, and understood, as these communities change over time and space while maintaining a projected, or virtual, sense of consistency. The recognition of the slippery nature of communities is useful because it recognizes that, while communities form around certain norms and shared approaches to recurrent social situations, they also have a self-understanding that contains its own rhetorical dimensions. The sense that certain questions of meaning fall outside of the discursive space of scientific communities is an effect of this rhetorical self-understanding; while these questions can have uptake by scientists, there's a sense that they are outside of their conceptual purview. The communities themselves can therefore be susceptible to rhetorical analysis, as to accept them flatly

on their own terms shuts out work that attempts to speak across communities and the cultural distinctions they may have.

On the other hand, this rhetorical/virtual dimension helps understand how communities change radically over time while maintaining some sense of consistency. For example, Kuhn describes scientific revolutions in *Structure of Scientific Revolutions* as "the tradition-shattering complements to the tradition-bound activity of normal science" (6), but notably the shift is not so sharp as to completely abandon the former community's members and self-understanding. Hacking, in his introduction to Kuhn's book, gives an example: *relativity*, which "had, at the beginning, far more repercussions in the humanities and arts than genuine testable consequences in physics" (xiii). Although initially outside of the scientific domain, the later revelation of its utility in physics led to a reshaping of the community's sense of their subject of study and role as a certain subset of the scientific community.

Communities of practice add an emphasis on the practices of these communities, and this is the term Guzdial makes use of in his pedagogical project. He notes that it emphasizes the fact that students want to learn about a practicing community within academia or related professions, be it historians, biologists, doctors, nurses, or teachers (33). His goals in using the term are in line with comp digital pedagogy because he focuses on identifying a community to facilitate effective, institutionally contextualized student learning. The emphasis on practice, though, helps bring in another term that will round out the theoretical construction of *discourse communities* outlined in this section. Guzdial's use of *communities of practice* stems from Jean Lave and Etienne Wenger's book on *situated learning*, which likewise emphasizes learning as part of becoming a member of a community, as a "situated activity" which recognizes that "learners inevitably participate in communities of practitioners" (29). The activities and practices of communities are important as

they illuminate the situations and actions that lead to the construction of genres, which in turn enable an understanding of effective transfer.

The practices that are made use of in certain communities can similarly be understood as changing throughout history without necessarily abolishing the original community. Kuhn's theory of scientific revolutions, for example, relates revolutions to the use of certain instruments or technologies, where what the tool makes visible takes on meaning within a theory or paradigm held by the community (39), reflecting that the mechanisms used in the practices of a community take on meaning through a certain conceptual framework held by the community. Whether looking at the virtual and rhetorical dimensions of a community or the practices within that community, the mechanisms and meaning validated by that community can help to understand not just what that community does, but how it defines the guidelines for developing more sophisticated understanding of the world, reflecting the interrelation of meaning and mechanism in the sciences across history and culture.

The emphasis on practice leads to the last term for understanding communities as a basis for cross-cultural understanding: *activity systems*. Nowacek theorizes the concept as relating subjects, objects of analysis, intended outcomes, and mediational tools, and emphasizes that the concept extends *discourse communities* by emphasizing the overlap and connections between communities (21). Note that her focus via activity theory on *subjects*, *objects of analysis*, and *tools* reflects the emphasis on mechanisms for communication and analysis in Swales' theorizing of discourse communities, while *intended outcomes* parallels his emphasis on a shared set of goals. Writing on the activities of members of these groups, Nowacek highlights that these activities will necessarily intersect with other groups, whether through collaboration or the fact that people can exist across multiple communities (31)—even if uncomfortably, as Snow's, Smith's, and Hayles'

works indicate. This approach to understanding communities is useful because it recognizes that not only can communities change in their paradigms, to use Kuhn's term, or virtual self-perception; they also interact with and are embedded in different or larger systems, which opens up the ability to understand the community outside of its own terms and from the perspective of a different cultural mindset. Given the dissolution of traditional boundaries as a result of the computer's role as a universal solvent, this ability to situate activity as reaching across various communities is important.[18]

---

18 The various understandings of "communities" described here help to address some of the concerns Joseph Harris posited about communities as a concept in composition over three decades ago. He describes hesitation toward the word on the grounds that the term is used vaguely, describing in sweeping terms groups of people without defining what comprises those groups or how they function (12); that it oversimplifies the idea of an academic community based on a selection of its features such as journal publications (20), while presenting that community as necessarily outside of that of our students (12); and that it reduces the complex network of communities students and other members of any given community might move through and be influenced by (19). From my perspective, several of these bugs are closer to features; in terms of the first and third points, I think these traits reflect the fact that communities are hard to define, that they do not always have strict rules of inclusion and exclusion that any given person can use to determine their (lack of) membership. Even for a community with relatively straightforward criteria like the community of medical doctors in the United States, that community is influenced by people without medical degrees, from researchers to technologists to scientists and more. And within that community, there will be different perspectives on certain kinds of treatment, or how to interact with patients, or what kinds of medical protocols should be followed in, say, a global pandemic. That variety, paired with the virtual perception of a community as described in Miller's work, reflects the complexity of any given community. Addressing that complexity, which is part of the concern expressed in the second point from Harris's work summarized above, is an opportunity to help students mediate between the specialized discourses they see in academia and the variety of communities they are part

There are new problems that arise with the idea of discourse communities in academia from the perspective of undergraduate students when considering the digital computer, and they reflect the new challenges to the two cultures problem written about in section 0.1. This returns us once again to the ideas of specialization and generalization. On the one hand, discourse communities have become more specific, such that even relatively smaller schools like where I completed my undergrad have major distinctions between communities of pure and applied mathematics, and further distinctions within pure mathematics between those focused on abstract algebra and analysis. On the other hand, keeping in mind the idea of computers as a universal solvent, communities now share an essential technology and communication medium that dissolves traditional boundaries.[19] Swales, reflecting on his work on discourse communities, describes the

---

of. Further, I think this understanding of community is more in line with contemporary understandings than the version Harris used, which to him connoted being "a nicer, friendly, fuzzier version of what came before" (13). Today, with the advent of the Internet, those sentiments seem less present in the term; local communities are less coherent and stable as the members are even less isolated, with countless online communities that any given individual might move through both available and ill-defined. Even massive discursive spaces like Twitter and TikTok have sub-communities within them, from politically affiliated groups of activists across several locations, to fandoms, to conspiracy theorists, to specialized interests like repairing old cars. People are part of and move through a variety of ill-defined communities as part of their daily experience, particularly if they spend time online. That is all to say, the concerns Harris had about the term are valid but, today, they are issues to address through more robust theorization of the term rather than appealing to a new term or metaphor like a city, as Harris does (20).

19 The previous footnote provides some examples of how this is at play in social media, but it has also introduced new issues for undergraduate students. Disciplinary boundaries are less clear when students go to do their own research, as they can perform search queries that collate results from a variety of sources, with the distinctions

uncertain role of computing for understanding them. He argues they "both influence and are influenced by the larger communities within which they are situated" as a result of several social factors, including the "era of cell-phones" ("The Concept"). Traditional boundaries remain, but they have become fragmented or dissolved because of the computer.

Composition instructors, then, particularly from the lens of comp digital pedagogy, should serve as facilitators for students to explore discourse communities that they hope to partake in, and frame writing through the lens of genre to make clear why writing as a practice is useful in terms of learning how academic discourse communities function. To do so enables students to envision themselves as budding members of these communities, while also enabling them to transfer knowledge and experiences from different contexts appropriately—or, in some cases, in a way that is productively inappropriate, as with Smith's and Hayles' work. While composition instructors cannot serve as experts on every community and sub-community within academia and the related communities students might intersect with as they write, they can help students understand the kinds of work academics do so that they can approach their later writing in more specialized discourses with more experience and confidence;[20] and further, they can encourage students to

---

between them being all the murkier due to the consistent formatting of their presentation. In the words of historian Lara Putnam, "Digital search makes possible radically more decontextualized research" (392), which risks putting students in a place where they feel like they have access to more information while masking the fact that they lack the contextual knowledge of where that information comes from.

20 This suggestion is in line with a challenge and solution described in Jennifer Juszkiewicz and Joseph Warfel's contribution to a collection that, as this dissertation does, focuses on "the intersection of rhetoric, writing studies, and computation" (Jones and Hirsu 1). Juszkiewicz and Warfel suggest computational literacy, as opposed to specialization, as a potential goal for instructors in teaching digital technology, with a recognition

seek out more specific understandings of communities they may hope to join with a well-defined framework for understanding communal norms and practices, with genres serving as key inroads for developing this understanding of writing as a situated activity.

2.2 Digital Composition Scholarship

2.2.1 Composition and Computers, Broadly

To review: a comp digital pedagogy approach attempts to navigate the two cultures problem by making use of three concepts from composition studies. Transfer describes how students can draw connections across contexts, with high-road transfer being particularly important for drawing connections across the two cultures. Genre helps students identify the

---

of the role of computation and mathematics (106). While they recognize that such a blanket expectation of all teachers is unreasonable, they note that "good work can be done when rhetoricians and composition scholars work with computational specialists" (106), and this modeling of collaboration reflects the triad of concepts in section 2.1. In contemporary academic work across disciplines, scholars and researchers will encounter parts of their work—particularly in the case of cross-cultural work—that they cannot reasonably take the time to learn with the level of depth required for the project. Understood as a recurrent situation in contemporary scholarship, such limitations can in fact be exigences for a generic response, of identifying potential collaborators, resources, or members of another community within one's university, and then reaching out to them effectively. Even if students do not necessarily reach out to someone else for specialized knowledge, teaching such a genre could enable the transfer of this important skill when students encounter a similar problem later in their careers.

recurrent communication events in the context of a specific community, which provide opportunities for transfer. Discourse communities frame these communities from a rhetorical angle, helping students identify the norms of future communities they might partake in and the contexts of genres in that community which in turn can enable transfer outside of writing courses. Comp digital pedagogy extends the goals of composition courses, particularly first-year composition, which focus on teaching students to write in a way that will support their work in later classes. The extension is considering how these ideas about writing can apply to digital technology to encourage students to bridge the cultural gap(s) between STEM and the humanities. Because digital technology has, akin to writing technology, become integral to students' work across disciplines and often requires specialized knowledge for use, the lessons learned from how composition teaches writing can extend to how students are taught digital technology. The new questions that arise stem from digital technology's superlative nature as meaningful mechanisms, or to use Smith's description, as "intentionally significant artifacts—the best we know how to build" (*Age* 39). Their technological nature and relative newness compared to writing, tied with their history in furthering the possibility for specialized study in STEM fields, means that their ubiquity is important for composition students, who will need to use the computer in their writing courses, majors, and extra-academic lives. Composition instructors can extend their extant skills into the digital domain to help students navigate this problem.

Now I want to turn to scholarship in composition pedagogy that focuses on digital technology. First, I will look at a selection of scholarship that looks at digital pedagogy and its intersections with composition broadly, to draw out the connections and distinctions between how the field has considered the role of digital technology in writing studies and courses, and the approach outlined in section 2.1, i.e. a comp digital pedagogy approach. In this section, I will look

at a short list of books and articles that provide such a widely cast net. In the next section, I will look at a selection of articles from the journal *Computers and Composition* that focus on first-year writing to see how the comp digital pedagogy approach is (or is not) reflected in scholarship that focuses on teaching practice and digital technology. The analysis in this section and the next section will in turn provide a better sense of how to apply comp digital pedagogy in first-year writing, as that context for the teaching of writing has a strong emphasis on ensuring the skills and knowledge acquired transfer to contexts outside of those classes.

The texts covered in this section range from 1989 to 2019. I selected them because they each attempt to look at the intersections of digital technology and composition studies from a bird's-eye view at different points over that three decade window, and range in focus from pedagogy to writing program administration, which shapes pedagogy. Further, two authors who contributed to much of the work discussed here, Cynthia L. Selfe and Gail E. Hawisher, served respectively as an original co-editor of *Computers and Composition* in 1983 and early co-editor starting in 1988, so it will be useful to understand their perspective before going to the next section.

The first two articles I want to focus on were published in *WPA: Writing Program Administration* in 1989 and 1996, with the latter serving as a direct response to the former. In the 1989 article by Jeanette Harris et al., they emphasize the responsibility of writing program administrators "to determine the role computers play in the teaching of writing" (35). They put forth a scaffolded approach of writing courses across semesters, which reaches beyond first-year writing, and they argue for a serious engagement with digital technology as technology across these courses. In a first-semester writing course, students might "learn some basic library terminology and how to use computerized databases" as part of research and argument development, as students work with teachers and librarians to understand how this technology is

used by librarians and the students they support (38). In the following semesters, students would shift to research writing and "more sophisticated, subject-specific research tools" followed by "using the computerized tools within their own disciplines to locate and retrieve information" (38). This general arc emphasizes helping students learn specific digital tools in ways that start in the local community of their writing class before looking outward to specific disciplines. While a three-course series of connected writing courses is not the norm at the University of Pittsburgh, I think that the approach reflects a commitment to teaching students how to use technology as part of their work in a way that can support their later work in the disciplines they pursue. This is necessarily a consideration of how to teach technology in a way that transfers out of the local context and into new contexts where writing and technology intersect, whether it be a humanities or STEM program.

Responding to Harris et al. seven years later in the same journal, Todd Taylor reaffirms the authors' approach while adding that "in order to make the kind of informed decisions that Harris and her colleagues call for, WPAs need quality information, and they need it updated frequently" (8).[21] Yet Taylor argues that research on computers and writing "has generally avoided talking about specific hardware and software configurations" due to rapid changes in technology (8). He argues that instead an emphasis on software is more apt and less volatile (11). There is some sense to Taylor's argument for first-year writing courses, where the nuts and bolts of hardware are apt to change and might be too in the weeds for that context. However, as software has become increasingly removed from the need to understand the hardware underlying it—e.g. with GUIs and

21 We will see an echo of this problem when discussing an English major at Pitt in section 4.2, as evaluating program efficacy has been hampered by a lack of easily accessible data on enrollment and program retainment.

the rise of accessible interfaces that lean away from the actual code underwriting software—I would argue that intertwining meaning and mechanism could benefit writing classes by making clear how the software in use is shaped by the underlying hardware, a point I will discuss further in Chapter 3 as I look toward composition and writing-intensive classes outside of first-year writing.

In Harris et al. and Taylor's work I see a reflection of my understanding of comp digital pedagogy and how it relates to extant digital pedagogy as described in section 2.0. In the broad strokes, my approach is not a repudiation of what has come before. Rather, it's a way to extend these goals into the present, with changes in technology and cultural milieu requiring shifts in focus and approach. In terms of the similarities, I think that Harris et al.'s suggestions capture the movement from the local context to a variety of contexts inside and outside of the humanities. In terms of differences, now that the relationship between hardware and software has become more opaque, there's increased utility in helping students understand the connection so that they do not take on complex technology in their work without understanding how it has not only affordances, but also limitations based on the underlying hardware.

Similar to Harris et al., Hawisher and Selfe in 1991 set terms for thinking about composition and computers in the decade to come, with three foci rooted in the growth of microcomputers: "instruction, research, and professional preparation" ("Introduction: Questions" 2). Given the increasing role of computers in the classroom at the time as enabled by the growth of microcomputers, which they rightly identified would continue into the future, they note that, "Not only must members of our profession keep abreast of theoretical perspectives on teaching and learning, but also they must attend to new hardware and software developments as well" ("Introduction: Questions" 2). Here they identify the need to keep a foot in both cultures, thinking

about the changing shape of composition studies as well as the ways technological developments play a part in the ever-shifting dynamic. Anne Frances Wysocki, in her introduction to a 2004 collection of which Selfe is a co-author, offers useful suggestions in this vein, namely in terms of how teachers can speak to the increasingly ubiquitous role of digital technology in writing practice: "[writing teachers] can bring to new media texts a humane and thoughtful attention to materiality, production, and consumption, which is currently missing" (7). While her language differs from mine, the impulse is the same: to consider how digital technology is mechanistic as a result of its materiality, while situating that mechanism in a meaningful cultural context. Writing students can then make use of that technology purposefully, rather than bringing into their own work the assumptions that such technology makes about the world.

In each of these writings I see an attempt to grapple with the increased prominence of digital technology in academic and everyday life, spheres which move between STEM and humanities subjects regularly. With digital technology's omnipresence in the present moment, students might make use of information retrieval algorithms, generative writing AI, or social media platforms as part of their work or everyday life. They might use specialized digital technology in their majors, but that technology can be a benefit or misleading deficit. For example, Juola and Ramsay relate a conference where a researcher used statistical software to analyze a dataset and found an incredibly esoteric distribution that fit his data. The connection was misleading, as that distribution only applied in rare instances that did not apply to the researcher's data, leading a statistics lecturer to share with Juola, "'Now, there's a man with a statistics program too powerful for him'" (266). The computer enabled the researcher to look at several distributions to find what best fit the data, but hid the conditions under which that distribution applies. What seemed like a

simple tool hid within it assumptions masked by the ease of use and ability for digital technology to provide several ways to see the data without sufficient context.

Jumping forward to the end of the 2010s, Sam Hamilton reflects on publicly available digital writing syllabi over 2010 to 2017 to see how the pedagogical practices align with broader pedagogical scholarship (158). The places where he found alignment were "direct instruction, collaboration, and experimentation" (171), a balancing act between telling students what is important and giving them space to solve problems themselves. The use of digital technology in particular seems to elicit the need for direct instruction, emerging from the varied skill levels of students and "very real time obligations and constraints of teaching a fifty minute class three times a week for fifteen weeks" (172), a recognition of the need to help students understand the mechanistic limitations they meet when using digital technology. Hamilton identifies one area, though, where there's a gap between the scholarship and the methods reflected in his dataset of syllabi: reflective writing (172). From a comp digital pedagogy perspective, the lack of reflective writing is an issue because it means the mechanistic learning isn't paired with purposeful consideration of the meaning of that learning process, or the interpretive possibilities opened and foreclosed by the mechanistic aspects of the technology under focus. When any software is taught, at a minimum, there should be sufficient time for students to understand what affordances are opened up to them through their use, as well as the limitations placed on their expression. Further, they should connect the affordances and limitations to not just their use in the digital writing class, but to the various discourse communities they hope to speak to as they advance in their undergraduate career.

Hamilton's analysis provides a useful inroad to how pedagogy and practice meet in classrooms. However, his approach has limitations that he recognizes, for example that his method

of collection via iterative web searches is not representative of all digital writing syllabi (171). Further, syllabi can misrepresent a course. Instructors might cover information in a class that is not listed in the course schedule, or they might change up their approach in response to what students find difficult or interesting. As a result, in the next section, I want to focus on a specific journal, *Computers and Composition*, and look at how writing instructors have framed their use of digital technology in first-year writing classrooms through articles that are designed to make that information clear and accessible to an outside audience. In doing so, I hope to better understand how comp digital pedagogy is or is not reflected in writing pedagogical practice with a focus on first-year writing.

2.2.2 Reading *Computers and Composition*

I have taken a few approaches to examining a corpus of articles from *Computers and Composition* to better understand the current state of digital writing pedagogy in first-year writing classes, as I want to identify useful scholarship on contemporary writing instruction that deals with computers and ensure that my work isn't ignoring these ongoing conversations. The choice to focus on *Computers and Composition* is one means of narrowing the scope—rooted in its prominence in digital-focused composition studies work and robust tagging/search system—but narrowing further from there has involved some failed approaches. Here's just one of them: as a means of selection, I set an arbitrary cutoff of how far back from the present I wanted to go in selecting articles, which I set at ten years, reflecting the approach in the last section at looking at writings over a three decade span. I searched "'first year' OR FYW OR FYC" across titles, keywords, and abstracts in *Computers and Composition* via an advanced search on the ScienceDirect page for the journal from 2014 to 2023, which resulted in a corpus of 35 articles.

From there, I had to consider how I went through the articles, as a close-reading of each seemed too granular for this section, which attempts to capture trends and general principles in first-year writing courses that deal with computers directly. My first approach involved sorting the articles by year and identifying which articles refer to transfer, genre, discourse community, rhetorical community, community of practice, or activity systems to see how those terms were or were not used over the years, which I would then compare to my own use of the terms. I had three initial questions:

1. How are these articles dealing, explicitly or implicitly, with the intersection of transfer, genre, and discourse communities as ways to integrate writing instruction and computers?
2. How can this approach contribute to first-year writing, as determined by looking at current lit on FYC and computers for what researchers identify as effective and ineffective?
3. Are there clear gaps that comp digital pedagogy could fill, or ways it could extend identified successes?

However, this quickly proved unruly. For example, Heather Fielding writes about "information transfer" in a way that differs significantly from the use of transfer in this dissertation (104), making it unclear whether the article really talks about "transfer" in a way that's relevant from the perspective of comp digital pedagogy. After reading through ten articles this way, I realized a new one was needed.

Any approach that relied on simple counting, while amenable to visualization, seemed unfit, too broad for purpose. Instead, I decided to cast a smaller net and spend more time closely engaging with a smaller set of texts. I then used the same search terms but over a smaller window: from 2019 to the present. The resultant corpus included ten articles, which seemed sufficient but not overwhelming for close-reading comparisons that can help address the three questions above.

However, there was one final wrinkle. I categorized the articles by those that seemed most immediately relevant, i.e. articles focusing either on FYC instruction and computers generally (e.g. Xiao Tan and Paul Kei Matsuda's "Teacher Beliefs and Pedagogical Practices of Integrating Multimodality into First-Year Composition") or using certain kinds of tools that could be useful in a wide variety of FYC courses (e.g. Kaylin O'Dell's "Modern Marginalia: Using Digital Annotation in the Composition Classroom"). By the time I was halfway through this set of articles, though, I noticed the relevance to the three questions waning. For example, Beth L. Hewett and Terese Thonus's "Online Metaphorical Feedback and Students' Textual Revisions: An Embodied Cognitive Experience" was predominantly about theories of embodiment and the use of metaphor in feedback (1-2), with very little focus on FYC itself. As I looked toward the remaining articles in the set, which focused on topics like "soundscapes" and online trolling, I found that the relevance to FYC and the concepts focused on in this chapter would be minimal.

The final batch of ten articles, then, included the five most relevant articles from the previous set of ten, then five more from *Computers and Composition* that were cited within that initial five and seemed to deal with FYC at the general level and/or in terms of FYC instruction, ignoring articles that focused on topics outside of this chapter or at, say, the programmatic level rather than the instructor level. It is these ten articles that I will write about in the next two subsections, the first of which focuses on the first initial question stated above, and the second of which focuses on the second and third initial questions, which proved quite similar in terms of what they drew out of the ten articles.

2.2.2.1 Transfer, Genre, and Discourse Communities

Across the ten articles, *transfer*, *genre*, and *discourse communities* are generally discussed as secondary to the articles' foci, with only one discussing all three concepts in depth. The only

possible exception is Mary K. Stewart's use of *communities of inquiry*, which gives useful insights for the use of *discourse communities* in FYC, as I will discuss later in this section. With that being said, the majority of these articles do repeatedly engage with the concepts and often interrelate them.

For *transfer*, Michael-John DePalma and Kara Poe Alexander engage with the concept most directly, emphasizing that conversations about the term "have been central to discussions in rhetoric and composition studies for nearly three decades" (183). They focus on *adaptive transfer* as an extension of the concept that—looking in part to Nowacek's work as an extension of transfer, as discussed in section 2.1.1—considers the wide variety of contexts across which transfer can struggle to occur. As they note in discussing the transfer of skills across media in multimodal composition, "transfer between contexts did not always or easily occur," and so the authors suggest a direct, reflective conversation on what skills from the textual composing process do and do not transfer to audio and video composition (192). This is in line with suggestions from Beaufort and the *Elon Statement* discussed in section 2.1.1, where metacognitive reflection that emphasizes transfer can facilitate the re-use of that knowledge in new contexts.

Speaking less directly on transfer, three other articles still provide useful insights into the way the concept is relevant to enacting comp digital pedagogy. Across these articles, the authors discuss transfer as a way to make use of student skills and interests in composition classrooms. In Xiao Tan and Paul Kei Matsuda's study on teacher beliefs and their relationship to pedagogical practice, the authors stress the possibility for transfer in multimodal-oriented courses from daily life into the classroom. They describe the "gap between formal schooling and daily use of technology" despite many students' basic facility with video editing, audio editing, and other skills; they suggest a closing of "the digital gap" by appealing to that prior student knowledge (8).

In J. Elizabeth Clark's 2010 consideration of the "digital imperative" instructors face in contemporary pedagogy, she argues that academia has insufficiently appealed to the skills and engagements with digital media students already have or are doing (28), a point that Kaylin O'Dell further echoes in her argument to use tools like annotation software to engage these skills and interests in the classroom (3).

These authors provide a useful reflection on the focus of section 2.1.1, which is transferring skills from composition courses to new contexts. The flip side is making use of students' extant skills and interests by framing them as tools for beginning and doing work in the composition classroom, which can then be paired with considering how the newly acquired skills might then further transfer to new contexts, academic or not, through metacognitive reflection.

De Palma and Alexander also draw attention to the role of *genre* in relationship to transfer: students' "print-based genre knowledge" does not clearly transfer at times, and it is up to the instructor-as-handler—to borrow Nowacek's phrase—to guide students in identifying what skills from those other genres are relevant in this new context. This approach speaks to my own experience. In one course, some students proposed video essays instead of a written final paper, and we would then have a conversation focused on what elements of both final papers and video essays would and would not transfer. For example, students needed to mix an academic voice and an entertainment-oriented one, which meant they had to navigate how to speak with energy and purpose in a way that engaged the audience in a way akin to video essayists, while placing their comments in an ongoing conversation with appeals to cited work. The assignment prompt and students' prior knowledge of both video essays and final papers became a site for setting expectations and guidelines for the students' work.

Although only some articles discuss the notion of a *discourse community* specifically, several focus on the idea of community in writing broadly in ways that are relevant here. De Palma and Alexander, for their part, had undergraduate students create "multimodal compositions for professional audiences" as a specific kind of discourse community (185). O'Dell's use of annotation software on web-hosted material brought into light public audiences (3), as did the creation of multimodal project portfolios in one of Clark's courses. In one case, a student of Clark found inspiration for taking her multimodal project portfolio online, where she could interface with veteran sites for other perspectives on the Iraq War as part of her focus on anti-war activism (30). Here, the student—who had initially struggled with writing due to being "hamstrung by the [five-paragraph essay]" (30), an example of negative transfer—found a discourse community, a community with a material and virtual identity that became a means to expand her own purview. Whereas the five-paragraph essay was a genre without an audience, the student's work on a digital portfolio had a clear relationship to an extant community, giving the genre shape and purpose.

Barbara Blakely Duffelmeyer, in her article on computers as both a tool and subject in composition courses, argues that FYC specifically can help students learn the kinds of "cognitive skills" such as critical thinking that will support their later work in an "academic community" (291). It is in understanding this learning process that I think Stewart's notion of a *community of inquiry* can help by dovetailing the notion of *discourse community* outlined in section 2.1.3. Stewart describes a *community of inquiry* as a site where "students engage in a combination of dialogue and reflection to question their existing assumptions about a subject matter and ultimately construct new knowledge" ("Communities" 68). I think this description is useful as it provides a way to think of the composition classroom as a discourse community, specifically one defined by the *temporary novice* status of composition students discussed in section 2.1.1. Composition

students not only learn skills that will, ideally, serve them in later academic discourse communities; they are already part of a makeshift academic discourse community defined by the learning process itself.

Across these articles, I see an emphasis on situating writing *and* digital technology in terms of identifying genres, the transfer of skills into the classroom, and the identification of academic and non-academic communities through which genres become salient. A digitally published multimodal text is subject to these composition concepts and can help frame how instructors rework their written projects to multimodal ones. Further, digital software is itself subject to these concepts. Consider O'Dell's example of annotation software: students are likely to be familiar with online annotation through footnotes and bracketed comments on Wikipedia or annotated lines on the popular lyrics website Genius, which is the same software O'Dell uses for reading in-class materials published online. These skills become the basis for students annotating texts online in support of their academic work, which could then in turn transfer out of the classroom by helping students understand how to annotate academic texts.

Thus, comp digital pedagogy is both in line with other work in composition on using digital technology for pedagogical ends, and provides a theoretical basis for interrelating the terms more directly. As discussed in the next section, having this theoretical basis paired with a defined theoretical understanding of technology can help extend the kind of work highlighted in these sections from *Computers and Composition*, and generally support digital pedagogical work in the humanities in a way that can support cross-cultural work.

2.2.2.2 Intersections and Interactions with Comp Digital Pedagogy

One of the most interesting articles of the set from my perspective is Lilian W. Mina's "Analyzing and Theorizing Writing Teachers' Approaches to Using New Media Technologies,"

where she outlines major theories of technology and performs a study to see how a selection of teachers, knowingly or unknowingly, make use of these theories in their work. She notes that a still-extant "lack of critical research on writing technologies" can partially be pinned to the lack of core theoretical work on technology in composition (4). In her 2010 article, Clark suggests a similar call for the field, writing that "we now find ourselves in a moment where we can begin to structure learning based on theories of technology and writing created over the last two decades" (29), but Mina's work indicates this issue remains largely unresolved by the time of writing in 2019. First, I will explain Mina's proposed framework and findings, and then expand on it with my own suggestions rooted in the theory of technology related in Chapter 1.

Mina synthesizes a framework developed by Andrew Feenberg across his career, emphasizing three approaches to technology: instrumental, substantive, and critical (2-3). While instrumental theories view technology as simply an instrument of human decision-making and desire—a social constructivist approach that, in the language of comp digital pedagogy, focuses on meaning as understood through the human goals contextualizing technology to the exclusion of a mechanistic consideration—substantive theories are closer to technological determinism, where the technology itself carries values that are then placed upon users, a focus on mechanism with meaning only coming into the picture in terms of a given technology's effects on human beings. More useful from Mina's perspective is Feenberg's critical theory of technology, which she describes as a rejection of both views in favor of one where there is mediation between intent, design, and context (3). O'Dell's use of annotation software, where she chose one annotation software over others because it would best match her goals in facilitating collaboration and interactivity (3), is an example of critical use of technology because it considers the affordances and limitations of each technology in the context of her classroom goals.

The framework Mina appeals to is oversimplified—a point she herself makes (13), which I will return to in a moment. It is easy to call an approach *critical* and argue it contains nuances that oversimplified depictions of competing theories lack, e.g. presenting substantivism as "ascrib[ing] hegemonic attributes to technology that, like a *superpower*, can change and restructure the social world … in which it is used" (2, emphasis added), or arguing that teachers using such an approach "see these technologies as the solution that will magically transform their teaching contexts" (3). Both statements seem more like hyperbole than reality; is it ascribing mythic properties to technology to believe that their mechanistic qualities might themselves affect the classroom? For example, might students all having laptops not apply subconscious pressure on them to engage in distraction through social media, partaking in an addictive cycle of use that those social media platforms algorithmically encourage? And further, do instructors really believe that introducing digital technology into their classroom requires no work by the instructor to ensure it is successful? I have my doubts.

But again, Mina addresses this issue, as the limitations became clear through her study of instructors' reflections on their use of technology: "while my decision to use Feenberg's classification of approaches to using technology as the framework of this study was not a foreign approach in computers and composition scholarship," she writes, "it magnified the shortcomings of Feenberg's theories on the analytical level and the value of marrying theories across the disciplines to conduct more robust research" (13). The reason is that, in her examination of nearly 150 instructors' use of technologies in classrooms through their self-reported reflections on their use, the majority indicated a "hybrid approach," i.e. an approach that integrates a mixture of two or more of the three theories Mina pulls from Feenberg, despite their apparent mutual exclusivity. If we take seriously Mina's and Clark's calls to consider robust theories of technology that can

facilitate better consideration of how technology is used in writing courses—and I believe we should—then I think that comp digital pedagogy has much to offer. While the articles I read from *Computers and Composition* demonstrate multiple approaches and foci when it comes to engaging with digital technology in composition and FYC in particular, there is also a sense that people are not sharing the full breadth of their work with each other. There is, of course, substantial diversity between approaches to teaching writing in composition studies, but there is generally a shared understanding of writing that underwrites the distinctions.[22]

In appealing to a meaning/mechanism dialectic, I sidestepped an attempt to call my theory deterministic, constructivist, or some specific mixture of the two approaches. I adopted the terms mechanistic and meaningful because they are analogous to these two broadly-defined approaches to theorizing technology, and putting them in dialectical opposition indicates that the two necessarily co-exist. Technology has mechanistic qualities, but those qualities are created by people in human contexts for their goals, which in turn can relate to mechanistic experiences of human beings (e.g. needing farming technology to facilitate the production of food which is needed for survival). Given Mina's findings of an overrepresentation of hybrid approaches, composition would benefit from more conversations on theories of technology and how they might inform writing classes that use digital technology. Further, I believe that the dialectical approach to digital technology outlined in Chapter 1, along with the explicit connection to writing technology in section 1.2 and relationship to composition concepts in section 2.1, can provide a framework that

---

22 See, for example, the collection *Naming What We Know: Threshold Concepts of Writing Studies* edited by Linda Adler-Kassner and Elizabeth A. Wardle, where a variety of concepts in the field are interrelated and contrasted through the various sections written by a variety of composition scholars. Implicit in the title of the book is the sense that scholars have at least some shared understanding of a variety of concepts important to the field.

will more directly relate to the work of composition instructors in the classroom. If we can connect instructors' already-mixed approach to incorporating technology into their classrooms to a more robust theory of technology, we can encourage "critical" use by relating the theory-of-technology components to the theoretical backgrounds writing instructors are already likely to have.

In the next chapter, I hope to demonstrate such connections through looking at courses I have taught in and outside of composition by considering syllabus design, assignments, and in-class activities. However, while there are recommendations at the activity level in articles examined here (e.g. Stewart, "Communities" 68), I also want to note that three separate articles make a different suggestion: training and programmatic level interventions for bringing some consistency to how instructors approach using digital technology in the classroom (Mina 14; Tan and Matsuda 10; and Robinson et al. 14). This programmatic approach to addressing the lack of a shared vocabulary and understanding around incorporating digital technology into writing classrooms will be the focus of Chapter 4.

3.0 Applying Comp Digital Pedagogy in/to My Own Teaching

In this chapter I will turn to my own teaching experiences from three courses. While the courses are not all writing-intensive courses, they reflect how I've tried to take my interests in digital pedagogy and composition and apply them as an instructor. I chose these courses because, while housed in English departments, they also fulfill general education requirements for a wide range of undergraduate students. These courses deal with writing and digital technology, but are not targeted purely toward writing students; as a result, they are ideal for considering how a comp digital pedagogy approach can enable the teaching of computing as an extension of the teaching of writing, speaking to a general undergraduate audience to support their work past the scope of the course. I will look at a mix of assigned content, in-class activities, lectures, and writing to see how they reflect, or could be improved by, a comp digital pedagogy approach with a focus on the notions of *transfer*, *genre*, and *discourse communities* as discussed in Chapter 2.

Along with an examination of material from my own teaching, I want to demonstrate how a comp digital pedagogy approach can help identify pedagogical opportunities for mediating contemporary issues at the intersection of digital technology and society. To do so, I will discuss a contemporary issue in writing classrooms focused on digital technology—the use of ChatGPT as part of the writing process, namely—and suggest a lesson plan that makes use of the conversation to engage students in the writing process from a comp digital pedagogy perspective. In those sections, I will identify the issue and relate some writing on the subject, describe the meaningful and mechanistic elements of the problem and the technology underwriting it, and make use of the three key concepts from Chapter 2 to help formulate a lesson plan that intervenes in the conversation through engagement with undergraduate students via writing.

The first of the three courses I will look at, Composing Digital Media, is a writing-intensive composition course, available to students who have completed first-year writing or its equivalent. Although classified as a "writing-intensive" course, it is more aptly a "composing-intensive" course where students can be expected to learn four or so different media forms and compose certain genres based on the given medium and software. I will talk about the general setup of the projects and how I attempted to connect students' extant experience with writing and rhetoric to digital composition, as well as two units; the first was a unit on making argument-driven video essays, which was largely successful, and the second was a unit on using databases to present a perspective on the chosen subject, which students struggled with more than the video essay unit despite the relative ease of learning the necessary software.

The second course, Digital Humanity, is a composition course that fulfills a philosophy general education requirement. While it tends to have a strong representation of students from a major in the English department, which I will discuss in section 3.2, the course's fulfillment of a gen-ed means that there are students from majors across STEM and the humanities. The focus will be on an in-class activity that connected students' understanding of rhetorical genres to the process of programming, which usefully demonstrates a cross-cultural approach to teaching about computers to a general undergraduate audience.

The third course, Narrative and Technology, is a writing-intensive literature course, which means it has the same pre-requisites as Composing Digital Media, but with an emphasis on writing about literature and literary analysis in the context of narrative and digital technology, with significant influence from media studies. I will focus on the first unit of the course where we discussed print technology and narrative theory as setup for the rest of the course, as well as a later unit on video games and the intersection of game studies and narrative theory.

In each of these sections, I will discuss the relevant part of the course and consider its efficacy in terms of meeting the goals prompted by comp digital pedagogy, namely: does this activity or assignment help students understand the subject in terms of the mechanical and meaningful aspects of the digital subject under focus, and does it integrate STEM and humanities perspectives on the subject? The terms *transfer*, *genre*, and *discourse communities* will be used to help parse why certain activities or assignments were or were not effective.

3.1 Composing Digital Media

This course asks students to fulfill a writing-intensive course requirement by composing with digital technology. The writing-intensive requirement, which comes with the expectation of composing more than 20 pages or its equivalent, exists for all students in the Dietrich School of Arts and Sciences, housing undergraduates across STEM and the humanities. As a result of this academic positioning, there was a type of learning that, while having precedent in more traditional writing courses, was pronounced: learning how to use a piece of technology in a way that might feel more like "technical learning," or learning the rules and technological manipulation required to compose. Writing courses do tend to involve some technical learning, such as formatting one's writing to be appropriate for a college course—be it paragraphs, citations, headings, font size/type, margins, etc.—and adhering to rules of grammar, but rarely do college students need to learn the basic mechanics of expressing thoughts in writing. By contrast, for something like video editing, without some basic experience with the relevant software and how it makes use of resources you bring in from elsewhere (e.g. video clips or music), a student cannot even begin the composing process. So while traditional writing courses do teach technical aspects of writing such as citation

practices, the conversations can often build on a foundation of years of writing experience in earlier educational settings.

Given the assumed relative lack of experience with the composing software, then, Composing Digital Media (CDM) needed to integrate more mechanistic learning—that is, learning the how-to of using different software via its interface— with learning how to compose meaningful media, media that often is defined by academic contexts as well as popular ones, from the argumentative essay to the video essay. As a result of the need to capture both elements, I think that CDM can be a course that combines meaningful and mechanistic kinds of learning in a way that integrates the two cultures by situating technical learning of software within a meaningful context of use via composition of familiar genres that have been transformed by digital contexts. The proximity of CDM to first-year writing and other writing-driven courses makes the value of the terms *transfer*, *genre*, and *discourse community* particularly relevant here; students were often confronted with those ideas in their own work, as they had to consider hybrid genres that were influenced by academic and popular composing styles, as well as what aspects of their prior experiences with writing and using computers did and did not transfer to the new contexts.

In the following subsections, I will discuss how the setup for the course attempted to deal with some of these questions about transfer and set the framework for the integration of mechanistic and meaningful learning that would carry on throughout the course. Then, I will discuss two of the four major units for the course. The first is the video essay unit, which I think was successful because of how it accounted for questions of *transfer*, *genre*, and *audience* in order

to enable students' composition processes. The second is a unit on critical databases, which was much less successful in ways that are made clear by the same consideration of those terms.[23]

3.1.1 Course Setup

The first two pieces of assigned content in the most recent version of my Composing Digital Media syllabus initiated the conversations that would take place over the semester on what transfers from students' previous writing courses and experiences, and what facets of digital composition are new. Given the relevance of these foundations to the video essay unit, I want to give an overview of the two pieces of assigned content and the in-class conversation around them.

The first reading is a chapter from Kristin L. Arola et al.'s *Writer/Designer: A Guide to Making Multimodal Projects* that outlines the process of rhetorical analysis as it applies to writing, and adds in the idea of *design choices* as especially relevant to the creation of multimodal texts (20). For the authors, rhetorical analysis is the consideration of elements of the *rhetorical situation*, defined by four factors: the intended audience and purpose of the text, its context of reading, and its genre (21). Already, then, the three key concepts from composition studies discussed in section 2.1 are present. For transfer, concepts from traditional rhetoric are restated, which students then are encouraged to consider in terms of their work in Seminar in Composition during in-class

23 I will be pulling from two syllabi reflecting two different semesters that I taught the course. Section 3.1.1 and 3.1.2 will refer to content from a syllabus for the most recent version of the class that I taught in the fall of 2021 (Appendix A, Fig. 2), where the setup and video essay unit are more focused in assigned readings and in-class discussion. The database unit was dropped in this version of the syllabus, so section 3.1.3 will be from the 2021 spring semester (Appendix A, Fig. 3).

discussion; the ensuing pages flesh out each term with examples from multimodal texts, e.g. applying the four terms to a parody video of a popular song made for a friend's birthday (22). Students are being encouraged to consider what elements of their prior learning transfer from the analysis of written texts to the analysis of multimodal texts.

The specific foci of rhetorical analysis that the authors identify also speak to *genre* and *discourse communities*. They use the term *genre* in a more expansive sense than that used in section 2.1.2; whereas my definition focuses on a recurrent response to similar exigences across time, Arola et al. describe *genre* as being more about the set of expectations a certain kind of text sets for a reader (26-7), whether that be a horror story compared to a fantasy story or a pulp magazine compared to an academic journal. Their definition is one students are more likely to be familiar with, but it is easily expanded to the more idiosyncratic definition I'm using as defined in Chapter 2: a recurrent form of text exists in response to repeated situations, which can be better understood by consideration of the text's intended audience, which the authors are also calling attention to. By looking at the intended audience and the context of a text's creation, Arola et al. are effectively calling attention to the relevant components of discourse communities as spaces that generate exigences for the creation of a text for a certain audience.

The elements of design that the authors bring into the picture reflect the need to not only transfer old skills, but consider skills or problems made newly relevant by the role of technology. For the kinds of texts discussed in *Writer/Designer*, the computer is generally being used to produce multimodal texts in the sense that the products incorporate some mix of text, video, audio, and/or interactivity through a digital medium. The technical dimension of student learning, then, is how to use software to compose while employing effective use of rhetoric and design.

Of course, design is still relevant in traditional written texts. Students, in theory, must consider things like font size, margins, and font choice. But in general, these decisions are limited by the requirements placed by the professor and the default settings in word processing software. Similarly, the other reading assigned in the first week of the course spoke to something that is technically relevant in traditional writing, but far less pronounced: the need to consider copyright when using materials found online as part of a multimodal text. Copyright is relevant for using written materials, but generally students understand how to quote or paraphrase and cite from a text, which covers the relevant bases of copyright for academic writing. However, this terrain can get muddy; for example, can students use a copyrighted song as background music because it fits the mood they're going for? How is the use of copyrighted material for a multimodal text similar to or different from copyright use in more traditional academic writing contexts? While it may be obvious to students that, say, a full page of an essay should not consist of a quote, it might not be as obvious that a full minute of a short video essay should not be made up of a clip, or that a popular song being used as background music might not fall under academic fair use. To help navigate these questions, we read Patricia Aufderheide and Peter Jaszi's "Fair Use, Public Domain and Creative Commons: They're Not All the Same," to give students background on an element they would be graded on, which is the effective *and* appropriate/justified use of materials made by someone else.

The consideration of what new problems arise that are not covered by what has transferred from engagement with written texts is a common issue in digital rhetoric. For example, in introducing a collection of essays on digital rhetoric, James P. Zappen emphasizes the importance of [a] "theory of digital rhetoric that recognizes how the traditional rhetoric of persuasion is being transformed in digital spaces" (324). Similarly, Aaron Hess says that "digital rhetoric requires

sustained attention to the ways that rhetoric changes in a technological era" (2), similarly considering not only what transfers but what new issues need to be addressed. By considering how elements of traditional domains such as rhetoric are transformed due to the role of digital technology, I think that digital rhetoric effectively incorporates meaningful and mechanistic components,[24] which I tried to incorporate into the design of the course.

This approach carried through the rest of the course, focusing on not only key ideas of transfer, genre, and discourse community, but also setting students up to consider what new problems they must encounter, which will include learning how to use software and working through technical guides to foster their creative work throughout the term.

3.1.2 Video Essay Unit

The second major project unit on video essays built on the setup described in the previous section and the first major project unit on audio narratives, where students created audio narratives using their own voices and audio resources found online in compliance with copyright, all edited together using *Audacity*. The jump from *Audacity*, which could be tutorialized easily for most students over one week, to Adobe's *Premiere Pro* was substantial. In fact, I have reworked this unit multiple times based on issues students ran into in creating thesis-driven argumentative video essays. In this iteration of the course, I saw the video essay unit as continuing the goals of the

24 Recall from section 1.0.1 that technical and mechanistic are synonymous in my use of the terms. Technical learning describes learning focused on the mechanistic processes of the subject, e.g. how to layer two audio tracks in software like Audacity, whereas the meaningful aspect of that learning would be considering the contexts where layering audio tracks would be rhetorically effective for the purpose of the text at hand.

previous unit. Students would learn about a variation on a familiar genre with the video essay, and continue to engage in technical learning with a harder-to-learn software. These two skills, which roughly correspond to the two poles of the meaning/mechanism dialectic, were present in the previous unit and continued to be emphasized over the course.

The iteration in the featured version of this syllabus tried to establish three foundations needed for students to compose their video essays (Appendix A: Fig. 2): learning how to use *Premiere Pro*; learning about video essays through examples to understand how they differ from traditional college essays; and learning how to compose their own video essays through script-writing and the editing together of audiovisual resources.

Whereas in previous terms I had introduced the unit with examples of video essays and in-class discussions of them, I found that students struggled to see how to account for the visual dimension of composing, leading to video essays from students that were often lacking in purposeful audiovisual design choices. As a result, I rebalanced the unit to feature more hands-on work with the software early on so that the techniques employed in example essays could be tied to the skills students were developing. In previous terms, most students recognized the genre but as viewers, whereas their relevant experience as compositionists was mostly through writing argumentative essays in college or high school. As a result, the transfer generally occurred from writing argumentative essays rather than video essays, which led to the design elements being neglected.

To counter this, I began the unit with online tutorials that were reinforced through an in-class lecture (Kennedy), followed by workshops where students would practice what they learned that session. To ensure students had some base level of interest in their work, I had them revive a mini-project from the audio narrative unit. In that unit, to help students learn *Audacity*, I had them

first learn how to record themselves in it by reading a short text of their choosing— one that they found particularly effective or important to them personally. Then, they found a mix of audio resources such as music and sound effects that they would edit in to further their facility with the software. By the end, they had an ungraded baseline for their audio narrative work.

In parallel to the audio narrative unit, students enacted what they learned about the *Premiere Pro* by bringing their mini-project into that software, then bringing in visual resources to match the audio, then eventually editing those resources and using effects such as motion of an image across a screen. By the end of this part of the unit, students understood what technology they would be using and what kinds of design decisions would be opened up to them before they saw any actual video essays, which enabled the second unit to focus not only on what transfers from their previous writing experiences with essays, but also on using their technical abilities through the software. When we turned to example video essays, students could see not only how a thesis, argument, and evidence were presented in an audiovisual format—that is, how elements of argumentative writing transfer to video essay writing—but also how their relatively limited editing toolkit could enable purposeful design decisions, such as shrinking or expanding an object while talking to demonstrate its decreasing or increasing influence or importance. Once those fundamental technical skills were established, we turned toward actual video essays to set up better ideas about the norms of the genre(s) students would be composing within.

I want to note the benefit of this structure from a comp digital pedagogy perspective. The key is how technical learning and meaningful rhetorical use are integrated from the beginning of the unit, which fosters the kind of dialectical understanding this dissertation aims for. Whereas previous terms saw less success because students did not often see the range of design choices *Premiere Pro* provided them when they began composing, the technical know-how required to use

Premiere Pro felt less like an opportunity and more like a set of strictures to accomplish their goals, which were mostly defined by their experiences with traditional textual writing. The mechanistic dimension of their learning felt just like that: a mechanism, a tool to accomplish their tasks. But mechanism and meaning exist in a dialectic. The tools *Premiere Pro* provides are meaningful because the mechanistic traits serve creative decision-making—purposeful design—in service of a video's goals. While it might make sense to teach the technical elements after introducing the genre, starting with the technical learning around a small, ungraded project helped students understand how the technical learning they were doing could be applied in a low-stakes learning setting. Then, they could see the range of design decisions those skills could support by seeing how more professional video essays use some of those tools to produce rhetorically effective work. In this light, the mechanistic learning was immediately paired with a meaningful context at a small scale, so that the movement to the large scale kept the two together.

The rest of the unit began with a session spent on understanding what video essays are, what genre(s) they connect to for students, and how the composition of those essays employed effective design to be rhetorically successful. We read a list by Wil Williams of the best video essays of the year, not to watch them but to see what kinds of videos were being made. The list includes several examples of media analysis—generally of film, television, or video games—or social analysis of online culture—e.g. social media or nerd culture. The reasons for that focus given the location of the videos on YouTube, which has certain audience-creator relationships that arise out of the design of the platform, becomes the basis of a useful conversation on how the genre interrelates with certain discourse communities online.

Additionally in Williams' list is a very helpful clarification about what qualifies as a video essay in a way that echoes the expectations of a college course:

> The video must have a thesis, and that thesis must be more than 'this is good' or 'this is bad.' The thesis should concern the impact of the subject matter, not just its content. This means no straight reviews (like La'Ron Readus's review of *Candyman*), no commentary/discussion videos (like Sherliza Moé's series on cultural appropriation in the *Star Wars* prequels and *Avatar: The Last Airbender*), no lore recaps (like My Name Is Byf's meticulous archival works of the *Destiny 2* lore), and no straight-up histories (like Sarah Z's retelling of the infamous DashCon).

This dictate helped bring the conversation to questions of what transferred from students' previous writing experiences in college. They were, at that point, familiar with argumentative essay writing, which set up a conversation about what was and wasn't a thesis. Students wanted to make videos about subjects that interested them, which were often also media or online culture topics; how could they make an argument that would befit an argumentative essay in a college course, while still speaking to elements of certain media or cultures they're familiar with that they find interesting, or love, or hate?

Finally, we looked at a small handful of video essays to tie together the current issues: what was the video's thesis, how did the essayist develop and support that thesis, and how did they use audiovisual design via editing to effectively express their argument beyond just words? First, we looked at a video that I have found useful in these contexts due to its brevity at under fifteen minutes long, a clearly-stated thesis early in the video, and its use of visual elements to clarify its points. The video, on Mark Brown's channel Game Maker's Toolkit's, is called "Making Games Better for Gamers with Colourblindness & Low Vision | Designing for Disability," and it opens with its thesis: "Video games are for everyone, and they can even be enjoyed by those who live with disabilities if game developers make certain design decisions or introduce certain options" (0:00). He demonstrates what certain games look like for people with colorblindness using color filters, and demonstrates tools that help developers see how their game looks with those filters (2:12). Here, he not only introduces the audience to how big of a problem colorblindness can be

for games designed without consideration of it, but he also shows how game developers have the tools available to address the issue. The content is useful because it presents effective use of the rhetorical components of composition as outlined in Arola et al., and because it shows how the tools at hand are employed to further the broader purpose of the video.

Next, students split into groups based on which of two suggested videos they watched ("How the pandemic", "Mr. Rogers"), and identified the established relevant elements as they're at play in the video—i.e. what was the thesis, and where were visual elements being used to help bolster the argument. By the time students shared their findings with the rest of class, they had not only developed understandings of how to do basic video editing, what video essays are, and how video essays make and support arguments; they had also set themselves up to create rhetorically purposeful, intentionally-designed work that balanced the needs and expectations of traditional essays, which exist in the discourse community of college courses for most students, and video essays, which they were familiar with as viewers in nearly every case. That term, the quality of the argument *and* design of the video essays was a cut above the previous term.

The rest of the unit provided time for students to work on their projects and get immediate feedback from me, as well as workshops to get feedback from a consistent small group of three to five people. These workshops allowed for revision based on feedback from peers in the immediate discourse community of the college classroom, turning back toward the rhetorical design of the video essay to find ways to improve it in terms of scripting and editing in response to feedback on the argument and presentation of the argument.

3.1.3 Critical Databases Unit

The unit on critical databases might sound odd following a description of units that seem much more familiar: audio narratives and video essays. That was, in fact, a part of the problem with this unit, and there were several parts. This unit stands as a useful contrast to the video essay unit because its problems show how a unit can struggle when it does not help students transfer prior knowledge in a way that enables understanding of the new genre as an extension of a more familiar genre. Further, it can struggle when there is a genre without a clear discourse community that initiates or receives the composed text.

The impetus for this unit came from reading work by Melanie Feinberg, who has written on the rhetorical dimension of digital databases. In the article "Two Kinds of Evidence: How Information Systems Form Rhetorical Arguments," which was included on the syllabus (Appendix A: Fig. 3), she argues that databases' rhetorical capacity comes from two elements. The first is "structural evidence, which arises from the way that a classification includes, arranges, and relates categories" (494). For example, if a digital collection of metadata about novels published in the United States over the 1800s features categories such as the sex or race of the author, it is necessarily arguing that those factors are relevant in understanding the collected materials. The second kind is "resource evidence from the selection of documents and their assignment to categories in the organizational scheme" (510). If the aforementioned digital collection of metadata about novels includes titles that were never formally published, then that collection has a rhetorical dimension based on what it includes and does not include. To include those novels might expand the kinds of authors featured given biases from publication houses.

The hope of this unit was to help students see how the organization of content—a feature of most websites, but especially websites hosting databases—is non-neutral. Their behavior is

shaped by the way the site or tool they are using structures what they see. What they see at all is similarly dictated. If a student does research on a topic via a popular web search engine, what they find will differ from what comes up through our university library's search function. Understanding how those two algorithms respond to their search input means understanding the rhetorical differences between the two. This unit was intended to help students identify the role of categorization in the shaping of their behavior online.

However, there were problems—and surprisingly, few of them were technical issues. *Omeka*, which allows users to create databases through a web interface with relative ease, did not seem to trip up the vast majority of students. However, they still struggled to understand what was expected of them, or how they could make decisions about how to categorize and present a database of some topic of interest to them in a way that was more than just straightforwardly presentational. Even though we read the Feinberg piece together, and students seemed to understand what she was saying, there was still a major gap: how could they comment on a subject through the process of creating a database? What would such a database even look like?

The ideas in comp digital pedagogy, I think, help explain the gap. Students did not on average have experience creating databases to draw from, and as a result, it was a very nebulous genre. Databases, from their perspective, were made by other people who understood how to categorize the subject formally, rather than something that individuals create in mediation of formally designated categories and personal understanding of the subject. They could see the connections to websites they use, e.g. the university library's digital collections, which we looked at together in class. If anything, this furthered the issue; students saw the genre as very specific, belonging to discourse communities of academics or maybe hobbyists/collectors. The mechanical properties of database creation seemed like the point in and of itself, a way to collect like materials

and present them publicly, rather than a way to make commentary on the subject through categorization. For instance, one student archived a certain generation of gaming consoles and related accessories; despite feedback encouraging him to identify the purpose in presenting these materials and identifying certain metadata about them, the connection on how to make a rhetorically purposeful database never happened. This was not the case for every single project, but it was more prominent than would have been the case had I better framed the subject. Were I to revisit this assignment, I would need to further consider how students make use of cataloguing and categorization online, some relatable examples of rhetorically purposeful databases, and a stronger integration of learning how to build the databases and how to revise its purpose and structure as one might a revised college paper.

3.2 Digital Humanity

Digital Humanity is an odd course. It's an English composition course that is occasionally, depending on the instructor(s), cross-listed in the History of Art and Architecture. It fulfills a range of educational requirements for students: in the University of Pittsburgh's Dietrich School of Arts and Sciences, it fulfills a philosophy general education requirement; in the School of Computing and Information, it fulfills an ethics/policy requirement; and it is a one of two options for a threshold required class in Digital Narrative and Interactive Design, an undergraduate major that bridges the English department and the School of Computing and Information. As a result, the student makeup of the course is usually diverse in terms of home discipline or school, including computer science, hard/soft science, and humanities students, with an over-representation of DNID students, who span CS and English. There is no assumption about facility with computers beyond

that required by the university more broadly—e.g. being able to access and check email, write and print electronic documents, and access course materials online via a CMS—but given the focus of the course on the effect of ubiquitous digital technology on human life, students in theory have at least some interest in learning about computers. Further, given the representation of students from across the two cultures, there was an underlying belief that students could learn, and would benefit from learning, how the meaningful and mechanistic elements of the computer were mutually constructed. In this sense, Digital Humanity is an ideal space to attempt to enact the ideas underpinning comp digital pedagogy, even though it is the furthest removed from writing classes proper of the three courses discussed in this chapter.

The first time I taught Digital Humanity was with a professor who co-designed the first iteration of the course, and we both were interested in highlighting the inner machinations of the computer, rooting the higher-level conversations about the influence of digital technology in topics such as surveillance and privacy, artificial and human intelligence, and digital citizenship in a developed understanding of the computer's mechanistic qualities such as binary encoding, programming/coding, and the initial technological needs that the digital computer was designed to meet. When I taught the course on my own the following term, I wanted to maintain this hybrid approach of relating the mechanistic traits of the computer and the meaningful contexts of its creation and use.

It is in this context that I designed the in-class activity discussed in this section, which attempted to help students accomplish three learning goals:

1. apply what they had learned about digital encoding;
2. engage in the process of programming conceptually as a way to model a problem in terms the computer can enact or act upon;

3. understand the relationship between the conceptual process of programming and the more technical process of coding.

The reason for these goals was that they represented the elements of technical and historical learning covered in the course up to that point, which was just over halfway through the term. Students had learned and read about the early days of digital computing through reading about the women who were part of the programming process for the ENIAC (Schwartz), Alan Turing's theoretical work on artificial intelligence, how concepts like numbers and language are represented in binary (Petzold, Philbin), how concepts like fairness in courtroom judgment are digitally encoded (Hao and Stray), and what code and programming languages are (Ford). Students understood that computers use continuous electrical signals to model binary on/off states, that this model allows for the representation of any concept that can be modeled discretely (e.g. the alphabet, integers, graduated color scales), and that coding with programming languages allows users to make use of the underlying technology in abstracted human terms.

Yet, the course was not a coding course, and expecting students to code would take a substantial amount of time that would not be justified given the focus of the course on the way such technology influences human life. The emphasis on programming relies on my definition of the concept in contrast to coding: while coding involves knowledge of a programming language and strict adherence to its grammar, programming is more conceptual. It requires one to think in terms of the available technology—a process performed by the historical example of the ENIAC women, despite the fact that they did not work with a programming language—while focusing on the broader problem being solved via the programming process. If students had an understanding of binary/digital encoding and digital representation, they would have the necessary tools to try to create a program without spending hours looking up rules of grammar and syntax or bug-hunting.

In the language of comp digital pedagogy, there was an attempt to include relatively minimal mechanistic learning to facilitate meaningful use of the mechanism.

The next section will describe the in-class activity that attempted to address these learning goals, which will demonstrate how mechanistic and meaningful elements of digital technology were incorporated in order to speak to a general undergraduate audience from both cultures. In the context of this dissertation, it serves as an example of teaching about computers in a way that crosses the cultural divide and thus serves student learning by helping them understand digital technology in terms of the meaning-mechanism dialectic.

3.2.1 Genre Generators

The activity under focus in this section followed a discussion of programming, programming languages, and the creation of the modern code paradigm. It was followed by discussion of *procedural rhetoric* (Appendix A: Fig. 4), or rhetorical expression accomplished through processes (Bogost 3), with an emphasis on digital procedurality. As a result, the activity was intended to bridge a discussion of coding and programming on the one end, and rhetorical expression facilitated through coding and programming on the other.

The activity took course over two course sessions of roughly 1.5 hours each. It was designed as follows, split across two days.[25]

Day One:

25 The following is an abridgement of the lesson plans I used. A more complete write-up can be seen in my contribution to the collection TextGenEd (Eldin).

1. *Setup*. (Re-)introduce students to the concept of *genre*. Talk about written genres students are likely to encounter in class—e.g. a non-fiction personal essay, a research paper, or an argumentative essay—and distinguish this understanding of genre from the broader use that distinguishes by narrative tropes, such as science fiction, fantasy, and westerns. Prompt students to name written genres, or provide them some examples, such as emails to a professor, obituaries, classified ads, recipe blog posts, news articles, etc.
2. *Love Letters*. The setup conversations lead directly into a rhetorical analysis of the love letter genre using sample outputs from Matt Sephton's implementation of the Christopher Strachey Love Letter Generator, which is useful because it only shows generated outputs. Ask students about what is and isn't changing between outputs, and relate these features to the broader social role of love letters as a genre.
3. *Coding Love Letters*. Next, show students Vee's implementation of the generator, which is useful because it presents the outputs along with the underlying code. Walk students through elements of the code such as the word lists under *var* on line 4 or the concatenation of strings using elements from the lists on lines 48 to 51. Cap off this part of the activity by emphasizing the essential tools used to generate new love letters: text strings, lists of words that can be chosen from at random and inserted into a text string, and the use of variables in text strings to create differences between sample outputs.
4. *Group Programming Exercise*. Break students into groups of between 4 and 6 students. If a subset of the class has experience with computer programming, distribute them evenly amongst the groups, as they might be able to guide how students enact their ideas into a conceptual program. Prompt them to identify a genre, evaluate its social context and use, identify key features that are easy and difficult to encode, and create a mix of text templates,

variables, and lists that could generate new instances of the genre based on the identified features.

Between Sessions:

1. *Code Student Programs.* Identify 1 or 2 student programs that seem particularly viable to represent in code. Present text from the student document that states the chosen genre, the students who designed the generator, the description of that genre, and the key features they identified. Then, demonstrate the code that enacts the program with comments that explain what a given section is doing. The code should be presented in software that can run the code and present outputs along with the code, so that the generator can be run repeatedly to look at several different outputs.

Day Two:

1. *Process Reflection*. Prompt students to reflect on their processes, e.g. asking about how they chose their genre, how they considered the role of the computer, and which key features they focused on and which they left out. Be sure to ask students if they consider what they did *programming* to emphasize the programming/code distinction.
2. *Present Student Generators*. Show students the formatted text and code. Read through the name of the genre students chose, the names of the students who designed the generator, their description of the genre, and the key features they identified. Then, relate a key feature to the code, which can generally be broken up for readability similar to the Vee implementation of the Love Letter Generator. For example, have all of the lists of terms in sequence, then the variables that choose from the lists, then the string template that makes use of the variables. If students identified that a salutation was important for an email to a

professor, for example, then relate this key feature to the lists, variables, and place in the template that generates the salutation.

3. *Rhetorical Analysis of Generators*. Now, take the same questions you asked on day one about the genre of love letters, but this time turned toward the genres that the student programs focused on. Finally, ask students if the generators perfectly or objectively represent the genre at hand.

As the final question asked of students indicates, the goals of this lesson are to reveal the co-presence of mechanistic and meaningful decisions being made when a computer program represents something from the world around it. While they had to consider mechanistic elements of design in creating their programs, rooted in the example of the love letter generator's representation of that genre, they also had to consider which features to include or exclude based on the limitations/possibilities of the computer, which involved decisions based on technology and their felt sense of what defined their genre. This lesson, I think, represented a successful attempt to not just teach students about how computers work and what it means to program on the one hand, or the fact that programming involves human decision-making—but instead, what it means to program in a way that mediates between the meaningful elements of representation and the mechanism in which those elements must be expressed. That is, it teaches them about the dialectical relationship between the meaningful and mechanistic elements of programming.

Further, I think this exercise demonstrates the value of keeping *genre*, *transfer*, and *discourse communities* in mind when teaching this dialectic. Students early on are prompted to make use of their prior experience with rhetorical analysis by applying it to a relatively simple representation of a familiar genre, transferring skills from previous writing courses and further transferring those skills again to a new genre that they themselves define. *Genre* is clearly the

centerpiece of the exercise, both because rhetorical analysis of genres is a skill likely discussed in earlier writing classes, and because students' knowledge of written genres becomes the basis of transferring their rhetorical analysis skills to what is likely a less familiar genre: a coded program. The familiarity of genres and analysis thereof then further becomes a means to transfer their awareness that genres are meaningful categories, i.e. categories defined by people in social contexts.

Finally, *discourse communities* come into play by situating their engagement with this unfamiliar genre in the context of actual human practice. Computer programmers make decisions about how to represent problems and the world around them, and they see an actual program created by a prominent figure in early computer history via Strachey's program, as well as present-day implementations by Vee and Sephton, meaning their own compositions of genre generators are not removed from the context of actual human activity. In sum, this activity leverages the three terms to help students understand the meaning-mechanism dialectic in a way that teaches them about how computers work, making use of their prior knowledge from composition contexts in a more general context to service a culturally diverse—in the Snow sense—group of students taking a general education course.

3.3 Narrative and Technology

Narrative Technology has some overlap with Composing Digital Media and Digital Humanity. Like Digital Humanity, the course focuses on the effects of computers—this time on narrative and the study/theory thereof—in a non-composition classroom context, in this case a literary studies context. Like Composing Digital Media, though, it is a writing-intensive course.

Like both, it is open to a general student body and well-represented by DNID majors, along with students from a variety of disciplines in STEM and the humanities, with the only pre-requisite being FYC.

I designed this course most closely in alignment with the main ideas and principles underwriting comp digital pedagogy, given that it is the most recent course I have taught and designed a syllabus for. As a result, I focused on ideas of *transfer*, *genre*, and *discourse community* as ways to teach the course. Further, given the focus of the course on the effect of technology on narrative, the course was well-situated for talking about the interrelation of mechanism and meaning from a literary studies perspective. In the next section, I will outline how I approached the design for the course, and then touch on a unit taught later in the course on interactive media that saw partial success.

3.3.1 Video Games and Cybertexts

When I started designing my syllabus for Narrative and Technology, I had a substantial amount of flexibility. Looking at other instructors' syllabi, I saw varied approaches, from use of different texts, to different media, to different kinds of scholarship. To frame my course, I decided to focus on what kind of discourse communities would be most relevant to a literature course on narrative and technology, which led me to a focus on narrative studies/theory. That is, I wanted students to understand what it means to study narrative from a literary perspective, with the major generic works in that community being academic articles connecting narrative theory to specific texts.

Further, I wanted students to transfer their knowledge of the analysis of traditional printed texts, a rhetorical skill built up in FYC or its equivalent, to the variety of media we would engage

with in class. I hoped that students would understand the study of narrative not as a loosely defined practice of reading literary themes into a text, but as a practice taken up by a certain group of scholars working in academic contexts, defining the terms and ideas that form the basis of their analysis. Thus, when students wrote, they would themselves be practicing writing in a defined genre taken up by a semi-coherent group.

The initial units were quite effective. We read an excerpt from H. Porter Abbott on what narrative theory is and how to define key terms such as *narrative* and *story*. We applied foundational concepts like the distinction between story and narrative discourse to familiar texts, namely different versions of a familiar fairy tale, which students compared and contrasted using their developing narrative theory vocabulary. The writing assignments encouraged this process: their first writing was a Narrative Theory Journal, where students answered basic questions about what narrative is and what it means to study it, before using that theoretical groundwork to make an argument in a Narrative Analysis Writing assignment that asked them to argue for whether the versions of the fairy tale were the same story and/or narrative discourse. I introduced students to a discourse community, and they learned how to work within that community's genres to set up the work they would do over the term applying these concepts and changing them in response to non-print media. Given students' familiarity with rhetorical analysis of written texts that could be assumed from the FYC pre-requisite, the main introduction here was to the specific language of narrative theory.

The course did not center digital media until over halfway through, instead taking time to talk about the media-specific features of print, comic books, film, and television. By the time we arrived at interactive storytelling (Appendix A: Fig. 5)—namely, hypertexts and video games—we had discussed the differences in storytelling between, say, the visual language of comics and

television, or the consumption models encouraged by film compared to television or comic books. But the weeks focused on interactive media ran into a mix of interesting successes and problems.

Students enjoyed playing and talking about video games. While sessions focused on discussing scholarship could be slow, to the point where I questioned how many students fully did the reading, the discussions of video games went completely the other direction; several students discussed playing the game multiple times just to see interactions they missed the first time, or to see if the ending they reached was pre-determined rather than a result of their choices. Students were happy to write about video games, with some of the most engaging work of the term taking place in these later units. However, despite all this, I found that there was an issue with connecting the narrative texts to the broader scholarship, and I think the language of comp digital pedagogy can help evaluate this problem.

To start: the first reading in the interactive media unit was the opening chapter to Espen Aarseth's *Cybertext: Perspectives on Ergodic Literature*, which is a book that is hard to place clearly in the context of narrative theory. He directly challenges the application of literary theory to new contexts in these pages, noting that "the interpretations and misinterpretations of the digital media by literary theorists is a recurrent theme in this book" (14), a critique he levies earlier in the introduction toward literary theorists who fail to distinguish "texts with variable expression [from] texts with ambiguous meaning" (3). How did terms like *ergodic* fit into the generic writings students had done thus far? The answer wasn't clear. Rebekah Schultz Colby and Richard Colby highlight this issue for the teaching of writing via games:

> In our experience, most writing teachers ask students to enact their learning through the production of text. However, in many writing classes, students have little access to the discourse communities that they are writing about or attempting to write within, so as David Bartholomae argued in 'Inventing the University,' students' writing still often takes on decontextualized meaning. (301)

That is to say, I'd moved from the familiar terrain of a defined discourse community—namely, narrative theory as a subset of literary theory—to one that was less familiar. In addition, the texts described were far from video games and digital media as they are understood today (e.g. the hypertext adventure game, *Adventure* by Will Crowther and Don Woods, or the hypertext fiction *The Fall of the Site of Marsha* by Rob Wittig). Too much was unfamiliar and there was insufficient prompting by me to transfer their knowledge of narrative theory and literary theory to Aarseth to consider how his work falls within and outside of those discourses, as well as their knowledge of interactive media through reading about the relationship between early hypertext fiction and video games. The contexts were too far from each other with insufficient guidance on how to connect those contexts. Students would not read an article that focuses more squarely on the intersection of game studies and narrative until two weeks later when we began a unit focused on video games via reading Henry Jenkins' "Game Design as Narrative Architecture." While students found the games played during this unit interesting—in particular *Emily Is Away* and *Her Story*, which more closely resemble modern video games than the hypertext examples mentioned above—the discussion about them was insufficiently tied to how a defined discourse community talks about games.

The final unit, which was focused more on video games rather than interactive digital media generally, was more successful, albeit with its issues. As mentioned, the unit opened with a reading from Henry Jenkins that discusses narrative analysis and narrative theory directly (2-3). This connection is emphasized with the first writing assignment of the unit, where students relate information they learned about the narrative of a game through play and exploration, to Jenkins' writing on environmental storytelling (5-6). Students' play and discussions about narrative in class

were directly tied to scholarship about play that clearly situates itself in the context of narrative theory.

The next week was less effective. Students played a different game and we discussed an article by Ian Bogost with a provocative title, "Video Games Are Better Without Stories." The end goal for the week was a writing assignment where students agreed or disagreed with Bogost's claim using examples from games played in class. However, I had made some mistakes in setting up the assignment. First, Bogost's work is of a different kind than most of the narrative theory and analysis read so far, which was largely academic. While Bogost is himself an academic, the article is more of a popular press opinion piece, being published in the *Atlantic* and lacking citations or engagement with scholarship in the field. Here, I had pulled from an unfamiliar genre as a way for students to practice their skills engaging with narrative theory, which was a mismatch that was not helped by a lack of engagement with a wider range of scholarship on narrative theory, media studies, and game studies in the article.

When I redesigned the syllabus for the coming term, I kept these issues in mind and reworked the structure and assigned content for the course. Rather than beginning over halfway through the term, digital media comes squarely into focus two weeks earlier. Prior to this, there are more readings about narrative theory and media studies, with a reading from Marie-Laure Ryan and Jan-Noel Thon on transmedial narrative and narratology, as well the introduction to a book by Susana Tosca and Lisbeth Klastrup on the effects of transmediality on narrative. Media studies is thus already part of the conversation before reading Aarseth, which is paired over the following weeks with work at the intersection of narrative studies, media studies, and game studies, namely through an article by Marie-Laure Ryan on interactivity as well as Jesper Juul's contribution to the first issue of *Game Studies*.

Along with the more balanced representation of scholarship at the stated intersections, I also tried to represent a more diverse range of assigned content to better engage students' interests. The previous version of the syllabus discussed topics like audience and participation in media via topics such as serial narratives, but I did not sufficiently consider how to take students' own transmedial engagement with narrative as the basis for building student interest via engagement with a variety of source types. Consider from the Tosca and Klastrup reading:

> This book focuses on the many ways that transmedial worlds are present in our everyday life and how they manifest in our social media activity. People are reading, watching and playing in transmedial worlds like never before. In addition they have developed a meta-consciousness about their own fictional consumption that is mostly manifested in their social media interaction, and in mundane forms of audience practices that we have named *networked reception*. (2)

If such transmedial interaction is something students are likely to already do in their own media practices, why not appeal to that mode of interaction through the assigned content? As a result, I included sources such as a less formal writeup on the history of hypertext fiction (Reed); a YouTube video on the role of AI in games and specifically in *Facade*, a game played in class (AI and Games); and a podcast episode by 99% Invisible providing historical context for a video game about computerized therapy. The attempt to relate the games being played to a set of interrelated pieces of scholarship as well as contextual pieces outside of scholarship, I think, will help the fictional texts feel more relevant and interesting to engage with from the student perspective. Further, I think the increased focus on interactivity overall via a variety of lenses will help make the role of interactivity and digital technology more immediate, further emphasizing how the mechanistic aspects of digital technology can benefit the conversations about the meaning-laden role of narrative in literary theory. Much like how digital rhetoric considers the impact of

digital technology on the domain of rhetoric, this new version of the syllabus is intended to consider the impact of digital technology on narrative.

3.4 AI And the Study of Writing

In this section, I hope to demonstrate how comp digital pedagogy can help formulate classroom interventions to address ongoing conversations about the role of digital technology in the university. First, I will explore the issue under focus and conversations around it, namely the effect of text generation models on writing in academia. Then, after briefly introducing the assignment that I designed in response to this conversation, I will explore how the main ideas of comp digital pedagogy helped me frame and build out the assignment, namely the meaning/mechanism dialectic and the key composition concepts of *transfer*, *genre*, and *discourse community*. Finally, I will provide commentary on the lesson plan, which is featured in Appendix B.[26]

AI has become increasingly relevant for writing classrooms in the past year. With the rapid rise in popularity and accessibility of machine learning used in the service of generative text algorithms since 2022, namely ChatGPT, there has been no shortage of concern. John Warner has an aptly titled multi-part series *Inside Higher Ed* called "Freaking Out About ChatGPT," with the lede for the first part asking, "What are we going to do?" Joseph M. Keegin writes that ChatGPT is a "plagiarism machine" and expresses concern about the lack of movement by administrators on the issue, while authors in both the *Chronicle of Higher Education* and the *New York Times*

26 You can also find the lesson plan online (https://github.com/addeldin/personal-writing-with-ai).

describe the alarm and race to address the issue by teachers and administrators (McMurtie, Huang). The possibility for these AI that can generate text based on user input to upend the writing classroom and students' writing abilities has led to a lot of concern.

Stephen Marche's "The College Essay Is Dead" does more than provide a worrisome forecast for college writing; it also relates the impending crisis that Marche identifies to the two cultures problem directly. In Snow, Marche sees much the same problem as I identify in the introduction to this dissertation: not only are the two cultures failing to see the full benefit of each other, but "[t]he rupture that Snow identified," Marche writes, "has only deepened." Generative text algorithms like ChatGPT could be a seismic change that makes the two cultures more codependent, according to Marche; while computer scientists will need to consider humanistic perspectives—as "[t]he philosophy of language, sociology, history, and ethics are not amusing questions of theoretical speculation anymore"—humanists will need to understand the impact of natural-language processing on language.

At the University of Pittsburgh, where I am working on my PhD, there is a resource page presented by the Teaching Center for faculty that provides some useful starting points ("ChatGPT Resources"). In their list of "inclusive teaching strategies," they include:

> Develop assignments that cannot successfully be completed using AI tools. This might involve having students complete part or all of the assignment during class or designing assignments that include tasks that are outside of ChatGPT's current capabilities. Examples might include assignments that require students to draw from recent events or class discussions or assignments that incorporate research and citations which you can then check.

While I think such an approach is useful, I want to come at it from the other angle: designing writing assignments that make use of ChatGPT to clarify how it works and can be utilized. For example, consider an article linked on the above Pitt page, Eric Prochaska's "Embrace

the Bot: Designing Writing Assignments in the face of AI." His third method for teaching with or around AI is an approach called, "If you can't beat them, join them," which includes rhetorical analysis of AI-generated responses, revising such responses, presenting on those responses, or otherwise interacting with results from AI text generation. I think this is in the right direction, but could go even further and do more to integrate student and AI writing.

Two articles from Inside Higher Ed provide more opportunities for working with students to make use of text generation AI. Susan D'Agostino, in her article "ChatGPT Advice Academics Can Use Now," features suggestions from several professors, including this advice from NYU's Nancy Gleason:

> Next, consider the tools relative to your course. What are the cognitive tasks students need to perform without AI assistance? When should students rely on AI assistance? Where can an AI aid facilitate a better outcome? Are there efficiencies in grading that can be gained? Are new rubrics and assignment descriptions needed? Will you add an AI writing code of conduct to your syllabus? Do these changes require structural shifts in timetabling, class size or number of teaching assistants?

Note the emphasis on an integrative approach, identifying what skills students need in the context of the course, and what on the other hand might be reasonably offloaded. In an example from a class I am teaching right now, a literature course, for short writings I often ask students to do in-text citations for works included on the syllabus, with no expectation of a specific format like MLA or APA nor a works cited list unless a text from outside of the syllabus is referenced. The reason is that the course is not intended to teach them proper citational formats, but rather to understand how to include important information in their writing such that I can verify and see the context of what they choose to include. The point is not more rigorous citational standards, but communicating where their information comes from. How might writing be taught to consider what is important for students to do, while helping them identify when and where AI is appropriate

as part of that process? This perspective is echoed in Jeremy Weissman's less-rosy eyed "ChatGPT Is a Plague Upon Education", where he suggests the development of student "familiarity and even expertise with these programs, since such skills will likely be in demand in the job market."

Others in D'Agostino's article provide fruitful suggestions. University of Mississippi's Robert Cummings suggests experimentation, a building of "AI literacy" so that students can understand the tools they have available as writers. North Carolina State University's Paul Fyfe gives assignments where students "cheat" through use of ChatGPT as an opportunity to start a conversation about the technology. College of Marin's Anna Mills suggests a back-and-forth between student expectations and understandings on the one hand, and outputs by ChatGPT on the other.

In each of these cases, I think there is a sense that the technology exists and will not vanish; it may very well be essential to future work in variety of job markets; and that there is an opportunity to help students understand how to intentionally make use of the technology as part of a broader writing process.

For additional perspective on the problem and the kind of solution Marche and others posit, I find two contrasting articles useful—one by Sandra Jamieson published in a composition journal and another by Will Yeadon et al. in an education-focused physics journal. The two authors disagree on the threat the problem poses, with Jamieson describing articles like Marche's as more of an issue than the technology they describe: "AI itself is not a crisis, but ignoring the crisis rhetoric and the implications it raises for our discipline and the work of writing may make it so" (153). Key to her reasoning is doubt that students want to or would cheat (154, 156), something that Yeadon et al. seem less confident in.

Yeadon et al. perform a small-scale study on whether AI-generated short essays in physics could yield a passing grade, and find that it writes at the level of a second-year physics student (5). I find their argument more persuasive than Jamieson's: "Our results imply that students in the bottom third of their cohort would have a significant incentive to submit AI generated work for the assignments instead of their own work" (5). *Incentive* is the key term here; while I appreciate the perspective that a well-designed course will encourage authentic student engagement, I have taught and observed courses where despite the quality of the syllabus, some students will do everything to cut corners and get the grade they desire, including outright plagiarism *without* the use of ChatGPT. As long as there is an incentive to pass a class by any means—and fulfilling general education requirements toward one's degree would certainly be an incentive for undergraduate students—and tools to take shortcuts, there is a risk that students will take advantage of the tool to attain the desired grade. I do not think that physics essays are so different in kind as to claim this incentive only exists in STEM, as the task of writing is still an attempt to draw out the student's meaningful comprehension of the interrelation between terms and topics covered in class, as evidenced by the sample questions that Yeadon et al. asked of students and AI, e.g. "Is Physics based on facts that follow from observations?" or "Does [Thomas S.] Kuhn or [Karl] Popper give a more accurate description of physics?" (4). If the incentive exists, there is a risk that students looking for a good grade rather than a learning experience will take available shortcuts, despite potential consequences. To believe that students, as a rule, don't want to cheat because they value learning is true of a subset, but I think it's idealistic to think students in general won't want to cheat or even attempt to do so.

That said, there is important overlap in the perspectives of the two articles. Both call for a reshaping of pedagogy and writing in light of the new technology, making the tool a purposeful

element of the process rather than ignoring it or trying to clamp down on student use. Yeadon et al. simply recognize the possibility of this solution, writing in the conditional, "We could argue that, in contrast to merely sounding a death-knell for certain kinds of assessments, this technology will once again force us to re-think assessment, and will confer far greater benefits in the end than the comparatively small drawback of having to redesign existing assessments" (8-9). Jamieson, on the other hand, is more specific: not only should there be "a re-turn to the pedagogies that shaped our discipline and commitment to student writing that propels it" (157), but composition scholars are in fact well-placed to do so given their established theories of writing and pedagogy (153). I find her position to reflect my own, that composition is a particularly well-situated field for dealing with the increasing blur and overlap in subject matter between the two cultures.

So, how do we do rework writing in light of the stated issues? Or rather, how can comp digital pedagogy take this contemporary digital issue that deals with writing as well as general undergraduate education, and form a classroom-based response that is rooted in writing pedagogy while supporting writing and digital activity outside of writing classrooms? In section 3.4.1, I will present an example of a writing exercise that incorporates AI in ways that I think match the vision presented in Jamieson and Yeadon et al., while also levying the key concepts at the heart of this dissertation: *transfer*, *genre*, *discourse communities*, and the meaning/mechanism dialectic.

3.4.1 Writing with AI

For this exercise, I have chosen to rework a unit commonly taught in Seminar in Composition at Pitt: personal essay writing, or essays that speak primarily to the author's experiences and perspective within a broader social context. When I taught Seminar in Composition, this written genre was recommended to be the first unit taught in class, and as a

result I think it is particularly apt for introducing generative text algorithms as a tool that can be used in student writing. The goal is to establish an awareness of how to use the technology effectively and ethically by familiarizing students with how to use it in service of their writing goals. The way to achieve that goal can be expressed through the key terms described at the end of section 3.4.0.

3.4.1.1 Transfer, Genre, and Discourse Communities

The two key elements of the assignment from a comp digital pedagogy perspective are the genre of the text and discourse communities around it—personal non-fiction—as well as the immediate context of writing and sharing—the composition classroom. The roles of transfer, genre, and discourse community arise out of these two elements.

To start, I want to consider the skills that might transfer from and to other contexts. Students are likely to have a wealth of experience with personal writing; they may have read non-fiction in high school, or enjoyed literary non-fiction, or read personal essays published in popular press outlets, or read and written personal short pieces via blogs or social media. The incorporation of technology is a logical step here, then, as students are likely to use computers to read or produce texts in this genre. Whether reading longer form work on a website, or reading and producing personal short form works via social media, students have familiarity with personal writing in digital contexts. Text generation algorithms like *ChatGPT* can be framed as another tool like word processers, web search algorithms, online databases, or *Grammarly*'s grammar checker that can be brought into the writing process ("Free Grammar Checker"), and the general norms of personal writing will likely be more familiar than, say, an academic research paper for students in a first-year writing course.

In terms of skills that might transfer from this unit to new contexts, the focus here is on the ethical use of generative text algorithms as part of the writing process. By making engagement with ChatGPT an essential part of the unit, I aim to ensure students are set to consider how they might use ChatGPT in new writing contexts, particularly given the role of reflective writing in solidifying student understanding of their writing practice.

The choice of a defined genre—both in FYC as it is often taught at Pitt, and in the world around it—helps students identify a starting point of familiarity for their writing and thus enables transfer from previous reading or writing contexts. Students have likely encountered several exigences for personal writing, whether it's self-expression online or articles published online expressing one's perspective or experiences. To wit: in Melissa Tombro's book on using personal writing in first-year writing contexts, she notes that students' "lives are infused by social media," resulting in experience with writing "public life stories" (6). Further, students have a more immediately accessible base of knowledge for answering questions about their own lives and experiences compared to, say, a well-defined research topic. Finally, I chose personal writing over several genres in part because of student familiarity, but also because of the apparent dissonance that arises from using automated writing to express something personal to one's lived experiences.

For the role of discourse communities, there are at least two at play in this unit that are worth highlighting. First is non-fiction writers, which can be literary or popular. Again, people employ personal writing online via social media and popular press outlets, which exist in the information ecosystem students are part of as they use digital technology and the Internet in their daily lives. The lesson plan, discussed in detail in section 3.4.1.3, further prompts students to write deeply about their past experiences in accordance with the discourse community of non-fictional writers.

The other major discourse community is reflected in the examples Tombro excerpts for her book: student writing, rather than professionally published materials (4). As discussed in section 2.1.1, students in first-year writing take on a temporary novice status, and as a result they form a unique kind of discourse community. Student writing itself becomes a cogent genre whose exigence is defined in the context of the classroom, with the writing itself being intended for other students in a similar position; at Pitt, this is emphasized in the course description for its first-year writing equivalent: "student writing will be the primary focus in all sections" ("ENGCMP 0200"). The emphasis on student writing as part of a temporary novice position sets students up to consider how their writing done for this unit can transfer to new contexts of student writing, thus making the use of ChatGPT something that can be made use of later in their undergraduate careers.

3.4.1.2 The Meaning/Mechanism Dialectic

The important question for this section is, how does ChatGPT work and how does that functioning relate to how students will use it? That is, how is the mechanistic aspect of ChatGPT relevant to student's meaningful composing contexts? I will not provide a deep foray into how ChatGPT works, both because of my own limited understanding and because I believe that a surface-level understanding of the underlying algorithm is sufficient for the purposes of this unit.

The essential elements of ChatGPT have to do with how it transforms user input into a legible output. First, ChatGPT relies on a probabilistic model based on words, with the probability for the next word in generated text depending on the words that have come before; second, these probabilities arise from the use of words in a massive corpus of online text; and third, the model incorporates randomness by not always picking the highest probability term for the next word (Wolfram).

How do these elements inform student writing? For one, they help to situate what kind of tool ChatGPT is. It does not search a database of texts or websites based on user input and return a list of options. Instead, it appears to create original written content that is meaningful in that it states in comprehensible language a response to the user's input. In fact, the results can be convincing in surprising ways. In Yeadon et al., for example, the authors prompted a model similar to ChatGPT with the following: "Explain why Shakespeare compared someone to a Summers' day instead of a Winters' day" (3). The response differentiates the days of the two seasons as being tied to different kinds of emotions, with summer being related to happiness. As the authors note, not only can the model recognize that the references to "Summer" and "Winter" refer to seasons rather than personal names, but it also recognizes the metaphoric associations with each as a means to answer the original prompt (3).

However, something that is easy to miss in reading responses to prompts from ChatGPT is that there is no underlying model of accuracy or truth. ChatGPT can create comprehensible falsehoods or invent sources, lending it an air of credibility that does not in fact exist. This is important: the probabilistic nature of ChatGPT's responses must be taken into account when using its outputs as part of the composing process. Fortunately, for personal writing, this is less of a concern than it would be for something like research writing; were I designing a follow-up unit on research writing, that would be a new factor to consider.

ChatGPT is a digital tool much like a web search, but its outputs must be understood as lacking an internal sense of truth or validity, instead being a result of how other web texts string words together in discussion of the subject at hand. While it generates text, it is not doing so as a summary of knowledge on a subject, but rather as a probability model based on how other texts have made use of similar terms, and the kinds of words that are associated with them. The original

context, the conscious selection of an apt term or turn for the sentence in accordance with a larger rhetorical purpose, the ability to place texts or authors or concepts in a conceptual hierarchy that forms the basis of further analysis—all of these are lost compared to the human composition process. When students make use of ChatGPT or other large language models focused on the generation of natural-sounding text, then, they must always check whether the output is producing accurate claims (e.g. if describing a scene from a movie, which could occur in the unit this section focuses on, then ensuring that the scene actually occurs as described) and whether the output might be influenced by underlying biases in the source text. Personal writing is a useful starting point for this conversation, as it is obvious on its face that ChatGPT cannot provide external insight into the author's personal life; it can only provide answers to prompts based on prior written text which can then serve as points of reflection.

3.4.1.3 Commentary on the Lesson Plan

The lesson plan for this week-long unit, included in Appendix B, walks students through a process of writing and revision using ChatGPT, with reflective writing and in-class discussion helping to reinforce what ChatGPT does, how to ethically use it as a student writer, and how to incorporate it into the writing process. I will summarize the lesson plan below, zooming in at various points to show how the concepts discussed in sections 3.4.1.1 and 3.4.1.2 are being applied.

Prior to the first session of the week, students should come to class with roughly two double-spaced pages in response to a personal writing prompt about a place or piece of art/media that is particularly important in defining who they are today. After a brief discussion reflecting on the writing process, the instructor leads an explanation of what ChatGPT is and its presence in current discourse on writing in college, along with a demonstration of the tool's sample outputs given various prompts. Finally, students are encouraged to author prompts that will result in

outputs from ChatGPT that resemble their own writing, with volunteered prompts from students being fed to ChatGPT in-class to guide a conversation on how the prompt might be adjusted to yield something more closely resembling students' work.

The first step the students take by writing about themselves is meant to familiarize students with writing within the personal writing genre. The prompts encourage reflection on something of importance to the author, with consideration of the impact of the place or text on their lives and how it achieved such effects. In the first class session, students begin by reflecting on the writing process—what was difficult, how they decided what to talk about, and whether their understanding changed over the course of writing. All of these elements of composing a personal piece of writing could fit in with any first-year writing course, as the genre and its norms are established and experienced through the composing process.

Next, over the explainer and conversation on ChatGPT as a piece of technology they can use, students are encouraged to familiarize themselves with what the technology is and what it does, to consider its role in the current cultural conversation around writing, to practice prompt engineering,[27] and to try to determine how the software operates. Here, students are prompted to think about the interrelation between the mechanistic aspects of ChatGPT—that is, how the underlying algorithms that the software relies on function—and its meaningful use within a specific discourse community, in this case the community of writers broadly and then, more

27 Prompt engineering describes the process of designing a prompt to produce a desired output. For an example from the lesson plan: if students ask ChatGPT to write about the importance of a location to them, the output will likely not be in the first person, which will be a substantial difference from their own writing. Students could then modify their prompt to specify that the output should be in the first person to increase its similarity to their own writing. For more information on prompt engineering, see Sarah P. Grant.

locally, the community of undergraduate writers in a first-year writing or writing-intensive composition course.

Before the second session, students continue to finesse their prompt and write roughly two double-spaced pages comparing their work to the output corresponding to the final prompt they decide on. Some questions include how close the resultant text is to their own writing, what it might have gotten wrong about the text or location's relevance, or what new ideas it might have generated for the student to consider.[28] After providing some reflective questions in-class on their writing, the instructor then leads a conversation about the use of AI in the writing process. Students are directly asked how they feel about the potential use of ChatGPT in educational contexts, what they would define as ethical use, how they would use ChatGPT in their own writing process generally, the potential impact of ChatGPT on society more broadly, and whether ChatGPT is notably similar to or different from tools such as spell-check in word processors or Grammarly.

Students prepare for the next session of class by revising their initial personal writing in the context of their work with ChatGPT—while also including a copy of the prompt and response they used and revising their reflective writing with additional consideration of how ChatGPT influenced their revision—and whether ChatGPT can be part of the process of composition for personal writing. In class, students and the instructor partake in a brief reflection on their writing, with additional consideration of the role ChatGPT can or should have in the writing process and the potential social implications of its use.

---

28 For example, if a student wrote about a certain text in terms of how it informed their understanding of a subject, they might recall a scene they did not write about if ChatGPT were to provide it as an example.

Through the written reflection and in-class discussions, students are encouraged to consider how their experience using ChatGPT informed their writing process, and prompted to consider how their use for this unit might transfer to new contexts in their undergraduate and later careers. Further, these conversations help students familiarize themselves with the process of using the algorithm toward a meaningful context, with the between-sessions writing encouraging students to consider how to best make use of the technology as part of their larger writing process. Here, ChatGPT is a technology that can be made use of in creating instances of a written genre within their immediate discourse community of undergraduate writers. Then, students are brought into conversation with each other to consider how to use the technology in future contexts.

This unit, in total, is meant to briefly familiarize students with ChatGPT and how it might be used in the writing process. Through in-class discussion, the revision of student writing, and reflection on how the use of ChatGPT can inform the writing process, students are encouraged to consider what skills might transfer from their previous experiences with writing and editing, as well as what skills from this unit they might transfer to later writing contexts; to consider the genre of the text they're composing, and how ChatGPT can be brought into the process of composing in that genre; to consider their local discourse community of student writers and how they can make use of the technology ethically; and the role that ChatGPT might serve in the meaningful process of writing based on the underlying mechanistic processes of the technology. In short, I think that this unit and the lesson plan for it guides students through an exercise in working with a contemporary, culturally relevant technology from the perspective of comp digital pedagogy.

3.5 Looking Forward

In this chapter, I have explored pedagogical applications of comp digital pedagogy as defined over Chapters 1 and 2 in this dissertation. I have looked toward my own teaching and pedagogical resources to identify where concepts from comp digital pedagogy are being applied successfully or insufficiently, with a focus on general education courses as ideal for integrating the two cultures as part of the learning process. Finally, I turned toward a contemporary issue surrounding writing and digital technology—the role of text-generation algorithms like ChatGPT in undergraduate writing and concerns thereof—as an opportunity to demonstrate how comp digital pedagogy can guide the creation of a classroom-based solution to the issue.

In the next chapter, I will look at how comp digital pedagogy can help guide pedagogical activity at the programmatic level and consider how to adjust or update comp digital pedagogy given closer focus on programmatic needs. I will do so by focusing on Digital Narrative and Interactive Design, an undergraduate major that bridges the School of Computing and Information on the one hand, and the English department on the other. This program inherently integrates the two cultures, and so it is an ideal site for exploring programmatic design and activity in the context of comp digital pedagogy.

4.0 A Case Study of DNID

The previous chapters have, in order:

0. framed the pedagogical approach of this dissertation as a means of addressing the cultural divide between STEM and the humanities;
1. further theorized this divide via the meaning/mechanism dialectic, which was then applied to subjects in STEM and the humanities;
2. related this dialectic to a pedagogical approach rooted in composition pedagogy; and
3. provided several examples of my application of comp digital pedagogy, an extension of composition and digital pedagogy, in my own teaching.

Now, I want to turn to what applications of comp digital pedagogy can look like at the programmatic level. To start, I will outline my experience working with the Digital Narrative and Interactive Design (DNID) program, a joint major between the Department of English and School of Computing and Information at the University of Pittsburgh. DNID's co-location between those schools makes it apt for considering what comp digital pedagogy can provide beyond the scope of the individual classroom. Then, I will write on the results of a series of interviews and evaluation of survey data I performed in order to better understand how the DNID program was formed; which student and bureaucratic needs it addresses; and how it might provide useful guidelines for attempting to counteract flagging enrollment in English programs through appeals to interdisciplinarity and cross-cultural work.

4.1 Program Experience

My experience with the DNID program began indirectly with the teaching of Composing Digital Media, which is a course option for students in two of the three "tracks" within the major ("Digital Narrative"). Only two or three students in each section of Composing Digital Media that I taught were declared DNID majors at the time, which was in the first two years of the program's creation in 2019 (Massimiani). The shift to teaching Digital Humanity and then Narrative and Technology led to more indirect involvement in the major, as these courses are the two gateway courses for the major. In the past two sections of Narrative and Technology that I've taught, for example, twenty-four of the forty-one students were DNID majors. While students in these three courses come from across the university, as the courses fulfill general education requirements, I noted early on that DNID majors seemed to just "get it." They were highly motivated in their writing, active in class, and avid about combining their digital skillset with the humanities-focused inquiry driving the courses.

As a result, I expressed interest in becoming more involved in the program beyond teaching, and became the program assistant, working under the director of the program, Jessica FitzPatrick. I helped to organize meetings amongst DNID instructors, plan and develop programming, and address student needs as expressed in the program's Discord server. Although this position was part time and only a small portion of my weekly work—being done in addition to the teaching, research, and writing I was already doing as part of my graduate work—it gave me insight into how those involved in DNID were attempting to address student needs and grow the program.

It was these experiences that encouraged me to look at the program more closely, as there are several parallels between the work in this dissertation and the goals of the program. At the

broadest level is the cross-cultural nature of the program by virtue of it being jointly run by the Department of English and the School of Computing and Information. Students come to DNID courses with a variety of interests and skills, with some being avid programmers interested in computer science, others being interested in information science proper, and others being artistic-focused users of digital software for the purpose of narrative design, e.g. using game engines in order to create or collaboratively design games. More specifically, my work with DNID students indicates to me the validity of comp digital pedagogy in setting students up for later academic and professional work by integrating humanistic inquiry and technical learning, with an eye toward how these things work together in the current digital landscape. These students are doing the kind of work that the rest of this dissertation expresses a need for, and they are doing so through an institutionally recognized structure.

Given the recency of the program, which began four years ago at the time of writing, and the successes I see as an instructor working in the major, I believe that closer scrutiny of how DNID operates at the administrative, programming, and curricular levels could prove useful for a wider academic audience interested in the incorporation of digital technology and computer science into humanities programs. Thus, I turn in the next section to a case study of the program in order to demonstrate how the program was formed, how it has continued to function, and how it has successfully enrolled and recruited students into the English program, in contrast to broader trends.

4.2 Methodology

The case study that this chapter centers around looks at the DNID program at the level of programmatic, curricular, and instructional design. It attempts to address three research questions:

1. How does the DNID program incorporate the cultures of the English department and the School of Computing and Information?
2. What influence does composition pedagogy, literature pedagogy, or digital pedagogy have on the design of the program at the levels of the curriculum and coursework?
3. How might digital technology be used to maintain the sustainability of English programs?

The first question emphasizes the two cultures problem at the heart of this dissertation, asking how the DNID program integrates the two cultures. The second question similarly pulls from the theoretical core of this dissertation by asking how pedagogy—in particular composition and digital pedagogy, but also literature pedagogy given DNID's placement in the Department of English generally rather than just the composition part of the department—can address the cultural divide.[29] While interviewees might not speak specifically to what pedagogical theories influence them, responses indicate broader approaches to course design and the building of a syllabus around certain ideas, themes, and assigned content. These two questions then, taken together, attempt to examine the DNID program from the theoretical perspective developed over the first four chapters of this dissertation.

---

29 It is worth noting that the Pitt lit program, part of English as much as its composition or film programs, has had courses that cross traditional boundaries of the field, e.g. with foci on game studies and interactive literature. In section 4.4, I will discuss how interview subjects framed the role of literature pedagogy in their own course development.

The third question brings in a new element to consider: the question of how DNID might provide a balm for falling enrollment in English and humanities programs. Recent scholarship and popular press analysis has identified this crisis. In 2023, Nathan Heller wrote on "The End of the English Major," noting that "During the past decade, the study of English and history at the collegiate level has fallen by a full third." The year prior, in an academic journal focused on pedagogy, Brian Cooper Ballentine describes the enrollment crisis and notes a reluctance in English departments generally to identify and initiate solutions (43). Data from the National Center for Education Statistics notes a 23.7% decrease in "[d]egrees in English language and literature/letters conferred by postsecondary institutions" from 2012 to 2018 ("Degrees in English"). By contrast, the DNID program has been quite successful in enrolling students, growing in number and creating demand for multiple sections of courses like Digital Humanity and Narrative and Technology, which regularly are waitlisted across the board. Thus, I hope that this study can help identify the root of this disparity between broader trends and the successes of the DNID program.

To address these questions, I am taking a mixed-method approach—albeit overwhelmingly qualitative by proportion—to the case study that comprises this chapter. The primary research being completed will be a set of semi-structured interviews with a purposive sample of administrators, advisers, and faculty who took part in the founding of the program and/or continue to be part of it.

I chose this approach for many reasons. First, I am necessarily looking at an element of the social world by focusing on a college major and the role of human beings in the construction and maintenance of that major, which makes my aims simpatico with what qualitative analysis enables in research, especially considering the attempt to draw out information from the local expertises

of my interview subjects (Hesse-Biber 455). I have established my insights into the program, but to better understand it complexly, I need to "attempt to understand the world from the point of view of research subjects" (Ruslin et al. 23), creating a more cohesive picture. The product will be a chapter that, as per John W. Cresswell's description of qualitative research, incorporates the voices of the interview subjects, my reflexive consideration of my role as interviewer and part of the program, a detailed description of the major, and the possibilities that a study of DNID presents for addressing the academic issues presented by the two cultures problem (44).

Cresswell additionally presents the utility of thinking of a case study as a kind of qualitative or mixed-method methodology. He describes case studies as "a qualitative approach in which the investigator explores a real-life, contemporary bounded system (a case) or multiple bounded systems (cases) over time, through detailed, in-depth data collection involving multiple sources of information" (97). Although in-depth data collection and analysis, particularly quantitative analysis, has proved difficult—largely due to a lack of data available about the nuances of enrollment in the institution—the focus on a bounded case, the DNID program, as the primary unit of analysis aligns my approach with this methodology. Cresswell draws a distinction in kinds of case study that is also useful: that between *intrinsic* and *instrumental* cases (98). My choice to study DNID is a mix of these: DNID is instrumental in so far as that it demonstrates a case that can serve as a solution to the theoretical problems defined in the early chapters of this dissertation, and intrinsic in that the success of the program in integrating the two cultures through a programmatic solution is remarkable and worth digging into. As will be noted in the analysis of the interview content, the success of the program is worth noting compared to some attempts at similar programs, making the value of studying DNID intrinsic as well.

As noted at the top of this section, I began with three research questions that have guided the case study. After receiving an exempt status from my university's Institutional Review Board (Appendix C), I went forward with identifying and interviewing appropriate subjects using semi-structured interviews (see Appendix D for the skeleton document I used to approach interviews). This approach seemed ideal for eliciting the kind of rich, situated data that would help to add detail to the picture of DNID that might be useful for further scholars seeking out programmatic solutions to problems of English enrollment and the two cultures divide, which is increasingly problematic in a world where interdisciplinary work has become far more normalized, as discussed in section 0.1.1.

Several scholars affirm the value of semi-structured interviews in qualitative research. Ruslin et al. highlight the relative flexibility of semi-structured interviews compared to fully structured interviews (22), and in reflecting on extant research note that semi-structured interviews enable valuable means of eliciting data beyond the main questions, namely through follow-ups and probes of what is particularly relevant to the interview subject at hand (24). I found this to be true in my experience interviewing for this project; while the questions I had written in advance proved useful at soliciting responses that helped to address the core research questions for this case study, I often found myself asking for clarification on a certain point, or even rewording questions based on my perception of the subject's likely interpretation of a question.[30] Further, I found the

30 For a small example, in the interview script (Appendix D), I refer to "DNID courses." However, some interview subjects were keen to emphasize that there are very few DNID courses per se, as most of the courses pre-existed DNID and have since become DNID-affiliated courses. So, I often switched my language from saying "DNID courses" to "DNID-affiliated courses," to avoid an interview subject focusing on that nuance over the

openness of semi-structured interviews to facilitate the strengths of qualitative research broadly, e.g. Sharlene Nagy Hesse-Biber's point that "[q]ualitatively driven praxis promotes a deep listening between the researcher and the researched" (456). My ability to follow up, introduce new questions, or tailor the wording of certain questions encouraged this deep listening process.

My approach to coding and evaluating the interview data follows in structure from my three research questions. The three broad categories of codes are determined directly from the pre-identified research questions: cultural integration, English program sustainability, and pedagogy, defined broadly as dealing with course design, assessment of which content to include in a course, and in-class approaches to the instruction of materials. This is, in a sense, a prefigured coding scheme, although I follow the advice of Cresswell in "be[ing] open to additional codes emerging during the analysis" (185). I allow for new codes to be created by performing thematic analysis, a method of qualitative analysis that attempts to identify themes or codes from the data itself. As Victoria Clarke and Virginia Braun describe in their book on thematic analysis, themes can be identified in two ways: a "'bottom-up' way, on the basis of what is in the data" and a "'top-down' fashion, where the researcher uses the data to explore particular theoretical ideas" (178). Importantly, they note that these approaches to identifying themes are often integrated in analysis, which is the approach I am taking here. I start with three broad categories of code that are representative of my core research questions, but then determine sub-codes that fall under those three broad categories through reading the interview data and identifying patterns. As a result, my approach to coding is a back and forth between my pre-defined research questions and the

---

information trying to be elicited by questions such as, "How do DNID courses differ from non-DNID English and SCI courses?"

categories of codes those produce, and what the data reveals to me about each research question that can be coded and tracked across the interviews. For example, when reading interviews, staffing was a frequently mentioned concern for DNID, as certain kinds of instructors are sought for teaching DNID-affiliated courses that are not always plentifully available. As a result, "staffing" became a code categorized under "English program sustainability," as staffing was clearly revealed by the interviews to be part of the considerations that need to be made in designing something like DNID and maintaining its success in fostering higher enrollment.

In addition to the interviews, I will briefly examine a pre-existing dataset, a 2022 survey of sixty-four students—including DNID majors as well as non-DNID majors—who had taken one of nine courses that fulfilled DNID and general education requirements. This survey includes questions that produce quantitative and qualitative results, both of which will be examined in addition to the surveys to provide some light on the student perspective.

The limitations of this study are in its purposive sampling, which has the potential to exclude perspectives on the major from faculty or administrators who were not included in the original sampling, who decided not to partake in the interviews, or who have left the University of Pittsburgh. Further, to better understand the student experience of the program would require further interviewing or surveys of student experiences in the major using questions tailored to the two cultures problem or how students experience the integration of technical and humanistic work in their courses. Finally, having more detailed quantitative data that showed not only the changes in enrollment in DNID over time since its inception, but also whether the growth of DNID came at the expense of other majors in English, or the bringing of students into the major after they take a DNID-affiliated course, or when students learn about and sign up for the major, would have

assisted the depth of the case study. However, as indicated, much of this data is inaccessible or does not exist, limiting the scope of the case study.

4.2.1 Interview Subjects

Because the sampling method was purposeful and involved identifying key figures in the program who might provide insight into its formation and continued functioning, I will not be using pseudonyms to refer to participants, a fact they were all made aware of as part of the recruitment process. In this section, I wish to briefly name who I interviewed and describe their role in the program, as I will be quoting and paraphrasing these people throughout the remaining sections in this chapter.

Four of the eight interviewees were involved in the creation or early formation of the major. Gayle Rogers, who became department chair for English the same year that DNID became available as a program, was involved in the administrative work that facilitated the creation of the program from the English side. Annette Vee and Dmitriy Babichenko, the former an associate professor of English as well as director of the composition program, and the latter a clinical associate professor at SCI, were both heavily involved in the development and design of the program in its early formation, serving on formative committees that enabled the inter-school cooperation and design of the broader DNID curriculum. Jeff Aziz, a teaching professor and advisor who serves as one of the three English advisors for DNID majors, was brought into the launch of the program to manage advising logistics.

Jessica FitzPatrick, who is the current director of DNID and a teaching associate professor, was brought into the program in its first semester as assistant director. The remaining three people interviewed—Justin Bortnick, Christopher Maverick, and Nathan Koob—are all teaching assistant

professors who teach multiple DNID-affiliated courses. Babichenko and FitzPatrick will also be excerpted when talking about pedagogy and teaching, as they have both taught DNID-affiliated courses.

4.3 Cultural Integration

The first research question deals with how DNID integrates humanities and STEM cultures by bringing together the English department and the School of Computing and Information, as well as how those in the program view interdisciplinarity more broadly. Out of the initial coding process, five codes arose related to cultural integration: there were discussions of the *formation* of the cross-school program and the *role of administration* in enabling this kind of integrative work; there were comments on *interdisciplinarity in general* and the *integration of English and SCI* in particular; and finally there were comments on *student experiences of interdisciplinarity*.

Therefore, this section will focus on the development of the program from the perspective of those involved in its formation in terms of how they understood the roles of interdisciplinarity and cross-cultural work in the creation of the program. It will then turn to how this cultural integration has remained a part of the program and its continued development, as well as how students have experienced the integrative work that the DNID program offers. I will not go into finer-grained details about course design and pedagogy until section 4.4, which will focus more on how instructors approach teaching DNID-affiliated courses in light of the broader systemic goals outlined in section 4.3.

4.3.1 Program Formation and Administration

The DNID program formed in response to administrative interest from outside of the English and SCI programs, interests that began to be identified in 2017 (Rogers). Both Vee and Rogers relate a push from then-Dean of the Dietrich School—where English lives with other humanities, social sciences, and STEM programs—Kathy Blee for a "synthetic major" (Vee), or "joint programs of some type with other schools" (Rogers). In response to this call, Rogers, Vee, and others in English began to examine the English program and digital-oriented classes within it. Rogers describes taking this early programmatic evaluation to Adam Lee, then-Dean for Academic Affairs at SCI, and finding mutual interest in developing the kind of cross-school collaborative effort being encouraged by the administration more broadly.[31]

Immediately worth noting is the institutional will for this kind of program, and the presence of professors and administrators in English and SCI who could envision a hybrid program centered around digital technology. Vee mentions this institutional support repeatedly; she notes that the collaborative spirit that fostered the development of the program might have stemmed from the fact that the call for the program "was coming down from on high." Further, it helped that there was an interested dean, and that even with a new dean in recent years, the interest remains.

The support for the program at that level was matched by enthusiastic collaboration between those in English and SCI. When I asked Vee, Rogers, and Babichenko about the early collaborative work designing the program, each expressed that disagreements about the shape of

31 Adam Lee and Zachary Horton, an English associate professor, were not interviewed, although both were present in the foundation of the programming.

the collaborative major were rare, contrasted by a strong collaborative spirit. Vee notes that "all of our conversations were friendly;" Rogers adds that "[w]e've really been on the same page," joking when asked about how diverging opinions on the founding of the program were mediated that there were "fist fights"; Babichenko similarly notes that "[w]e didn't really have any difficulties in collaborating," and that in fact the experience was so positive that it led to further collaborations between members of SCI, e.g. him and members of English like FitzPatrick, Maverick, and Stephen Quigley, another professor who teaches DNID-affiliated courses. Babichenko further adds, "I think everybody was kind of invested in creating a program that students would actually benefit from, and also everybody was interested in the program succeeding because it was really kind of like the first cross-school, cross-departmental, you know, completely cross-disciplinary program that the university has ever had." While Babichenko noted very marginal cultural differences—namely in emphasis on job prospects for the major—Rogers noted that neither group "plays to stereotype. They're not a bunch of humanities-averse bots, and we're not a bunch of book clubs who don't know any technical skills." In fact, instructors on both sides, such as Babichenko and Vee, were already doing this cross-cultural work, and were able to be relied on to help develop the program.

Thus, a major part of DNID's success appears to be the role of deans, department administrators, and faculty, as all were interested in the idea and energized to make it come about. Further, as Vee notes, there were "administratively savvy people" like Lee and Rogers in SCI and English, respectively, who could facilitate the collaborative work. As a result, the success in starting the program appears to be rooted in a mix of institutional will at the level of deans, department/school administrators, and faculty, with a willingness across DNID to see what value the two sides of the program bring to the collaboration. The fact that there were so many people in

the necessary places who could see the value of both English and SCI, I think, speaks to the way increased interdisciplinarity has changed the nature of the two cultures problem as described in section 0.1.1, as there exist major figures who can understand the value of the "other" culture, especially when there is such a shared interest in creating positive student outcomes.

The administrative work, even just from the English side, is significant. FitzPatrick relates her role as director as involving the development of programming, curriculum design, liaising between English and SCI, leading a service committee in English for steering the major, and engaging in community outreach to integrate DNID into the surrounding community. Rogers describes managing budgetary concerns, hiring needs for the program, and finding money for classroom support, such as the purchase of Arduino kits. Again, the motivation of people working in the program is a major driver of its efficacy; across the board, there is a sense that the program is offering something exciting that might even stand as a model for other programs (Babichenko), and a collaborative spirit that minimizes conflict arising from cultural differences.

That said, there are places where institutional norms and limitations impact the success and progress of the major. In the development of the program, there was a desire to include more programs than just English and SCI. Vee states:

> But we basically just couldn't manage to have more than one other department at the table with SCI. And English was big enough that it could kind of play evenly with SCI. … So that is still an institutional barrier, because I think I would still like Studio Arts courses or other courses to count for the major. But the barriers are—it's like administratively, how in order to offer something for a major, you have to offer a class *x* number of times every year….. And you know, once you make it required then like, you're dependent on another department, and if the department can't staff it, then, you know, the whole major falls apart.

The DNID program could have been *more* interdisciplinary, but institutional barriers and matters of departmental size had to be considered, limiting the extent. So, even when the general

bureaucracy is in favor of such a program, there will be limitations to who can be involved based on factors like program size and the need to coordinate between multiple departments and schools.

Additionally, the novelty of DNID creates problems in terms of how traditional administrative structures attempt to address the new issues that arise from a cross-school, cross-disciplinary program. For example, FitzPatrick's role as director of the program is somewhat unique compared to directors of other, better-established programs in English like literature or composition. "Jess is in a position," Vee says in reference to her work as director of DNID, "where she's not fully located in any program," a point FitzPatrick echoes: "I'm a director, but I'm a director whose role is different than, let's say, a teaching faculty member who is the Director of Undergraduate Studies for literature, which is a one-school, kind of in-house English department-only program." By virtue of DNID being comprised of courses from other programs—whether it be English literature or SCI—FitzPatrick must serve a unique role of not only directing the program, but liaising between other programs and schools to manage the course offerings and staffing that will support both DNID and the original location a course sits in.

Another administrative issue for such a program comes down to advising. Vee mentions the difficulty of "trying to navigate across two different sets of advisers," because as Rogers adds, "There's not one set of DNID advisers. … Rather, you're advised by your home department," requiring coordination between advising across the two schools. FitzPatrick also highlights the difficulty in addressing questions such as, "How do students find an advisor, how do they communicate with them, how do they run meetings? Who has what permission forms for classes that come from both halves of our programs?" Babichenko provides an example of this issue, where there was a misunderstanding from Dietrich-side advisers in how an independent study

could function as a capstone, leading to a weekend and day of "answer[ing] 67 emails from students."

Part of the difficulty in advising stems from the specific approach to curricular design taken by those designing DNID. Both Rogers and Vee relate a contrasting example to DNID, Stanford's CS+X program, discontinued in 2019 after its initial creation in 2014 (Leighton). Vee and Rogers both describe a key problem with that program being that it was not a new, synthetic major so much as it was a designated double major, something that on the one hand students could already do, and on the other hand meant students attempting the program were overwhelmed by course loads, scheduling, and the lack of actual integrative work offered by the major. These points were echoed by Joy Leighton in her writeup for *Stanford News* about the shelving of the program.

By contrast, part of what makes DNID appealing and effective is its approach to curricular design. First, Rogers and Vee both emphasize that they wanted to design a major that functioned as a single major, with Vee noting that beyond the course load problems of a double major, there is an issue with cognitive load: "it's too much for the students to kind of make those connections and to carry the weight of that interdisciplinarity all on their own." Second, and worth noting for other programs interested in replicating some of DNID's successes in terms of navigating bureaucracy, the major was largely synthetic in that it looked at pre-existing courses that could fit into this new major. Vee, for example, notes it would not have been possible to "all of a sudden come up with like, five new courses that were synthetic, co-taught courses," and accordingly, Rogers posits that "90% of the courses already existed." Not only did this approach avoid needing to design multiple new courses and set up co-teaching dynamics that involve schedule synchronization between professors as well as additional costs for the university, it also meant that students could find the major through the exploration of courses that are not *just* DNID courses.

This design, while effective at mediating between the development of something new and working within the structures that exist, is also where we see examples of administrative barriers rooted in cultural differences between English and SCI that had to be overcome. Rogers and Babichenko illuminate the distinction. As Rogers says on English courses, they often fulfill gen-ed requirements and thus have a wide variety of students from various disciplines, which can serve as part of recruitment: "You leave multiple directions open and that's what course gen-eds are for in a university, let[ting] you find your path. And so, I want to say all but one or two courses in the whole DNID curriculum has a gen-ed [designation] from the Dietrich side." A benefit of this approach is that students might discover a program like DNID through their attempts to fulfill gen-eds in, say, their sophomore year, and still be able to complete the major in time. This is made even easier due to the lack of pre-requisites in English besides, generally, first-year writing (Rogers).

By contrast, SCI courses often have multiple pre-requisite courses; as Babichenko explains, "before you're allowed to take a database management systems course, you have to take courses, you know, *a*, *b*, and *c*. But in the Bachelors of Science in Information Sciences, that's kind of assumed. It's assumed that everybody knows. But then students coming in from the English side and advisers from the English side wouldn't necessarily know this." Thus, pressure is once again put on advising facilitated by clear course selections for what counts in the major and clear outlining of pre-requisites for courses. There is some cultural conflict that arises from the relative lack of pre-reqs in English compared to their necessary role in SCI, a conflict likely to arise in other interdisciplinary contexts integrating humanities and STEM cultures.

4.3.2 Interdisciplinarity in General and in DNID

Before speaking to interdisciplinarity and cultural integration in DNID in terms of English and SCI further, I want to highlight some perspectives on interdisciplinarity generally that motivate those I interviewed for insights into the DNID program. Notably, interdisciplinarity is already on the minds of those who have been essential in the establishment and growth of the program.

The most fruitful conversation I had in this regard was with Aziz, a DNID advisor on the English side. He describes himself as "an interloper into other people's professional cultures" as well as "a very science-y humanities person." I find his observations on the value of interdisciplinarity broadly to be useful here. He argues that there are valuable communications across the cultures of the sciences and humanities that get ignored when the two cultures distinction becomes "reified," rather than seen as a site where crossover is already happening. He further identifies the value of interdisciplinary communication: "what happens when you bring together people in an interdisciplinary community? They start developing a common language, like a trade language, right? And let's face it, it's fun being an interloper in the professional languages of other discourses." Here he addresses the unique communal creation that forms from interdisciplinary work, a kind of hybrid-yet-new discourse community that can expand the horizons of all participants. "When you're drawn out of your little comfort zone, you discover things that you once dismissed as having little value are actually central to the work you're doing. This is what something like DNID can really do. This is what I think these humanities-applied sciences collaborations do really well, is make people say, 'Holy shit, I have been living in a tin can.'" FitzPatrick echoes this, stating that cross-disciplinary programs require the development of a "shared vocabulary," an ability to "think[ ]about what are the community's norms, and how do we even start to consider that community, right? What are our shared values?" In these claims I see

reflections of what Smith tries to bring to computer scientists or what Hayles brings to both the history of technology in *HWBP* and to literature in examinations of electronic literature. The interloping enables new kinds of insights.

Similarly, Bortnick and Babichenko express a tendency toward interdisciplinarity in their work as instructors. “I’ve always done [interdisciplinary research],” Bortnick says, as “it’s just a necessity, especially if you work in games, unless you’re one of the very few sort of like, people who can do it all.” The kinds of work enabled by digital technology, e.g. game design, in a sense necessitate interdisciplinarity, as nigh-zero people can “do it all.” As an example, he relates his contribution to a capstone project for SCI students, where he does not offer programming advice, but instead helps students engage with questions about design so that those students can consider how their programmed elements of a game can cohere into a single text.

Babichenko approaches his instruction from a fundamentally interdisciplinary perspective. Consider this anecdote from a course he is teaching in SCI:

> Like, I never teach technology for the sake of technology because that's kind of pointless. There are tutorials on the web, like how to do that. But being able to contextualize this knowledge…. So like this particular capstone, we're working on the problem of, you know, creating immersive media experiences for cultural preservation, and we're working with disappearing cultures in Ecuador. And it's a much larger research project, but the capstone is kind of situated in that context. And in order for students to be able to develop technologies, they really have to understand the cultural background. They have to understand the historical background, you know? They have to understand about colonization, about the economic position of these people. They have to understand what types of methods, you know, archaeologists and anthropologists use to collect this data. And then they have to understand the data itself. So the computational and the data methods are very tightly interwoven with humanities methods.

In order to effectively teach students about the technology and data they use, Babichenko centers them in terms of their use, in terms of the kinds of questions that the technology helps to address, and in consideration of how the technology informs the understanding and attempted

solutions to the problem. Humanities and STEM cultures are at core integrated in order to maximize the understanding of the technology and the contexts it exists in. Much like myself, as described in the introduction to this dissertation, Babichenko relates some difficulty he had early on in his academic career with STEM courses that arose from the lack of attention to context, or the meaning of the apparently rote information he was learning in biology, chemistry, and calculus classes. It was only when, for example, calculus was put into a context of use in an engineering course that the formulae and rules took on meaning. In the case of his teaching related in the quote above, interdisciplinarity took the form of recognizing the already-existing connections between STEM and humanities perspectives in digital technology to facilitate a developed, complex, contextual understanding of the relevant technology.

Clearly, those involved in the major recognize the importance of interdisciplinarity in bringing together varied perspectives for new potential outcomes. What is the value of this integration for English and SCI in particular? That is, what do those involved in DNID perceive to be the value that English and SCI bring to the program? And further, what opportunities, successes, and challenges have they witnessed in this cultural integration?

Although there was due reticence in, as Vee phrases it, "avoid[ing] a too pat separation of English and SCI which was like, English brings feelings and SCI brings technical skills," multiple people reaffirmed the broad cultural divide of an emphasis on meaningful, interpretive practices in English and mechanistic, technical learning in SCI. Vee states that a goal for the program was that rather than "the kinds of feelings … caricature," English would bring "more of a human focus to technology," which involves "critical engagement" that is common to English and relatively underrepresented in SCI proper. A similar dynamic was asserted by Bortnick and Babichenko, instructors on either side of the collaborative program. Bortnick argues that English brings an

emphasis on methodology, and he focuses on newer models of teaching English: "there's sort of a newer, more effective way of thinking, I think, which is, you know, an English degree is about training you in a way of thinking that you can apply to many different disciplines and things." Again, part of the emphasis of comp digital pedagogy is its preparation of students for a world where digital technology is omnipresent. SCI brings, by contrast, "the technical side, right? We're not teaching programming," he adds, but learning such skills are essential to certain career paths attainable by CS degrees such as game design. "They'll [SCI] teach you best practices in code and software design and all that good stuff."

Babichenko's assessment of the value of each part of the program is similar, although he speaks more specifically in terms of the broader values of students in SCI and English. As a SCI instructor, his insight into that student population is useful.

> A lot of SCI students—you know, students in information science and computer science programs—they try to develop technology for the sake of developing technology. And a lot of times they… even when I teach a game design course or game development courses, students develop games and interactive experiences for the sake of technology, right? So like, it is cool to develop a VR application or it's cool to develop a first person perspective game, but then those games, or those experiences, are very mechanical.

I find the use of the word *mechanical* here to be particularly apt given the language used in the chapters of this dissertation. As indicated by the emphasis on pre-requisites in SCI courses, often students are learning skills, potentially with consideration for future use in industry or other post-academic work, but often with less consideration of the contextual, purposeful use of that technology. By contrast, Babichenko adds, "one of the things that English really brings to the table is getting students to think, you know, if you develop this mechanic, what part does it play in the story? What does it really, like, help the user achieve? How does it position the game within the larger world?" In integrating SCI and English, there is an opportunity to not only bring technical

learning to English students who may, for instance, want to learn how to use a programming language in order to design a game, but there is also an opportunity to engage SCI students with more purposeful, contextualized use of the technologies they familiarize themselves with in their computer science or information science coursework. Fitzpatrick, similarly, notes that English brings an emphasis on "the rationale for why those skills [e.g. storytelling] are going to be beneficial for DNID students … even if they're interested more in the computational side. And I don't mean storytelling only in a fictional sense, right, but also how do you consider an audience, how do you work with a partnership, how do you communicate across team positions?" There is an emphasis on the use of a process or technology in context, with skills supporting purposeful use of that process or technology.

The benefits of cultural integration are intended to be bidirectional. Maverick is careful to note this lack of one-sidedness: "I think we often view DNID as, how do we bring the humanities to computer science students as opposed to the other possibility, which is it could also be bringing technology to the English lit students." Similarly, Koob posits that DNID is of note because it brings to English "a lot of areas that at university level tend to be focused in SCI-type departments, things like web design, game design, you know, those sorts of things," with him further echoing Babichenko about his emphasis on learning the use of relevant technologies in historical, cultural, and scholarly contexts.

There are important nuances that interview subjects mention about this integration. Vee, for example, notes that there already has been technical learning courses in English, e.g. in Composing Digital Media. Further, FitzPatrick frames the strengths of SCI as being focused on "explicit design implementation," or a consideration of what tools or skills will be needed to execute a plan. This does not mean the learning process for SCI students exists without context,

but rather that the emphasis is placed on an executable action plan for developing a viable product. She also brings in the consideration that SCI tends to be "more driven towards thinking about and with industry." Thus, the skills learned aren't entirely out of context, but rather the context is less about the purposeful creation of a digital product and more about the creation of an object legible to future employers, who will expect certain demonstrable skills such as programming facility with certain languages.

The integration process, driven by a mix of highly motivated faculty, administrators, and deans, can clearly enable the dialectic engagement with digital technology outlined in Chapter 1 of this dissertation, or the treatment of digital technology and its products as *meaningful mechanisms*. Those in the program recognize the broad cultural divide between the more interpretive and contextual approaches in English and technical learning in SCI, but also recognize that the placement of these kinds of students and courses together can benefit both English and SCI students.

Some of those benefits have already been identified by interviewees, namely Aziz and Babichenko. On the English side, Aziz describes the work of one of the first DNID students, who "did a project seminar on prosthetics" and later developed a podcast about inclusive design. He emphasizes the possibility for DNID to encourage these kinds of students, as "one of the things that we want from a joint humanities program is that ferment of humanities people, working ideas with one another, taking things from concept to execution with a lot of, you know, student scaffolding, right? … I think we've been good at that. I think that as a program DNID really has cultivated interesting student work, student work that otherwise might not be getting done." From the SCI side, Babichenko describes a common problem discussed in section 0.0, footnote 2: English-side students often cannot see themselves as people who can program or do math. He

describes students “who for their entire lives, they’ve either been told or they thought, ‘I’m just bad at programming,’ or, ‘Math is hard,’ all of a sudden it’s like a light bulb comes on and they’re like, oh, I can do this.” By placing technical skills in a meaningful context, once-reticent students can feel empowered to develop technical skills because those skills bear meaning in the work that drives them, e.g. producing an inclusive design podcast.

4.4 Pedagogy

Now that the development, design, and continued cultural integration that the program represents have been established, I want to turn to the instruction of DNID-affiliated courses. I had initially conceived of this section, as seen in the initial research question in section 4.2.0, as being about pedagogy and pedagogical theory. However, questions focused on pedagogy often did not result in responses about pedagogical theory or frameworks, but instead about teaching practice broadly, or sources instructors tend to use repeatedly. As a result, the sub-codes focused less on, say, the role of composition pedagogy in teaching DNID courses, and more on the teaching decisions that seemed most meaningful to the instructors I interviewed: how they approach *course design*, their *selection of materials* for teaching, and *teaching humanities vs. technical subjects or materials*. Further, given the active participation of these instructors in the program beyond the classroom, I will also speak to their *work outside of the classroom* for the major. Finally, I will relate broad *reflections on DNID students*, as interview subjects were regularly able to speak to how that student body does and does not resemble students in other majors, in particular students who are English or SCI majors but not DNID majors.

4.4.1 Course Design

When it comes to course design at Pitt, whether talking about DNID or any other English major, it's important to start by noting that no two versions of the same course are going to be exactly the same. As Vee states, "we have a strong belief in faculty autonomy for classes," which leads to substantial variation in how a course is approached. For example, my approach to Narrative and Technology started by identifying essential texts in narrative theory that speak to a variety of media, then trying to scaffold from the familiar terrain of print, to atypical printed narratives, to film and then television, to electronic literature, and finally to a variety of games, with the scholarship framing conversations about each medium and genre. This was rooted in my desire to appeal to and expand on my knowledge of narrative theory, and a sense that such an approach met the title and generic description for the course, thus meeting students' expectations. Maverick, who teaches the same course, describes a different approach, albeit one equally rooted in meeting the established course goals:

> So before I look at anybody else's syllabus, I look at this course description. I decide, what do I want this course to be? In my mind, what is this course? And then I look at everybody else's syllabus from the last couple of times, and I look at what were they trying to do. And sometimes I agree, sometimes I don't agree and so it's more of a well, OK…. So like I said, I teach Narrative and Tech heavily book- and film-based. That was a conscious decision to not teach it as a video game course and that was mostly based on the fact that I knew that most of the kids coming in would expect it to be. So I started there, saying in the middle of the course, I need to teach Marshall McLuhan's "The Medium is the Message," and then how do I branch out in both directions from there?

While there is an attempt to develop shared norms and understandings—as Vee says that "it is important for teachers who are working in these classes to understand that they're part of the DNID program"—it's worth noting this institutional norm in English of classroom variety and faculty autonomy. Maverick avoided the teaching of video games while I embraced it, but in both

cases we are still meeting the description and expected learning outcomes of a course called Narrative and Technology. There is a set of shared values and method to course design, but room for tailoring the course to one's expertise and interpretation of the course students expect to take.

That being said, I want to note the common emphases. First is an emphasis on *making*, on the purposeful design of actual texts or a mix of digital and physical artifacts. Vee describes the English side of the program as having "more kind of emphasis on hands on work," a "hands on … exploration of the technology." Aziz further speaks to the importance of project design, with students in his project seminar having to consider design as part of their final projects. Maverick describes a particular emphasis on making in courses like Composing Digital Media, with scaffolding from no experience to being able to create a fully animated project, a point Koob echoes about that course specifically as encouraging more of a maker-approach to projects. In my own teaching, as discussed in Chapter 3, I often have encouraged or required students to compose creative or purposeful, narrative-driven projects. As I write this chapter, three weeks out from the due date of the final for my current section of Narrative and Technology, I know a student plans to design a mod for a computer roleplaying (CRPG) game, enabling him to use the game's assets to design a standalone narrative experience as an exploration of how narrative is uniquely developed in computer roleplaying games. (I await evaluating it eagerly, even if it means having to purchase and learn the interface for a game from a notoriously unapproachable genre.)

The other major element of commonalities among course design was the desire to deal with and discuss technology as it is relevant to student life right now, in keeping with the recognition of digital ubiquity described in Chapter 0. Bortnick emphasizes the need to explain "to the students why it's relevant to them right now." He engages students with "big social problems" and the influence of "both technology and … narrative," relating the discussions of technology in society

to the theoretical framework of narrative encouraged by a course like Narrative and Technology. Writing becomes an important part of this process for Bortnick and Koob; Bortnick says that some classes, like Digital Humanity, involve several short writings about the role of technology in students' lives, and Koob emphasizes that "writing is still important to me," in addition to his emphasis on "new experiences with technology, thinking about the study of technology." Bortnick describes an interaction with a student that resonates with my own experience; he paraphrases them as saying "I always come out of the classroom with my head like this [heavy, expanding hand motions around head], but I'm really glad that we're talking about these questions, because they're really important to like, the world." In my own experience, a SCI-side DNID student taking my Digital Humanity course in her senior year noted that the conversations we were having about what it means to have intelligence and how AI functions felt essential and missing from her SCI education more broadly.

But again, it is worth noting that there is no sharp distinction between DNID and non-DNID courses. DNID courses are built out of pre-existing courses, and thus accomplish goals set before the major that are at least hopefully in congruence with the major's goals. When asked about distinctions between DNID-affiliated and non-DNID-affiliated courses, Babichenko and Rogers both emphasized the lack of distinction besides a couple of courses that were designed for DNID majors in particular—a small fraction of courses that count for the major. Babichenko emphasizes that DNID students taking affiliated SCI courses go through the same learning process as the non-DNID students, and Rogers emphasizes that, as per the norm in English courses, students might come to a class from a variety of backgrounds and perspectives—which is a benefit to the program, as it can bring in more students and creates cross-disciplinary classrooms.

4.4.2 Assigned Content and Instruction

Zooming in from course design, the way materials for syllabi and assigned content are selected and taught bears discussion, as it is in this selection process that we can see how the course-building work of instructors speaks to the cultural integration that DNID provides. In this section, I want to speak to how professors identify both humanities and more technical resources for teaching in class, how they approach teaching humanities and technical information, and the distinctions or commonalities they identify in assigning and teaching about such content.

In terms of selecting humanities-rooted texts, e.g. literature/literary texts or scholarship from a humanities discipline, the approach does not appear to differ from selecting such materials for English courses in general. Maverick, in his approach for a course like Narrative and Technology, identifies "foundational [works] toward narrative theory," which he teaches in "combination … [with] things that I just like to teach." An example he provides is Robert Coover's "The Babysitter," a difficult narrative text; he identifies the text as useful for a course like Narrative and Technology because, despite being a printed short story, later conversations in class make it newly relevant, e.g. a discussion of ergodicism, which is usually applied to video games via Aarseth's book on cybertexts. FitzPatrick similarly notes that, if a course is going to talk about something like game studies, then she will be sure to find key games studies figures and discuss major discourses in the field such as the ludology and narratology debate, which I have likewise covered in Narrative and Technology.

Bortnick describes pulling resources not only from his own research performed during his dissertation work, but also from less formal sources like a podcast reading club that discusses horror and science fiction. This podcast has inspired him to include texts such as E.M. Forster's "The Machine Stops," a text that elicited rich discussion when discussed in my class this past

semester. Bortnick echoes Maverick's approach, being sure to identify relevant sources for the course, but also appealing to "a community of scholars or enthusiasts all around you." In my own experience teaching, I have felt this; I research the subject for a course I will be teaching, but I also appeal to works I am familiar with in my own life—e.g. a particularly complex, story-driven game that I think will engage students in questions about narrative and technology—as well as conversations I have with professors like Bortnick and Maverick, who have made recommendations to me for possible texts to teach when we've connected at, say, a game jam for Pitt students that featured many DNID majors.

The identification of technical writing, videos, or other kinds of materials often was a mix of appealing to popularly available resources, and explanatory tutorials and texts that the instructor is familiar with from their own experiences. For example, Maverick describes having initially considered textbooks for teaching several pieces of Adobe software, but then he ran into problems of assignment load for students. In addition, the software was changing too much, a problem particularly present with the new emphasis of regularly updating subscription models for "owning" software. Instead, as I myself have done, he appeals to sources like LinkedIn Learning or YouTube tutorials, an approach Koob also takes while mixing in his "library" of instruction materials.

There are some unique challenges facing an instructor of a DNID course that requires technical learning. While the experience of researching foundational theoretical or literary texts in a field for teaching a new class is a process familiar to most English instructors, there is not always an obvious solution for how to teach technical knowledge, whereas those on the SCI side are more likely to have formal training with a variety of relevant technologies. Often, it comes from an instructor's felt sense of what kinds of tutorials are out there and which would be most appropriate for students after evaluating as many as possible given limited time constraints. I myself had to do

this when finding the most minimal tutorial series possible for teaching students *Premiere Pro* in a short period of time, as I was not an advanced user of the software.

But integrating the two kinds of sources can be difficult but rewarding for instructors who feel prepared to do it. For example, Koob describes how he approaches teaching something like 3D in film. For an Introduction to Film course, he will "have them read kind of just a basic, general, here's maybe an overview of 3D history or something…." By contrast, in "[Introduction to] New Media, we read actually like, trade texts, so I have them read a mix of stuff from like *American Cinematographer* about literally, here are the important elements of what you need to know to shoot a 3D film, and here's how you put that together." In another class, he describes integrating histories of game companies with "nuts and bolts" assigned content, as this enables him to show "how we kind of need the humanities to really understand the technical." In this case, the assigned content can be put into conversation in terms of how the humanistic impacts the technical and vice-versa, but it requires knowledge of the technology, how it works, and what kinds of resources are available that might be put into conversation with each other.

When it comes to teaching this assigned content, instructors were generally quick to emphasize the putting into conversation of the humanistic and technical qualities of the work under focus for the course. Bortnick, who explains a minimal approach to teaching technical information, relates teaching Twine, which due to its user-friendliness is approachable for students. This frees up the amount of time spent on technical learning. Other instructors, though, emphasize the integrative approach to humanities and technical learning more strongly, similar to how Koob describes his process above. For example, Maverick describes teaching technical information in terms of how to use software in a course like Composing Digital Media, but emphasizes the purposeful context of use that the software enables, asking questions like, "how do we address

your topic using a blog? How do we address your topic using an infographic? How do we address your topic using a video?" Similarly, in describing her work for the same course, FitzPatrick relates giving students time to learn and play around with the software, paired with conversations about how and why to use certain tools. "Often in the classes I'm teaching we're focused a little bit more on, how can I just make this thing using this other thing? So that's when it becomes, why are you making the decisions that you're making? How are you using this technology?"

And clearly, this approach does not only exist on the English side of the program. To revisit the block quote excerpted from Babichenko in section 4.3.2, he views the teaching of technology *qua* technology alone to be rote and prone to failure in terms of engaging students. "[I]t's actually more, like, about situating the technological base in the context of a social problem," he says. "Like, I never teach technology for the sake of technology because that's kind of pointless." Whether on the SCI or English side, there is a sense that the teaching of technical and humanistic information are mutually beneficial, and even essential for providing the full context. Across the various instructors I spoke to, I see this integrative approach in play, fitting the broader sense of what a STEM-humanities collaboration can offer through something like DNID, where highly motivated faculty and administrators see the importance of interdisciplinarity for students.

4.4.3 Out-of-Classroom Work

In this section, I want to briefly speak to the other side of those teaching DNID courses, which is their high degree of investment in the program and supporting students in it. While coursework is essential to this conversation, the work that the interview subjects for this project do outside of the classroom is also important to note, as that kind of motivated work has been important in supporting the program.

Maverick, for example, describes participating in an array of service work for and/or via the program. He has participated in community outreach programs teaching code or related technological practices to local youth; he has served as a mentor and judge at a yearly game jam that is often comprised disproportionately of DNID students; and he has attended showcases, e.g. for students who completed an internship at a local game development studio. Further, during a term where director FitzPatrick was on leave, he managed equipment in an associated digital lab for the program, coordinating with IT to ensure newly delivered computers were set up for students' needs, and fostering programming development, e.g. workshops on software packages.

Bortnick has also contributed to the game jams, and additionally hosts a monthly reading group about games that is attended by DNID students. Further, he is active about identifying people in the game industry who might come speak to students, relying on his presence in the game design community and attendance of related events to bring in these kinds of resources. Koob also describes developing programming and running a workshop series, while FitzPatrick mentions "working with students on independent research ventures," which fosters the creative work of students in the program.

Combined, it is clear that those involved in DNID are motivated to support students not only in the classroom, but outside of it as well. As a result of the program's incorporation of technical learning and digital software into its central focus, there is massive benefit to the kind of service work these faculty do for students beyond the classroom. The more formal mechanisms for recognizing and rewarding this kind of work, the more instructors can provide that kind of support.

4.4.4 DNID Students

Finally, I want to note what kinds of students were anticipated when designing the DNID major, and how the people I interviewed perceive the DNID student body, as I believe this will help demonstrate the kinds of students who can make an interdisciplinary, cross-cultural program like DNID succeed to the degree that the program has so far.

Both Vee and Rogers express that, while the decision for a cross-disciplinary program was prompted and encouraged by deans and administrators, the possibility for the English-SCI collaboration stemmed from the needs and desires of an existing student body. Vee relates that early leads in developing the program were "looking for students who were interested in … the human side of design," but more importantly, they "were thinking of students in English who wanted to do more technical work" but experienced a lack of opportunity to do so in English broadly. Rogers specifically asks and answers, "where did this major come from? The students created it themselves. The students led us to giving them a path." I find it significant that deans, administrators in English and SCI, and students themselves all saw the need for an integrative, cross-cultural program. As discussed in section 0.1, there is an ever-increasing crossover between the ways of seeing that STEM and humanities offer as enabled by digital technology, and this has impacted the way universities manage disciplinary boundaries. From top to bottom, people in academia see the needs demanded by this era of digital ubiquity, and the mutual excitement to enable this work is important for understanding the design of DNID and how it has managed to foster such positive relationships across English and SCI.

And indeed, the students in the major now fit the initial vision of who could be supported by a major like DNID. Rogers describes attending the Digital Media Showcase, where many DNID students present projects they have worked on and seeing the kind of work desired by the program,

e.g. “[c]reating digital narratives, building interactive products that draw on fundamental things we do in an English department.” Babichenko similarly “see[s] students really, really understanding like, the value of different skill sets that they bring to the table,” e.g. “students who come from [a] purely English background collaborating with students who come from information science or computer science backgrounds.” FitzPatrick describes DNID students as “theory-energized,” as “[t]hey are invested; they are driven; they want to be building these things and they see a really unique and important avenue for kind of, the nexus that we exist in, in our program.” Students had a felt need prior to DNID to integrate the technical and the humanistic, and DNID has managed to provide this opportunity to students through its integration of both cultures at the level of curricular and course design.

Aziz adds that DNID students “have a kind of identity.” While many students do see themselves as falling more on the English or SCI side of things, he notes that “they coexist really, really well and learn from one another really well and complement one another’s skill sets well,” reflecting an ability to work collaboratively. Others that I interviewed were similarly glowing about what they identify as strengths of DNID students. Maverick relates students regularly going above and beyond the minimum requirements in an animation project. Babichenko describes DNID students as being “a lot more creative,” a point Koob echoes when describing them as “really knowledgeable and interesting. Like, they have a lot of … neat arguments to make.”

That said, both also mark current limitations that the student body faces. Babichenko notes less of an emphasis on career goals that their skills can scaffold into compared to SCI students, and Koob explains that students often have trouble taking their well-formed ideas and scaling them up to a larger project. While there is clearly room to improve in supporting student work, the motivation of students, paired with the energy of faculty and administration, contributes to a

program where there is excitement for cross-cultural learning and collaborative work—an important part of digital project development, as working with digital technology for projects often involves identifying one's own shortcomings and leaning on other people's specializations to foster one's own work.

4.5 English Program Sustainability

The previous sections, 4.3 and 4.4, outline the creation of the program; how those inside it perceive interdisciplinarity and cross-cultural work; course design; in-classroom teaching and out-of-classroom student support; and perception of DNID students. In this section, I build on these observations by relating them to the successes of the program, and what the program's history might reveal for avoiding issues of a national decline in enrollment for humanities programs. This is an issue English has had to face in particular, as described in section 4.2.

The sub-codes in this section were focused on *program successes* and *program challenges*, which will include reflection on the previous sections, but will additionally consider challenges and successes directly addressed by interviewees, namely in terms of *career prospects* and *staffing*. Finally, I will discuss *future directions for the program* identified by interviewees. In total, this section will synthesize some of the exciting work being done in the program identified in sections 4.3 and 4.4, and additionally consider opportunities and difficulties that such a program creates and faces.

4.5.1 Program Successes

There is one notable marker of success that several interviewees commented upon: enrollment and recruitment. DNID, starting in 2019 with fewer than thirty students (Rogers), has expanded to include roughly 150 students in 2023 (Rogers; FitzPatrick). Aziz contrasts this with other English programs: where other universities are experiencing the woes of "a shrinking English department in a school that's cutting the humanities," English at Pitt has been successful in maintaining enrollment, which DNID has contributed to. He adds that "it's not because the humanities have sold their soul for a mess of pottage," but rather because the kind of work being done is exciting and cutting-edge; for example, beyond the student level, he highlights the work Vee herself is doing with generative AI, setting a tone for the program of sophisticated integration of human and technological questions.[32] Student engagement, it's worth noting, is high: Vee highlights that "[i]n the reviews that [students] write, you know, the kind of surveys and things like that, they seem to like their classes; they like their teachers; they are interested in what they're doing," with students commenting that "this was a major they would have always dreamed of." Even further, she notes that Pitt has directly recruited students who have come to Pitt *for* DNID, buoying the program along with its ability to recruit students taking courses in the program, e.g. for gen-ed requirements. As Vee says about the design of the program, particularly in its formative days, it stands out as unique, as much of the integrative work offered in DNID occurs elsewhere "only at the master's level, or, you know, only [for] game design."

---

32 It is worth noting that interview subjects repeatedly made reference to each other's work in this way, whether discussing their scholarship, teaching, or other work in the program. The sense of collaboration and mutual respect amongst colleagues certainly helps to sustain a program like this.

In the survey taken of students who were taking DNID-affiliated courses—but not necessarily DNID students—nearly seven in ten signed up for the course to fulfill a gen-ed. When asked if the course "changed your immediate or long-term career or educational plans," while many students indicated that it hadn't, several also indicated a shift toward considering DNID. One student writes, "I found out that I just loved DNID, and this class made me realize my passion for it"; four students indicate changing their major to DNID or adding it directly in response to the course. Additionally, in the survey students were asked if the course they took made them "want to take more classes outside my academic major." Over two thirds of students indicated they agreed or strongly agreed (67%), compared to the remainder indicating either degree of disagreement. Notably, even more students responded in the affirmative to the question of whether the class made them "want to take more classes in the liberal arts" (79%). While I was unable to acquire more detailed enrollment information, as described in section 4.2, this survey indicates success at capturing at least some students taking courses, often to fulfill gen-eds, by introducing them to DNID or helping them see how the program could benefit their career goals.

Many of the people I interviewed also pointed out that DNID successfully encourages modes of thought that are fitting for our contemporary moment. As described in section 4.3, Aziz was keen to draw this out. He says, "I really think DNID is a very smart response to the way in which language is produced and is circulating *at this moment*" (emphasis added), and notes the program "captures the right sort of people," being "legible to students" who are clearly interested in the integrative work the program offers. Along with key features like learning project development, DNID courses encourage students to bring together their technological understanding with what Aziz calls "students' concerns, identity," an attempt to "respect particular literacies that students bring to the classroom." That is, students "don't stop being a member of

Rainbow Alliance [an undergraduate LGBTQ+ club]," or "being a Vietnamese person who goes home and makes spring rolls with her mother." By recognizing the value of not just technical skills or learning, and not just humanities modes of inquiry, but also the positionality of students, DNID is set up to be, in Aziz's words, "one of the places in which we're going to be evolving the standards of the social conduct of computing jobs and jobs that intersect with computing in the future."

Rogers, Babichenko, and Maverick—representing a spread of people in the program, from administrator, to SCI-side instructor and administrator, to English-side teaching professor—each highlight such modes of thought as well. Rogers states that "digital narrative is a way of thinking about the ways that a lot of people compose narratives *now*" (emphasis added), as even traditional printed narratives are shot through with digital ubiquity, by our "read[ing] on devices all the time, every day." Babichenko, as referenced in section 4.3.2, comments on students who understand "the value of different skill sets that they bring to the table," with students once reticent toward math and programming finding new ways to approach the subjects once they have taken on contextual meaning through classroom practice. In describing the momentum of contemporary society, Maverick describes the "need to have a world beyond where we are," which is to say a world where human questions of ethics and past discourse on technology are brought into the conversation of technological progress, facets of the conversation that are "largely lost on" major figures in tech. Across these comments, I see a recognition of the success of integrating the two cultures. When taken into consideration with the design of the program—intended to appeal to students taking gen-eds and offering students an opportunity to integrate English and CS without simply double majoring—I believe that students see the value in such interdisciplinary work and

are even hungry for it, as the success in enrollment and attracting the right kind of students so far indicates.

I will speak more to employment in section 4.5.3 in regard to future directions for the program, but it is worth noting that despite the relative newness of the program, there are indications of success at the level of post-undergraduate work. Rogers describes a standout example: he helped organize for a local gaming company, Simcoach Games, to take on seven interns from the program, working for a "summer on creating games for neurodiverse, neurodivergent teens, especially teens as they're heading to college." Of the seven interns, five became full-time employees of the company; one of the others had not yet graduated, and the other took on another job offer instead. This indicates that "Simcoach valued the students," and that "we created something that has appeal to external entities." Even in the limited scope of local game design companies, the integrative, literacy-respecting education that DNID provides clearly has value outside of just the program, and even outside of game design jobs for major studios. The kinds of work students can do coming out of a program like DNID is desired, and even further, students learn career possibilities they might not expect. In speaking of Simcoach Games, FitzPatrick highlights a student who prior to the internship did not realize she enjoyed and was skilled at team management work. She grew take on more work in that position as part of her professional development, a potential new orientation for a career rooted in work began in DNID.

The DNID program has been successful in terms of enrollment, integrating the two cultures, and—although it is still too early to speak to employment at the broader level—appealing to potential careers that students might be placed in. In an era of declining enrollment for English and the humanities, well-considered and -structured interdisciplinary work like DNID can appeal to students, teach them how to work in an interdisciplinary environment and the broader world,

and even help them identify opportunities for employment that pull on their technical and humanistic experience and knowledge.

4.5.2 Program Challenges

While the energy in the program, as captured by my interviews, is one of collaboration and excitement for student work, there are still challenges that were identified, the bulk of them dealing with questions of administration. First and foremost amongst these challenges is staffing, a problem highlighted by Vee, Maverick, Rogers, and FitzPatrick. Speaking as a teaching professor hired for DNID courses, Maverick notes that ultimately, DNID is still a "small program … there's [three or] four of us devoted to it full time?" FitzPatrick pins this problem on the administrative work she must undergo. "I have to be really collaborative," she says," in the way that I try to get things on the schedule, and the way that I try to figure out who our instructors are going to be, and the way that we try to get instructors to rotate through different classes, because it's not only them working for my program. They're also working for other programs at the same time." There is a real desire for DNID courses; Rogers states that they "could run ten more sections of Composing Digital Media a year if we had the people" at the staff level, calling it a "perennial concern," as "[w]e keep hiring. We keep growing." But that desire cannot necessarily be met based on current staffing and funding lines.

This is not a problem solved by just hiring more English instructors, either. As Rogers adds, when hiring for something as specific as animation, there is a need to have "somebody who can really … give both a critical and production focus to how we do animation. … So faculty expertise is as much of an issue as numbers." As Rogers adds, he could teach a wide variety of traditional literature courses with some prep, but he would be completely unprepared to teach many

DNID courses based on his experience with technology—a feeling I can relate to looking at the full course offerings to students. Instructors need skills and the ability to contextualize those skills, which means hiring people who exist at this unique intersection. Additionally, there should be opportunities for faculty development programs. FitzPatrick states "we also want instructors who are willing to either admit that they have the chops for different technologies … but also instructors who are willing to learn these things, because they see how they might fit in the classes that they're teaching." Instructors need to have extant skills or be able and willing to learn relevant technologies, which can be quite a high load of learning that an instructor may or may not find relevant for incorporation in the courses they teach. As Vee puts it, "you need people on both the English and the SCI side who are technical- and humanist-oriented, and kind of understand what the major is about. And that's a hard thing. That intersection is hard to hire for."

Staffing does not have a simple solution of "hire more people" for a program like DNID. It involves evaluating the skillset of extant staff and hiring instructors who can do the kind of cross-cultural, integrative work the program demands. Given that few instructors will be fluent in a wide variety of technology that they can speak to as needed, there will be necessary administrative work to hire instructors who can fulfill certain gaps in technical knowledge while still being well-suited instructors for courses that are often capped at under twenty-five students. Further, there should be opportunities for faculty development, to help extant instructors understand how they might contribute to such a program by appealing to their technical skills or offering opportunities to develop them. DNID's problem is not an abundance of teachers with too few students; it's the opposite. Managing this issue is far from simple when it comes to managing the actual teachers who can do the work that the program relies on.

Administrative organization and barriers are also highlighted as areas of difficulty that are worth noting for those looking to replicate the success of the DNID program. Most notable is that, while DNID is placed within English and SCI, it is not a typical English program. The director of the program, FitzPatrick, is "not fully located in any" of the major English programs (Vee), which makes it stick out as different from, say, literature, or composition, or film studies. This issue reinforces the staffing issue, where instructors for highly-enrolled DNID courses are often located in programs that are not DNID, subject to those scheduling needs, which requires weighing which programs have which professors available for DNID courses while also meeting the other, broader needs of their program. FitzPatrick emphasizes many bureaucratic conversations, e.g. advising, as I'll speak to in a minute, or how to design capstone sequences to continue student development as they reach the end of their undergraduate careers.

In addition, when designing a cross-disciplinary and even cross-school program, there are other nuances that Rogers highlights about not overstepping into other humanities programs' terrain. "We're an enormous department," he remarks, as English is the largest humanities program at Pitt. "A lot of other ones are very small, and they would be upset if we were to just kind of teach their material, in the same way that if we looked at the curriculum of the Spanish department and just stole all the books they were listing and said, 'Hey students, we'll teach them in English if you want to take them over here.' That's being a bad neighbor." Vee notes that there was a desire to include more programs that could contribute to the collaborative nature of the major, but when you cannot be sure that a course will be consistently staffed or have sufficient enrollment, it makes this additional cross-disciplinary work more difficult, as the major might have requirements that are not offered often enough to be reasonably met. These bureaucratic difficulties are real and limiting to the program, so even while there has been success in bringing together English and SCI, it is

worth noting the array of possibilities that could not be included, such as the inclusion of an obviously relevant program such as Studio Arts. This is not due to bureaucratic malice or negligence, or a lack of care on the part of anyone in any of the relevant programs. It is simply a difficulty worth noting for the program that arises out of its institutional location, which is likely to be relevant for other programs considering implementing a program like DNID.

Finally, there are difficulties that arise at the advising level when trying to help students navigate a cross-school program. As described in section 4.3.1, early problematic questions included how students find advisers (FitzPatrick), and communication or advising errors that result from, say, advisers in English lacking complete, top-to-bottom understanding of the SCI side of the program (Babichenko)—an understandable problem when considering the higher number of pre-requisites in SCI compared to English. Babichenko adds that this problem is bidirectional: "we need to do a much better job because SCI Advisers don't quite understand the Dietrich side of things and Dietrich advisers don't quite understand the SCI side of things." FitzPatrick indicates some optimism for dealing with this problem as the program grows, however:

> I also think it's been hard for us as an administrative team, right, to fully understand the way things might affect each other or how students might be moving through the program. And so now that we've got our feet wet, right, and we've been able to see growing classes get through the program and graduate, we have a better sense of where, okay they're gonna need some more support as they start to choose their capstone experiences, right? Okay, starting in their sophomore year, we really need to make sure they understand that their SCI-side classes have pre-reqs, because otherwise they're going to go to choose electives as upperclassmen and not be able to get in, right?

While the problem can help be ameliorated by increasing understanding of the bureaucratic norms and limitations students encounter, it is still worth noting that interdisciplinary, cross-school programs require advisers who can understand not only their own program's norms, but also a potentially very foreign set of norms from other programs.

4.5.3 Future Directions

DNID is still a young program, and already those involved are identifying places for expansion and improvement. For example, Vee notes the program has the potential to "expand into a master's" or something similar, or even a 4 + 1 program, where students spend an extra year as undergraduates to get more formalized training in advance of seeking employment or further academic work. At the smaller scale, both Vee and FitzPatrick note that student tracking will improve as the program increases in longevity, giving a better sense of what students find most valuable in the program and the gaps that they need addressed as part of their undergraduate education.

The subject discussed most in terms of future directions for the program dealt with employment and internships. While Simcoach Games provides an exciting success story for the program, there are still many questions and concerns about what DNID offers for students in terms of post-undergraduate work. There was consideration on both the English and SCI side during the development of the program of what employment opportunities would exist for students going through the envisioned major. For SCI, Babichenko relates conversations with people "in the industry," such as with an *Atlantic* editor, about the kinds of employees they sought, e.g. people who could not just visualize data but "understand the underlying data." Courses that were chosen as candidates for DNID were in part tied to the discoveries from these conversations, rooted in opportunities in industry. Rogers also "interviewed[ ]potential employers" and received similar feedback: "Time and time again, they said, 'Somebody who has some hard skills in tech, but for God's sake, please, be creative. Know how to write. … Know how to solve problems with design, et cetera.'" Vee adds that they considered, "What jobs do we want our students to get?" which then provided insight into course selection. While there is insufficient data to indicate how successful

DNID alumni are at acquiring jobs in a variety of industries, it is clear that the program was designed with these questions in mind. As much as the program integrates contemporary modes of thought, it also brings with it a consideration of the context in which undergraduate learning occurs, which must include questions about professionalization.

Babichenko relates a moment from an early meeting between SCI and English people that, while intended as a joke, points to why questions of professionalization are so important in this interdisciplinary space. As he asked "'What kind of jobs do we expect our students to get?', somebody from the English side kind of half-jokingly said, 'We don't really think about, you know, specific jobs.' And so like, to me, that was the only kind of cultural thing that didn't quite make sense." To be clear, this comment reads as ironic and containing a self-aware jab at the perception of employment opportunities for English majors, and Babichenko frames it as such in word and in tone in the interview. As indicated above, consideration of industrial opportunities was part of the conversation on both sides, and that motivated the collaborative development of the program in ways that both sides agreed upon. But FitzPatrick reaffirms the cultural difference that the joke underlies: "SCI's a little bit more driven toward thinking about and with industry, which is where a lot of our students want to go. … And I think that that's a really interesting element that some of our classes and instructors focus on, but not quite as overwhelmingly on the English side." Thus, it is important to stress that part of the integration of different programs or schools in order to encourage interdisciplinarity does have to consider cultural differences, such as how one program emphasizes the relationship between a degree and a specific job in a relevant industry. If Simcoach Games is any indication, the openness to this conversation about employment opportunities has set the program up well to support students not only in integrating

certain ways of thinking, but finding ways to make those ways of thinking marketable after graduation.

Those in the program seem optimistic about employment opportunities looking forward. Koob describes a sense that the approach to traditionally SCI domains like web and game design from the critical perspective English provides will lead to stronger resumes. Aziz describes some offhand examples of students who have used DNID to pursue broader goals such as museum curation or advocating for accessible design, although the full breadth of possibilities is yet to be realized. Maverick notes a potential future direction for the program in terms of employment: many students are interested in game design, but he tries to emphasize to students that "[t]here are options. You could do more than just code video games. That's not the only thing we do." As an example of another avenue that could be better-emphasized and pursued for further development in the major is user experience design; "[t]here's a lot of possibility for UX as a discipline," a discipline he is well-skilled in and has the industrial experience for guiding students in that regard. A part of the continuing conversation of employment opportunities for DNID students, then, will also need to include more consideration of the full breadth of opportunities available.

4.6 Looking Forward

The DNID program reflects the work this dissertation argues is well-suited to help English programs succeed in an era of digital ubiquity. While there remains a cultural divide between STEM and the humanities, there is also a high potential for interdisciplinary work. There is potential for work that integrates the two cultures by co-attending to matters of mechanism and meaning when it comes to digital technology. While the previous chapter outlined my own

integrative approach in my teaching, this chapter has sought to demonstrate how this approach might be enacted at the programmatic level. I began my graduate work before the DNID program had formed, and the theoretical work done in this chapter was not done in reaction to DNID, yet I believe that the interviews that comprise much of this chapter demonstrate that my approach is in alignment with the program as a whole. Clearly, those on both the SCI and English side of the program see the value in each other's work, and students are reaping the benefits of pursuing their interests while engaging with those interests from the perspective of both cultures, guided by a group of energized faculty, advisers, and administrators who wish to foster their cross-cultural work.

Such a program, I argue, is not only timely and important for pedagogically preparing our students for a digital world; it is also an opportunity for the humanities to grow with the times and make itself an essential part of contemporary discourse, while appealing to students who see the value of both lenses and encouraging their work at these intersections. The program certainly has challenges and room for growth, but as I believe this chapter has demonstrated, it can provide a corrective to declining English and humanities programs by making the perspective they offer an essential part of the work being done with digital technology in academia, industry, and everyday life.

Those in other universities looking to replicate the success of the DNID program might consider several key factors, then. First, I cannot understate the coordinated, collaborative effort among administrators, deans, and faculty to offer students something valuable to them, with an understanding of how interdisciplinarity between STEM and humanities disciples could benefit their lives and careers. As this dissertation has argued, this cross-cultural work is an opportunity

for students and pertinent to the present day, to student's lives *now*. Having a diverse team with this shared understanding can create the momentum needed to overcome bureaucratic impasses.

These programs will certainly run into potential issues. The emphasis on designing a synthetic curriculum is a useful starting consideration to decrease the amount of work for students and faculty in considering what defines the new program, especially when it can appeal to existing student populations who might be interested in the interdisciplinary avenues opened to them. There are also difficulties to prepare for; for example, staffing. How do you appeal to your current teaching pool, encourage faculty development to increase the range and number of sections for courses that can be offered, and then hire new instructors to fit certain niches while maintaining the broader pedagogical ethos of the program(s)? The DNID program provides some detail to the kinds of struggles and solutions that can enable the creation of a successful interdisciplinary, cross-cultural program. For example, we see the need for strong administrative support; an appeal to extant resources—e.g. people already doing that cross-cultural work; classes that are at the intersections; and students who are pursuing these kinds of connections; a focus on student outcomes in terms of employment and other opportunities given the skills they develop; and an ability to navigate the litany of questions that come up from bringing together schools or departments that have different norms and advising needs

In the next chapter, the conclusion, I will provide a bird's-eye view of the dissertation, reflecting on the efficacy of its pedagogical solutions, and considering future directions for research on how to form a cross-cultural reply to our contemporary moment, both in terms of the omnipresence of digital technology and the need for a response that considers the mechanistic and meaningful aspects of the technology that now underwrites our society and everyday life.

5.0 Conclusion: A Teachable Moment

Let me restate and extend the list that began the previous chapter to provide a tidy summary, and then talk about something completely different.

The previous chapters have, in order:

4. framed the pedagogical approach of this dissertation as a means of addressing the cultural divide between STEM and the humanities;
5. further theorized this divide via the meaning/mechanism dialectic, which was then applied to subjects in STEM and the humanities;
6. related this dialectic to a pedagogical approach rooted in composition pedagogy; and
7. provided several examples of my application of comp digital pedagogy, an extension of composition and digital pedagogy in my own teaching.
8. Turned to what applications of comp digital pedagogy can look like at the programmatic level through a case study of the Digital Narrative and Interactive Design program at Pitt.

Anyway, this past week of teaching was a mixed success. I had decided to change up the syllabus to Narrative and Technology in several ways, part of which included the last, pre-working-on-finals week of class being focused on a single game. I was hoping to shift from the focus on several different games, only ever played across two class sessions at most rather than the three times the class meets weekly, to a single game, diving deep into the text as we had the previous semester when we spent weeks reading *House of Leaves*. Plus, given that the game I chose, *Eliza*, deals with a contemporary issue—automated digital therapy—I had figured that the story combined with multiple endings would elicit a class discussion on par with the exciting ones

we'd had about "The Machine Stops" or *AI Dungeon*, which uses ChatGPT to roleplay with the user.

But while we did cover the important topics, the energy wasn't *there* nearly as much as I expected. Part of this could be that we just came off talking about *Among Us* and *Minecraft* in the context of emergent narrative, which was admittedly more fun as students played these games together in groups. Part of it could have been that it was the week before Thanksgiving break, and students had more on their minds than talking about a reading-heavy, relatively low-interactivity game dealing with relevant cultural topics at nine in the morning. But I think, instead, it has made me reflect on the fact that students—while finding the subject matter and characters interesting—found the lack of interactivity in terms of fewer system mechanics compared to, say, *Minecraft* or other games we'd played in the previous weeks, to be limiting to the game as a whole. Sure, they could pick from several different endings, but those were just different perspectives on the game's questions about digital therapy and the modern West Coast tech scene. They didn't feel like real expressions of what they wanted to do as players, as participants in the story.

I think that when designing the syllabus, when I decided on a game we would spend more time with, I thought that anything too systems-heavy would be alienating to students who had less experience playing video games. But I think that I underestimated them; they had learned to play games that involve exploring a 3D world through a first person perspective; they had played games that involve crafting systems; they had played games that involve both moving an avatar in 3D space and typing text into interpreters, bouncing off the technology as part of the roleplaying experience; they'd navigated interfaces that simulate old messaging systems and modern smartphones as part of delivering a narrative experience. If I made sure to provide proper context for the game and how it works in class, and dedicated some time to playing it together so people

could learn the controls—which I already do for any game we play—then not only would students have likely been capable of playing a more complex game, they might have found the conversation more engaging. As a result, over this past break, I've been exploring games with more simulation elements and ability to impact the story in complex, personalized ways; they will be harder to learn and write about, but I think that, with proper pedagogical framing, it will lead to more interesting conversations.[33]

I hope it's clear that I don't view my pedagogical approach to these classes as solidified. Every time I teach a class, I learn something new about how to best engage students' interests and elicit useful conversations and interesting compositions. When I started teaching, I barely knew

---

33 For example, although I do not think I will use this game specifically for a variety of factors, I recently played *I Was a Teenage Exocolonist*. While the game still has some visual novel elements, it has far more simulation elements. You choose what kind of person you want your character to become over ten years of their life, decided a month at a time. The activities you choose to do reveal not only unique story moments, but they also impact your stats, which can inform what options are available to you later. Further, if you choose to say, spend your character's youth studying engineering and the humanities, you will spend more time with some characters over others, leading to conflict when you might be interested in befriending someone else. Further, along with different ending story beats that are informed by player decision-making, a player's story is further personalized by their profession and the relationships they built over the game. While the game is quite systems- and simulation-heavy, it does so in service of telling a wildly variable narrative, personalized to the player's choices. As indicated, I was able to take engineering and humanities courses over playing sports or working on the hydroponics farm; later, I could teach students as my character had grown and the previous professor had, due to some inaction of mine that I was unaware of, died. I achieved "The Professor" ending, and felt deeply satisfied by the person my character had become as described by the end-game summary. I think such a game would engage my students more; while it is more difficult to learn and play, it might better fit their expectations of a truly interactive narrative experience.

anything about DNID, and now I feel like my approach to teaching has found a space where it can be fostered and further developed. I do think, though, that this dissertation establishes a foundation that, *hopefully*, escapes the idiosyncratic and instead offers ways to think about teaching or program design for others who find themselves at the intersections of digital technology and the humanities, who view themselves as "interloper[s] in the professional languages of other discourses," to quote Jeff Aziz, the DNID adviser I interviewed for the previous chapter.

The central concept to this dissertation is *comp digital pedagogy*, defined in section 2.0 as shorthand for "this dissertation's approach to digital pedagogy." Well, more usefully, it's defined as an extension of digital pedagogy via composition pedagogy—in particular the concepts of *transfer*, *genre*, and *discourse communities*, as discussed in the rest of Chapter 2—and a certain understanding of *computer*, c*omputation*, and *computing*. That understanding, defined in section 0.2 and expanded on in Chapter 1, requires looking at digital technology simultaneously as a material object, as a certain kind of technology called an *information processor*, and as a form of thinking and use deployed by people as they encounter the device in varied contexts.

The emphasis on the technological and humanistic elements of the computer serves two purposes: first, it helps to address the two cultures divide addressed by C.P. Snow which, as established in the introduction to the dissertation, remains despite some notable changes six decades on. Second, it supports the main work of Chapter 1, which is theoretically expanding on Brian Cantwell Smith's notion of *meaningful mechanisms* as essential for studying computers. This approach, which dialectically considers the meaningful (i.e. clearly interpretive, human-defined) and mechanistic—or aspects of functioning that appear closer to some objective process outside of human perception—elements of technology, integrates the perspectives of both cultures

to fully frame the context of the digital technology that is now ubiquitous in our daily and academic lives.

Although I provide several examples of what this dialectical way of thinking looks like in section 1.1 to demonstrate its utility—analyzing subjects from the philosophy of mathematics to understanding the viewing habits of modern fan communities—Chapter 2 re-centers this conversation to focus on its pedagogical application. Given that part of the changed nature of the cultural divide is that there is increased opportunity for interdisciplinarity in the academy, and that composition instructors have long had to consider how to teach a specialized subject in service of a general student body for later use in life, scholastics, and work, I argue that undergraduate instruction is an ideal space for teaching with this dialectical approach in mind, as it can now support students in understanding and purposefully using digital technology much as composition classes have done for writing. This is the collective vision that comp digital pedagogy is meant to communicate: that undergraduate pedagogy is a chance to address the cultural divide via digital technology, an exemplary meaningful mechanism that is necessary to address in the classroom as it is relevant to our students' work and lives.

Chapters 3 presents what comp digital pedagogy has, thus far, looked like in practice for me as an instructor. I have tried to take this approach to understanding digital technology and addressing it pedagogically in my own work, to mixed success, as my experiences from Composing Digital Media, Digital Humanity, and Narrative and Technology indicate. But I see it being effective in engaging students and in providing them a valuable set of skills, both in terms of familiarity with software and ways of thinking about computers. I think that not only does comp digital pedagogy engage students in topics that interest them; it respects their ability to understand the humanistic and technical components of the conversation, setting them up for considered use

of digital technology in later projects. The focus is on what this approach offers for students, and I think that early indications are that it does offer something useful, although as my story in this conclusion indicates, it's very much a work-in-progress.

Finally, Chapter 4 looks at how the DNID major offers a programmatic implementation of many of the ideas at the core of this dissertation. As expressed through evaluation of interviews with several key figures in the program, it is focused on supporting students who want to do interdisciplinary work, integrating STEM and humanities cultures by integrating STEM and humanities schools and programs. While there are growing pains along with room for further growth, I believe that DNID presents a model for not only bolstering humanities programs in this digital era, but also demonstrating the value of supporting cross-cultural work. More importantly, it shows that students see this value, indicating that I am not lost in theory-land while students look anywhere else for getting their degrees' worth out of their college experience.

The future of DNID, of my own teaching, and of "this dissertation's approach to digital pedagogy" are in flux. In a sense, each of these things began in roughly 2019, and already the world looks quite different, whether speaking about digital technology or just about any other facet of daily life. How can DNID continue to grow as a program, taking on students, addressing staffing needs, setting students up for meaningful employment, and perhaps enabling further interdisciplinarity through the integration of other programs, despite bureaucratic limitations? How can I ensure that I teach my students just enough about the nuts and bolts of whatever technology or software we are discussing, *and* that my students correlate that learning with the human uses of the technology or software they themselves will partake in? How can I design my syllabus and select course materials to best foster these conversations?

I hope that, in the unlikely event that someone outside of my committee reads this, that the practical applications of the theoretical work are clear, and that others can take them and use them to inform how they teach subjects or texts they are interested in. As I start to share my teaching more, e.g. through *TextGenEd* or an upcoming meeting of instructors in an AI teaching cluster, I hope to in turn hear from others how my approaches, and perhaps the assumptions underlying them as outlined over the past two hundred or so pages, might be refined, improved, or expanded. For example, to Aziz's point that we want to respect the literacies students bring to the classroom, I wonder: how can we best design projects to teach students how to purposefully use their chosen medium or technology, while allowing their use to be informed by who they are coming into the classroom?

I further hope that the DNID program grows and designs clearer solutions for addressing staffing needs, and that documentation on the program becomes more detailed such that other programs can look toward its design for implementing such a program at their own university. I believe that the work of DNID is exciting and the most interesting vector explored in this dissertation for implementing the ideas of comp digital pedagogy, but it is still one program at one university. To see others share their experiences developing such programs, with or without the influence of knowing about DNID, would contribute to a more robust conversation about how cross-cultural work, particularly between the humanities and computer science, can be the starting point for changing what programs universities offer to students in this digital world.

Recently, the news site *Axios* ran an article providing evidence for a "comeback" by the humanities in the midst of climbing STEM enrollment (Kingson). They note that there is far from a wealth of optimism for the humanities, but offers some points for consideration. First, Kingson provide some counterexamples, such as University of California Berkeley's climbing humanities

majors, which Sara Guyer, a dean at the university, attributes to the ability of the humanities "as a way to make sense of our current moment" (qtd. in Fullerton). A recent executive order has likewise tried to reaffirm the value of the humanities in the present (Biden). We can see an approach that emphasizes the relevance of these disciplines today reflected in universities offering digital-oriented programs, such as the various digital humanities programs around the country, or commentary by an MIT dean, Augustín Rayo, about the "mutually informing" perspective that STEM and the humanities can bring.

Part of speaking to this present moment is recognizing, as discussed in section 4.5, the need to focus on what value a program provides for students. *Axios* quotes MLA director Paula Krebs as saying that improved enrollment is occurring "where there's actual conscious attention to giving the humanities the resources they need to make a case for their value" (qtd. in Kingson). In one of the older articles cited in the roundup, from *The Atlantic* in 2018, president of Macalester College Brian C. Rosenberg, argues that English majors need to be reworked to be "more focused on what employers will immediately find attractive" (qtd. in Selingo). DNID offers a model of what identifying employment connections and opportunities to a curriculum can provide, particularly when a humanities discipline is paired with a STEM discipline through a focus on digital technology. Comp digital pedagogy encourages an emphasis on pedagogy focused on digital technology as the basis for identifying how to provide these potential correctives for English and related majors, but at the moment, there is still intense heterogeneity when it comes to approaches being employed. I hope that comp digital pedagogy can provide one way to think about approaching this issue.

I close on a final hope: I think my students and I both need cyberpunk fiction to stop being so relatable and relevant. It is getting both old and depressing.

Appendix A Syllabi Materials

Figure 2: Syllabus schedule for the video essay unit of Composing Digital Media, taught fall 2021.

<table>
<tr><td colspan="3">Week Six</td></tr>
<tr><td>M</td><td>10/4</td><td>Unit Two Set-Up</td></tr>
<tr><td colspan="3">Due:

• Do: Install Premiere Pro (or use computer labs), go to “Learn” on the left sidebar when you open the program, and complete the first five tutorials (“Premiere Pro overview,” “Importing media,” “Preparing your clips for editing,” “Editing your clips,” and “Exporting your project content”); these are short, so don’t stress too much
• Do: Linkedin Learning “Premiere Pro 2020 Essential Training,” Introduction, Sections 2 & 3 (skip Section 1) https://www.linkedin.com/learning/premiere-pro-2020-essential-training/launching-adobe-premiere-pro</td></tr>
<tr><td>W</td><td>10/6</td><td>Premiere Pro Work</td></tr>
<tr><td colspan="3">Due:

• Come to class with your audio reading from Week Three (either just the reading or the edited version you made) and three pieces of b-roll, images, or other audio-visual material (do not just bring three images; mix it up)
• Do: Linkedin Learning “Premiere Pro 2020 Essential Training,” Section 4 https://www.linkedin.com/learning/premiere-pro-2020-essential-training/launching-adobe-premiere-pro</td></tr>
<tr><td colspan="3">Week Seven</td></tr>
<tr><td>M</td><td>10/11</td><td>Workshops and Reflections</td></tr>
<tr><td colspan="3">Due:

• Do: Linkedin Learning “Premiere Pro 2020 Essential Training,” Sections 9 & 12 https://www.linkedin.com/learning/premiere-pro-2020-essential-training/launching-adobe-premiere-pro
• Make: Add effects to your video project and upload to Canvas (post on your group’s forum post)
• Write: Upload your reflective writing piece by the end of the day; note you will have time in class to do this (post on Canvas on Assignments page; this will be graded on a check/check-plus/check-minus system)</td></tr>
</table>

W	10/13	Video Essays

Due:

- Read: Wil Williams, "The best video essays of 2020" (read the intro and description of each video; you do not need to watch any videos) https://www.polygon.com/22202828/best-video-essays-of-2020
- Watch: Game Maker's Toolkit, "Making Games Better for Gamers with Colourblindness & Low Vision | Designing for Disability" https://www.youtube.com/watch?v=xrqdU4cZaLw
- Watch *either (not both)*:
    - Vox, "How the pandemic distorted time" https://www.youtube.com/watch?v=-S_f-huz-EU
    - Will Schoder, "Mr. Rogers and the Power of Persuasion" https://www.youtube.com/watch?v=_DGdDQrXv5U

Week Eight

M	10/18	Proposals + Studio Time

Due:

- Write: Proposal and Outline for Video Essay (post on Canvas on Assignments page; this will be graded on a check/check-plus/check-minus system)

W	10/20	Workshops of Introductions + Studio Time

Due:

- Make: Rough Draft of Introduction to Video Essay (~1-1.5 minutes) (post on Canvas on both the Assignments page ***and*** your group's forum post)

Week Nine

M	10/25	Workshops of Rough Draft + Studio Time

Due:

- Make: Rough Draft of Video Essay (see handout) (post on Canvas on both the Assignments page ***and*** your group's forum post)

W	10/27	Studio Time

Due:

- None; bring your draft to work on

Week Ten

M	11/1	Presentations
Due: • Make: Final Draft of Video Essay (post on Canvas on the Assignments page)		
W	11/3	Setting Up Unit Three
Due: • Do: Install Twine (see top right) https://twinery.org/ • Read/Do: "Twine 2 Guide," "Getting Started" section (you can ignore "Publishing on Itch.io" and "Adding to IFDB") https://twinery.org/wiki/twine2:guide • Do: Bring the text of your writing excerpt from Week Three		

Figure 3: Syllabus schedule for the critical databases unit of Composing Digital Media, taught spring 2021.

Week Twelve		
Tu	4/6	Forum Post on Feinberg
Due: • Post on the Discussion Board post regarding this week's readings (see either Discussions or Assignments on Canvas)		
W	4/7	CLASS: Introducing Critical Archives
Due: • Write: Proposal for Critical Archive (post on Canvas; this will be graded on a check/check-plus/check-minus system) • Read: Melanie Feinberg, "Two kinds of evidence: how information systems form rhetorical arguments" • Read: Find a digital collection at Pitt (https://digital.library.pitt.edu/collections); read the main page of it and look at how they categorize their objects • Do: Omeka Tutorials (only the following, as listed under Build a Website – Start Here!: "Publicizing your site", "Manage Collections," "Add Items," "Searching," "Change Site Navigation," "Manage Appearance Settings," "Manage Item Types," "Manage Item Type Fields," "Manage Tags" https://info.omeka.net/build-a-website/		
Week Thirteen		
W	4/14	CLASS: Workshopping Our Critical Archives

Due: • Do: Rough Draft of Critical Archive		
Week Fourteen		
W	4/21	CLASS: Critical Archives Wrap-Up
Due: • Do: Final Draft of Interactive Narrative + Author Statement • If it's your unit to present, be ready to do so!		

Figure 4: Syllabus schedule surrounding the genre generators activity in Digital Humanity, taught fall 2022.

Week 8: Thinking with Computers – Programming & Language

We've discussed encoding as a way to represent ideas, objects, places, etc. in language the computer can understand, but how do people leverage its resources to achieve certain goals? What is the history of this practice, called programming, and how has our understanding of it changed over time?

- Paul Ford, "What is Code?," *Businessweek*, June 11, 2015, **Section 1 (all), Section 2.2-4, Section 7.5.** http://www.bloomberg.com/graphics/2015-paul-ford-what-is-code/
- Thomas Haigh, Mark Priestley, and Crispin Rope, "EDVAC and the First Draft," in *ENIAC in Action: Making and Remaking the Modern Computer*, 2016, **pages 142-9**. https://canvas.pitt.edu/courses/163763/files?preview=9867671
- Gillian Terzis, "Computers Were Supposed to Be Good," *The Nation*, Jan 30, 2019. https://www.thenation.com/article/archive/peoples-history-of-personal-computing-joy-lisi-rankin-review-silicon-valley-bros/

Week 9: Thinking with Computers – Software & Games

What can games tell us about how computers work and the kinds of thinking they encourage? What new possibilities for human communication and expression does this open up compared to, say, writing or film? What are the consequences of what games can offer us as users of computers? This week, we look at video/computer games as specifically computational media
.

- Ian Bogost, "Procedural Rhetoric," in *Persuasive Games*, 2007, **pages 1-14; 28-46***. ***Note: the PDF includes the entire first chapter, which is 64 pages. That's a *lot*, and includes stuff that's less important for us. I used "strikethrough" to mark the pages you can skim.** https://canvas.pitt.edu/courses/163763/files?preview=9867714
- Game Maker's Toolkit, "How Game Designers Protect Players From Themselves," original video essay, Oct 10, 2017. https://www.youtube.com/watch?v=7L8vAGGitr8

• Rob Davies, "Video game loot boxes linked to problem gambling," *The Guardian*, Apr 1, 2021. https://www.theguardian.com/society/2021/apr/02/video-game-loot-boxes-problem-gambling-betting-children

Figure 5: Syllabus schedule for the unit on interactive media in Narrative and Technology, taught spring 2023.

Week 9	**Unit 3: Participatory and Interactive Narrative**	
M	3/13	Ergodic Literature and Interactive Storytelling
Due: • Read: Espen Aarseth (1997), "Introduction: Ergodic Literature" in *Cybertext: Perspectives on Ergodic Literature* https://canvas.pitt.edu/courses/188017/files/folder/content?preview=11482876 • Play: *Adventure* (1976) for at least 20 minutes. https://quuxplusone.github.io/Advent/play.html • Read: *The Fall of the Site of Marsha*, "Spring '98" https://collection.eliterature.org/1/works/wittig__the_fall_of_the_site_of_marsha/index.html o Note that there are several linked pages, e.g. "Memorial Page" and "Throne Angel Bulletin Board", and those pages themselves can have links. Click through to read as much as you can find from the various subpages in the "Spring '98" version. If a link doesn't work, don't worry about it.		
W	3/15	Interactive Narrative
Due: • Read: *The Fall of the Site of Marsha*, "Summer '98" and "Fall '98" https://collection.eliterature.org/1/works/wittig__the_fall_of_the_site_of_marsha/index.html		
F	3/17	Participation and Interactivity
• Play: *Emily Is Away* (2015) https://store.steampowered.com/app/417860/Emily_is_Away/		
Week 10	**Unit 3: Participatory and Interactive Narrative (continued)**	
M	3/20	Interface, Design, and Interactive Narrative
Due:		

<table>
<tr><td colspan="3">• Read: Abbe Don (1990), “Narrative and the Interface” in The Art of Human-Computer Interface Design
https://canvas.pitt.edu/courses/188017/files/folder/content?preview=11482886
• Play: Her Story (2015) for at least an hour
https://www.herstorygame.com/</td></tr>
<tr><td>W</td><td>3/22</td><td>Interactive Narrative</td></tr>
<tr><td colspan="3">Due:

• Play: Finish Her Story</td></tr>
<tr><td>F</td><td>3/24</td><td>Finishing Unit 3, Setting Up Unit 4</td></tr>
<tr><td colspan="3">Due:

• Write: Narrative Theory Journal #3</td></tr>
</table>

Appendix B Personal Writing with AI Instructional Guide

Appendix B.1 Top-Level

This activity is designed to take roughly one week of class sessions with some writing done between class sessions by students. I have written the instructional guide for courses that meet three times per week (for roughly 45 minutes to 1 hour).

While you can collect submissions each session, I recommend not collecting and grading any writing until the end, excepting maybe collecting a copy to verify the work is being kept up with.

Please note that this guide is just that: a guide. You are welcome to change it as you see fit for your classroom, and I would in fact love to hear about anyone doing so and how they went about the activity.

Appendix B.2 Materials and Software Required

Students will need a device that can access the internet, an account with OpenAI, access to ChatGPT, and a way to store and access its outputs. Ideally, students will have access to their own laptops or in-class computers. Students could, if needed, access ChatGPT via their phones and access the outputs later on a separate laptop. Students will also need access to word processing software for writing and submitting written work.

Note that you will need to check on the day of the first session that ChatGPT or another AI chat is up and usable.

Appendix B.3 Prior to Session 1

Appendix B.3.1 Setup

Estimate: 10 minutes

Ask students to come to class with one to two written pages about a personal topic.

I have provided two examples in this guide that can be used, and obviously both options could be offered to students. Given that students will be sharing the writing with their instructor and talking about their experiences with writing and ChatGPT in class together, offering both options might help students find a topic they are comfortable with sharing their experiences of. While students can avoid speaking to any specifics in their writing in terms of discussions with peers, it is worth letting students know that it will not be turned in to the instructor as-is with no further discusssion so that they can make an informed decision about how personal they want their writing to be.

Here are two optional prompts A and B, which will be built on in the instructional guide with further prompts for writing and questions for in-class discussion. In cases where the distinction in instruction is significant, I will separate the two with a header, but in cases where it is relatively insignificant (like in-class questions differentiated only by asking about a `text` or `location`) I will use bracketed formatted as code, e.g. [text or location].

Prompt A

Write about a piece of art or media (what I'll generalize as a "text") that is particularly important to you. What you choose might be what you most enjoy, but focus on picking something that had a profound personal impact on you, helped you to better understand a concept or something about your life, helped you solve an important problem in your life, or otherwise prompted a significant change for you.

In roughly 2 double spaced pages:

- briefly explain the text and what it's "about" in general terms;
- write about the elements of your life that are important for understanding the impact the text had on you;
- explain how or why the text achieved its effect;
- include at least two specific examples (e.g. scenes in a movie, episodes of a show, characters in a book).

Students should attempt to address the various elements of the prompt cohesively, rather than answering each question individually in sequence.

Prompt B

Write about a place that is particularly important to you. You might choose a town, neighborhood, cafe, or other kind of location, but focus on picking somewhere that you can speak to the specifics of, and how it in some way informed or shaped who you are today.

In roughly 2 double spaced pages:

- briefly explain the location;

- write about the elements of your life that are important for understanding the impact the location had on you;
- explain how or why the location achieved its effect;
- include at least two specific examples (e.g. places in the neighborhood, memories, or people).

Students should attempt to address the various elements of the prompt cohesively, rather than answering each question individually in sequence.

Appendix B.4 Session 1

Appendix B.4.1 Writing Reflection

Estimate: 10 to 15 minutes

To begin the session, ask students who are comfortable sharing what they wrote about to do so. If you chose to allow both prompts, you might ask which ones people chose, and why.

You might also ask to each student as they talk about what they wrote, or to the whole class after several students have given examples:

- Was it difficult to think of what to write about? If so, how did you end up picking your subject of focus?
- How did you go about choosing the relevant parts of your life to write about?
- Was it clear from the outset of the writing what impact the [text or location] had on you?

Appendix B.4.2 ChatGPT Introduction and Exploration

Estimate: 15 to 25 minutes

To start, briefly explain ChatGPT. You can reference the `introduction.md` file in this repository, read a brief explainer article as a guideline. If you have time, you could read through the article together and ask questions throughout the reading.

Some questions to guide this introductory conversation might include:

- Who here has heard of ChatGPT? What did you know about it already?
- Who here has used ChatGPT? What for? What were your impressions of it?

Next, bring up ChatGPT on a projector to show the class.

First, demonstrate some straightforward prompts and read the results. I recommend sticking to something covered together in class, but some optional prompts might be:

- What is the best way to write the introduction to a college essay?
- Write a 1 page paper in the style of a college application essay explaining how I could better contribute to society by attending the University of Pittsburgh as a computer science major

For each, ask students whether they think the response meets the expectations of the prompt, and how the response would or would not different from one written by a human being.

Finally, ask:

- How do you think ChatGPT is producing responses? What influences the output?
- How is the output similar to or different from human writing?

Appendix B.4.3 ChatGPT Tinkering

Estimate: 15 to 25 minutes

Engage students directly with ChatGPT by rooting it in their writing. To do so, give them a few minutes to do the following:

- Write a prompt for ChatGPT that is most likely to produce writing that resembles what you wrote about for today.

If any students are willing to volunteer their responses to be put into ChatGPT and see the results, then do so. If not, you can come prepared with a pre-generated prompt, such as explain how the TV show Black Mirror helped me get over my lifelong anxieties about technology. Again, appealing to a shared text the class has engaged with would be ideal here.

After each response, read it aloud or ask the student to read it aloud. Then, ask them some follow-up questions:

- How close would you say this is to what you wrote?
- What's similar? What's different?
- Did it accurately describe what about the [text or location] was important to you?
- If you were to rework your prompt to get it closer to your writing, what would you do?

I recommend doing this with at least 2 students or instructor-generated sample prompts.

If these two subjects do not come up, it is worth emphasizing them:

1. You need to specify for ChatGPT to write in the first person if the student wrote in the first person.
2. You need to add with specific examples or some variant of it to get specific details, as was specified in the initial prompt.

Appendix B.4.4 Setting Up Session 2

Estimate: 10 minutes

Explain to students that for next time, they will use their prompt to create a writing response, and should rework their prompt at least two or three times to get it closer to what they wrote (including getting a response in the first person and including two specific examples). Then, they should **write between 1 and 2 double spaced pages** comparing their initial writing to the ChatGPT output.

Guiding questions should include some variant(s) of the following:

- How close would you say ChatGPT's writing is to what you wrote? What's similar? What's different?
- Did it accurately describe what about the [text or location] was important to you?
- What examples did it select? Are they the same examples you chose?
- What did it completely get wrong or miss that is important to you?
- Did it give you new ideas, examples, or topics to write about that you had not considered in your initial draft?

Students can answer the questions one by one or address the various elements of the prompt cohesively.

If there is time left, encourage students to create an OpenAI profile via their phones, tablets, or laptops. For those that cannot do so, encourage them to work further on the prompt they will give to ChatGPT.

Appendix B.5 Session 2

Appendix B.5.1 Writing Reflection

Estimate: 10 to 15 minutes

To begin the session, ask students generally to share the prompt they submitted to ChatGPT, how they changed it from the initial prompt they wrote in class in session 1, and what they think about the writing ChatGPT produced as a result.

From there, if questions listed in the Setting Up Session 2 subsection above have not been addressed, use them to prompt further examples from students.

Appendix B.5.2 ChatGPT General Discussion

Estimate: 20 to 30 minutes

Following the initial reflection, initiate a more general conversation about ChatGPT and its role in the writing process.

- Did using ChatGPT at all influence how you feel about its potential use as a student? Are you more or less likely to use it?
- If you are someone who would use ChatGPT as part of the writing process, how would you incorporate it?
- What are the ethics of presenting text wholly written by ChatGPT for writing assignments?
    - What about using paragraphs?
    - What about using it to determine the structure, but rewriting each paragraph to be in your own voice?

- What (other) ways might ChatGPT be ethically incorporated into the writing process for something like personal writing?

  Then, broaden the conversation to ChatGPT's role and potential impact more generally.

- Do you feel like ChatGPT is simply another tool, like automatic spelling and grammar checkers or a calculator? Or is it fundamentally different than those kinds of tools?
- Having used ChatGPT, does it feel like something exciting and new, or is it of uncanny and off-putting? Or is it something else entirely?
- Do you think ChatGPT will impact your academic career, or what you do after you graduate?
- Which industries or communities might ChatGPT impact? Do you think it'll make a big splash, fizzle out, or be restricted to a few very specific use cases?
- Do you think that ChatGPT will have a net positive or negative impact on society, or on you personally?
- Do you plan to use ChatGPT in the future, and if so in what contexts?

Appendix B.5.3 ChatGPT Free Write

Estimate: 5 to 10 minutes

If time allows for it, give students some time to write down their overall thoughts on using ChatGPT in the writing process and on the technology more generally before setting up the final collection of writing they will turn in for this activity in session 3.

Appendix B.5.4 Setting Up Session 3

Estimate: 10 minutes

Explain to students that for next time, they will be turning in the "final products" of this activity, which includes three elements:

1. A revised version of their original personal writing. They are welcome to use their initial writing as a template, but should make any adjustments prompted by reading ChatGPT's version, whether it be new examples or an adjusted structure of how the ideas are presented.
2. A printout, PDF, or transcript of the final version of the prompt they gave ChatGPT, and the ChatGPT output in response to that prompt.
3. Their initial reflective writing turned in for session 2, revised to address two new guiding questions:
    - Did ChatGPT influence your revision of your original personal writing? If so, how, and if not, why not?
    - Do you think ChatGPT can produce or be part of the creation of personal writing? Why or why not?

Appendix B.6 Session 3

Appendix B.6.1 Writing Reflection

Estimate: 5 minutes

Technically, this component of the activity can be cut entirely if you feel like the in-class discussion hit all the main points. However, it might be useful to ask students the following questions, two of which reiterate the new part of the reflective writing.

- Did ChatGPT influence your revision of your original personal writing? If so, how, and if not, why not?
- Do you think ChatGPT can produce or be part of the creation of personal writing? Why or why not?
- What do you think will be the role of ChatGPT in writing in college, and how do you feel about that role?
- If ChatGPT can produce an A+ essay consistently across several courses, is that a problem? Does it signal a threat to learning writing in college, or do instructors need to change something about writing assignments?
- Is writing produced in response to a prompt by a person fundamentally different than the writing produced by an AI?

Appendix B.7 Guiding Realizations

1. ChatGPT produces writing in response to a parsed prompt using a large corpus of written content on the internet, which has similarities and differences to how humans respond to prompts based on the sum of their experiences based on interactions with and writings by other people.
2. ChatGPT can be incorporated into human writing in a variety of ways, and students can use ChatGPT in ways that do not violate academic or personal integrity.
3. ChatGPT will have an impact on writing in society, and students can learn how to use it effectively to understand what roles it may have and how they feel about those roles.

Appendix C Institutional Review Board Approval

EXEMPT DETERMINATION

Date:	October 5, 2023
IRB:	STUDY23090156
PI:	Addison Eldin
Title:	The Two Cultures, Digital Pedagogy, and the Digital Narrative and Interactive Design (DNID) Program
Funding:	None

The Institutional Review Board reviewed and determined the above referenced study meets the regulatory requirements for exempt research under 45 CFR 46.104(d).

Determination Documentation

Determination Date:	10/5/2023
Exempt Category:	(2)(iii) Tests, surveys, interviews, or observation (identifiable); and for which limited IRB review was conducted via expedited review, (4) Secondary research on data or specimens (no consent required)
Determinations:	• Students / Employees
Approved Documents:	• Pre-Existing Dataset, Category: Data Collection; • Interview Questions.docx, Category: Data Collection; • Consent to Participate in Research.pdf, Category: Consent Form; • HRP-721 - WORKSHEET - Exemption_Tests Surveys Public Behavior_Version_0.01.docx, Category: IRB Protocol; • Introductory Script.docx, Category: Recruitment Materials;

Appendix D Survey Questions

General Questions, asked to all participants

- What is or was your role in the DNID program?
- What kind of work do or did you do for the program on a weekly or semesterly basis?
- What does the English program bring to the major, in your view?
- What does the School of Computing and Information bring to the major, in your view?

Foundational Questions, asked to those involved in the founding of the program

- What was the impetus for creating DNID?
- What kinds of students were envisioned when creating the program? Do you see those kind of students in the major now?
- What institutional barriers had to be overcome? How did you overcome them?
- Were there any instances where cultural differences between SCI and the English department caused conflict or enabled useful conversations?
- Tell me about the experience of collaborating with people from SCI [or the English department if they're from SCI].
- What was the decision-making process like for designing the program's curriculum?
- Were there diverging opinions in the founding of the program, and if so, how were those opinions mediated?

Administrative Questions, asked to program administrators and faculty who were part of the formation of the program

- How do DNID courses differ from non-DNID English and SCI courses? How are they similar?
- What kind of instructors are sought for teaching DNID courses?
- Is running DNID different from running programs that are not cross-disciplinary in nature? If so, how?
- What about the program do you think has been successful?
- What issues has the program run into?

Advising Questions, asked to program advisers

- Do you find there to be any differences between advising DNID students compared to non-DNID students? If so, what are they?
- What differences (if any) do you see between DNID students and other students that you advise in English?
- What challenges do you face in advising a cross-school major?
- What kinds of careers or other post-undergraduate activity are DNID students typically interested in? Are these different from non-DNID English students?

Teaching Questions, asked to faculty

- What courses have you taught that are part of the DNID curriculum?

- How do you approach designing learning goals for DNID courses? Is this approach different than designing learning goals for non-DNID English courses?
- How do you approach teaching a DNID course compared to non-DNID English courses?
- What disciplines, scholars, or concepts inform your pedagogical approach for DNID courses? How do they show up in your teaching?
- How do you determine which sources or kinds of sources to include as assigned content in your syllabi?
- How do you teach students about technical information or knowledge about digital computers or software in your course?
    - How does the way you approach teaching technical information differ from teaching humanities scholarship or other genres?
    - How do you balance teaching about how digital technology or software work with more traditional humanities modes of inquiry?
    - What kinds of sources do you use to teach about digital technology or software? How do you find and evaluate them?
- Do you notice any broad differences between DNID students and students in English or Computer Science who are not DNID majors?

Bibliography

Aarseth, Espen J. “Introduction: Ergodic Literature.” *Cybertext: Perspectives on Ergodic Literature*, John Hopkins UP, 1997, pp. 1-23.

Abbott, H. Porter. “Defining Narrative.” *The Cambridge Introduction to Narrative*, 2nd ed., Cambridge UP, 2014, pp. 13-27.

“About,” *Quanta Magazine*, Simons Foundation, https://www.quantamagazine.org/about/. Accessed 24 May. 2023.

Abel, Jonathan E. and Shion Kono. Translator’s Introduction. *Otaku: Japan’s Database Animals*, by Hiroki Azuma, U of Minnesota P, 2009, pp. xv-xxix.

Adams, Tarn. “Depth of Storytelling in Dwarf Fortress: Tarn Adams on Demon Invasions and Cheese,” *YouTube*, uploaded by On Doubt, 29 Mar. 2018, https://www.youtube.com/watch?v=2mgUeJkALEE.

—. “Dwarf Fortress Creator Explains its Complexity & Origins | Noclip Interview,” *YouTube*, uploaded by Noclip - Video Game Documentaries, 9 Jun. 2020, https://www.youtube.com/watch?v=VAhHkJQ3KgY.

Adler-Kassner, Linda and Elizabeth A. Wardle. *Naming What We Know: Threshold Concepts of Writing Studies*. Utah State UP, 2015.

Agre, Philip. "Toward a Critical Technical Practice: Lessons Learned Trying to Reform AI." *Social Science, Technical Systems, and Cooperative Work: Beyond the Great Divide*, edited by Geoffrey Bowker et al., *Psychology Press*, 1997, pp. 131-157.

AI Dungeon. Beta version for web browsers, Latitude, 2023.

Among Us. 2018. Version v 2023.11.7 for Windows PC, Innersloth, 2023.

Arola, Kristin L. et al. “Analyzing Multimodal Projects.” *Writer/Designer: A Guide to Making Multimodal Projects*. Bedford/St. Martin’s, 2014, pp. 20-39.

Audacity. Version 2.4.2, Audacity, 26 Jun. 2020.

Aufderheide, Patricia and Peter Jaszi. “Fair Use, Public Domain And Creative Commons: They’re Not All The Same.” *Tech Dirt*, Floor 64, 2012, https://www.techdirt.com/2012/05/30/fair-use-public-domain-creative-commons-theyre-not-all-same/.

Aziz, Jeff. Personal Interview. 24 Oct. 2023.

Azuma, Hiroki. *Otaku: Japan's Database Animals.* Translated by Jonathan E. Abel and Shion Kono., U of Minnesota P, 2009.

Babichenko, Dmitriy. Personal Interview. 26 Oct. 2023.

Ballentine, Brian Cooper. "Undergraduate Research and the Enrollment Crisis in English Literature." *Pedagogy: Critical Approaches to Teaching Literature, Language, Composition, and Culture*, vol. 22, no. 1, 2022, pp. 43-60, doi:10.1215/15314200-9385454.

Bartholomae, David et al. *Ways of Reading: An Anthology for Writers*. 11th ed,, Bedford/St. Martin's, 2016.

Bartholomae, David. "Inventing the University." *Journal of Basic Writing*, vol. 5, no. 1, 1986, pp. 4-23.

Bawarshi, Anis. "The Genre Function." *College English*, vol. 62., no. 3, 2000, pp. 335-360.

Bazerman, Charles. "Systems of Genres and the Enactment of Social Intentions." *Genre and the New Rhetoric*, edited by Aviva Freedman and Peter Medway, Taylor & Francis, 1994, pp. 67-85.

Beaufort, Anne. *College Writing and Beyond: A New Framework for University Writing Instruction.* Utah State UP, 2007.

Berkeley, George. "The Analyst." 1734. *De Motu and The Analyst: A Modern Edition, with Introductions and Commentary*, edited by Douglas M. Jesseph, Springer, 1992, pp. 159-221.

Biden, Joseph R., Jr. Executive Order on Promoting the Arts, the Humanities, and Museum and Library Services. 30 Sept. 2022. *The White House*, https://www.whitehouse.gov/briefing-room/presidential-actions/2022/09/30/executive-order-on-promoting-the-arts-the-humanities-and-museum-and-library-services/.

Blume, Stuart. "What Can the Study of Science and Technology Tell Us About Disability?" *Routledge Handbook of Disability Studies*, edited by Nick Watson et al., Routledge, 2012, pp. 348-359.

Bogost, Ian. *Persuasive Games: The Expressive Power of Videogames.* MIT Press, 2010.

—. *Unit Operations: An Approach to Videogame Criticism.* MIT Press, 2006.

—. "Video Games Are Better Without Stories." *The Atlantic*, The Atlantic Monthly Group, 2017, https://www.theatlantic.com/technology/archive/2017/04/video-games-stories/524148/.

Bolton, Christopher et al. "Introduction." *Robot Ghosts and Wired Dreams: Japanese Science Fiction from Origins to Anime*, edited by Christopher Bolton et al., University of Minnesota Press, 2007, pp. vii-xxii.

Boluk, Stephanie and Patrick LeMieux. "Dwarven Epitaphs: Procedural Histories in *Dwarf Fortress*." *Comparative Textual Media: Transforming the Humanities in the Postprint Era*, edited by N. Katherine Hayles and Jessica Pressman, U of Minnesota P, 2013, pp. 125-154. *Electronic Mediations*.

Bortnick, Justin. Personal Interview. 17 Oct. 2023.

Braun, Virginia and Victoria Clarke. *Thematic Analysis: A Practical Guide.* SAGE Publications, Inc., 2022.

Bush, Vannevar. "As We May Think." 1945. *The New Media Reader*, edited by Noah Wardrip-Fruin and Nick Montfort, MIT Press, 2003, pp. 35-47.

Campbell-Kelly, Martin et al. *Computer: A History of the Information Machine*. 3rd ed., Westview Press, 2014. The Sloan Technology Series.

Ceruzzi, Paul E. *A History of Modern Computing.* MIT Press, 1998. *History of Computing*.

ChatGPT. GPT-4, Open AI, 29 Aug. 2023.

Clark, J. Elizabeth. "The Digital Imperative: Making the Case for a 21st-Century Pedagogy." *Computers and Composition*, vol. 27, no. 1, 2010, pp. 27-35, https://doi.org/10.1016/j.compcom.2009.12.004.

Colby, Rebekah Schultz and Richard Colby. "A Pedagogy of Play: Integrating Computer Games into the Writing Classroom." *Computers and Composition*, vol. 25, no. 3, 2008, pp. 300-12, doi:10.1007/s13347-014-0169-4.

Collini, Stefan. Introduction. *The Two Cultures*, by C. P. Snow, Cambridge UP, 2012, pp. 1–51. *Canto Classics*.

Coover, Robert. "The Babysitter." *Pricksongs & Descants: Fictions*, Dutton, 1969, pp. 206-39.

Cresswell, John W. *Qualitative Inquiry & Research Design: Choosing Among Five Approaches*. 3rd ed., SAGE Publications, Inc., 2007.

Crowley, Sharon. *Composition in the University: Historical and Polemical Essays.* University of Pittsburgh Press, 1998. *Pittsburgh Series in Composition, Literacy, and Culture*.

Crowther, Will and Don Woods. *Adventure*. 1976. *Adventure*, Arthur O'Dwyer, 2020, https://quuxplusone.github.io/Advent/play.html.

Danielewski, Mark Z. *House of Leaves*. 2nd ed., Pantheon Books, 2000.

De Mol, Liesbeth and Giuseppe Primiero. "Facing Computing as Technique: Towards a History and Philosophy of Computing." *Philosophy & Technology*, vol. 27, no. 3, 2014, pp. 321-326, doi:10.1007/s13347-014-0169-4.

"Degrees in English language and literature/letters conferred by postsecondary institutions, by level of degree and sex of student: Selected years, 1949-50 through 2017-18." National Center for Education Statistics, 2019, https://nces.ed.gov/programs/digest/d19/tables/dt19_325.50.asp.

DePalma, Michael-John and Kara Poe Alexander. "A Bag Full of Snakes: Negotiating the Challenges of Multimodal Composition." *Computers and Composition*, vol. 37, 2015, pp. 182-200, https://doi.org/10.1016/j.compcom.2015.06.008.

Diaz, Sandra and Lauri Kempson. "What Will They Learn? A Report on General Education Requirements at 100 of the Nation's Leading Colleges and Universities." American Council of Trustees and Alumni, 2009.

"Digital Narrative and Interactive Design Major." *University of Pittsburgh Dietrich School*, 2022. The Dietrich School of Arts & Sciences Undergraduate Studies, https://www.asundergrad.pitt.edu/sites/default/files/DNID.pdf.

Dreyfus, Hubert L. *What Computers Still Can't Do: A Critique of Artificial Reason*. MIT Press, 1992.

Drucker, Johanna. "Why Distant Reading Isn't." *PMLA/Publications of the Modern Language Association of America*, vol. 132, no. 3, 2017, pp. 628-635, Cambridge Core, doi:10.1632/pmla.2017.132.3.628.

Duffelmeyer, Barbara Blakely. "Critical Computer Literacy: Computers in First-Year Composition as Topic and Environment." *Computers and Composition*, vol. 17, no. 3, 2000, pp. 289-307, https://doi.org/10.1016/S8755-4615(00)00036-0.

Eldin, Addison. "Genre Generators." *TextGenEd: Teaching with Text Generation Technologies*, edited by Annette Vee et al, WAC Clearinghouse, 2023, https://wac.colostate.edu/repository/collections/textgened/rhetorical-engagements/genre-generators/.

Eliza. Windows PC version, Zachtronics, 2019.

Elon Statement on Writing Transfer. 2015. Accessed 20 Feb. 2023. http://www.centerforengagedlearning.org/elon-statement-on-writing-transfer/.

Emily Is Away. Windows PC version, Kyle Seeley, 2015.

"ENGCMP 0200 - Seminar in Composition." *University of Pittsburgh*, catalog.upp.pitt.edu/preview_course_nopop.php?catoid=132&coid=721218. Accessed 29 Aug. 2023.

Engelbart, Douglas. "From Augmenting Human Intellect: A Conceptual Framework." 1962. *The New Media Reader*, edited by Noah Wardrip-Fruin and Nick Montford, MIT Press, 2003, pp. 93-108.

"Explore," *Fandom*, Fandom, Inc., https://www.fandom.com/explore. Accessed 4 Jan. 2023.

Feinberg, Melanie. "Two Kinds of Evidence: How Information Systems Form Rhetorical Arguments." *Journal of Documentation*, vol. 66, no. 4, 2010, pp. 491-512, doi:10.1108/00220411011052920.

Fielding, Heather. "'Any Time, Any Place': The Myth of Universal Access and the Semiprivate Space of Online Education." *Computers and Composition*, vol. 40, 2016, pp. 103-114, https://doi.org/10.1016/j.compcom.2016.03.002.

FitzPatrick, Jessica. Personal Interview. 20 Oct. 2023.

Ford, Paul. "What Is Code?" *Bloomberg*, Bloomberg L.P., 2015, https://www.bloomberg.com/graphics/2015-paul-ford-what-is-code/.

Forster, E. M. "The Machine Stops." *The Oxford and Cambridge Review*, no. 8, 1909, pp. 83-122.

"Free Grammar Checker." *Grammarly*, Grammarly Inc, https://www.grammarly.com/grammar-check. Accessed 29 Aug. 2023.

Fullerton, Sarah. "Defying negative stereotypes, humanities majors are booming at Berkeley." *Berkeley News*, UC Regents, 31 Oct. 2022, https://news.berkeley.edu/2022/10/31/defying-negative-stereotypes-humanities-majors-are-booming-at-berkeley/.

Gladstein, Jill and Brandon Fralix. "2017 Four-Year Institution Survey." *National Census of Writing*, 2017, https://writingcensus.ucsd.edu/survey/4/year/2017.

Grabiner, Judith V. "The Centrality of Mathematics in the History of Western Thought." *Mathematics Magazine*, vol. 61, no. 4, 2018, pp. 220-230, doi:10.1080/0025570X.1988.11977377.

—. "Is Mathematical Truth Time-Dependent." *The American Mathematical Monthly*, vol. 81, no. 4, 1974, pp. 354-365, JSTOR, doi:10.2307/2318997.

Grant, Sarah P. "What is prompt engineering?" *Zapier*, 2023, https://zapier.com/blog/prompt-engineering/.

Guzdial, Mark. *Learner-Centered Design of Computing Education: Research on Computing for Everyone.* Morgan & Claypool Publishers, 2015.

Haigh, Thomas and Paul E. Ceruzzi. *A New History of Modern Computing.* MIT Press, 2021. *History of Computing*.

Haigh, Thomas et al. *ENIAC in Action: Making and Remaking the Modern Computer.* MIT Press, 2016. *History of Computing*.

Hamilton, Sam. "Reflection(s) in/on Digital Writing's Hybrid Pedagogy, 2010–2017." *Computers and Composition*, vol. 52, 2019, pp. 158-174, doi:10.1016/j.compcom.2019.02.006.

Hao, Karen and Jonathan Stray. "Can you make AI fairer than a judge? Play our courtroom algorithm game." *MIT Technology Review*, 2019, https://www.technologyreview.com/2019/10/17/75285/ai-fairer-than-judge-criminal-risk-assessment-algorithm/.

Haran, Brady. "The Scientific Way to Cut a Cake - Numberphile," *YouTube*, uploaded by Numberphile, 17 Jun. 2014, https://www.youtube.com/watch?v=wBU9N35ZHIw.

—. "Zeno's Paradox - Numberphile," *YouTube*, uploaded by Numberphile, 7 Apr. 2013, https://www.youtube.com/watch?v=u7Z9UnWOJNY.

Harris, Jeannette, et al. "Computers in the Composition Curriculum: Looking Ahead." *WPA: Writing Program Administration*, vol. 13, no. 1-2, 1989, pp. 35-44.

Harris, Joseph. "The Idea of Community in the Study of Writing." *College Composition and Communication*, vol. 40, no. 1, 1989, pp. 11–22. JSTOR, https://doi.org/10.2307/358177. Accessed 30 May 2023.

Hawisher, Gail E. and Cynthia L. Selfe. "Introduction: Questions for the 1990s: Setting an Agenda." *Evolving Perspectives on Computers and Composition Studies: Questions for the 1990s*, edited by Gail E. Hawisher and Cynthia L. Selfe, *National Council of Teachers of English*, 1991, pp. 1-6.

Hayles, N. Katherine. *Electronic Literature: New Horizons for the Literary*. U of Notre Dame, 2008.

—. *How We Became Posthuman: Virtual Bodies in Cybernetics, Literature, and Informatics.* U of Chicago P, 1999.

—. *My Mother Was a Computer: Digital Subjects and Literary Texts.* U of Chicago P, 2005.

—. *Postprint: Books and Becoming Computational.* Columbia UP, 2020. *The Wellek Library Lectures*.

—. *Writing Machines.* MIT Press, 2002. *Mediawork Pamphlet*.

Heller, Nathan. "The End of the English Major." *The New Yorker*, 2023, https://www.newyorker.com/magazine/2023/03/06/the-end-of-the-english-major.

Hesse-Biber, Sharlene. "Qualitative Approaches to Mixed Methods Practice." *Qualitative Inquiry*, vol. 16, no. 6, 2010, pp. 455-68, doi:10.1177/1077800410364611.

Her Story. Windows PC version, Sam Barlow, 2015.

Hewett, Beth L. and Terese Thonus. "Online Metaphorical Feedback and Students' Textual Revisions: An Embodied Cognitive Experience." *Computers and Composition*, vol. 54, 2019, p. 102512, https://doi.org/10.1016/j.compcom.2019.102512.

Hodgkin, Luke. *A History of Mathematics: From Mesopotamia to Modernity*. Oxford UP, 2005.

Hottinger, Sara N. *Inventing the Mathematician: Gender, Race, and Our Cultural Understanding of Mathematics.* State U of New York P, 2016.

"How the pandemic distorted time." *YouTube*, uploaded by Vox, 7 Sep. 2020, https://www.youtube.com/watch?v=-S_f-huz-EU.

I Was a Teenage Exocolonist. Windows PC version, 2022.

Jamieson, Sandra. "The AI 'Crisis' and A (Re)turn to Pedagogy." *Composition Studies*, vol. 50, no. 3, 2022, pp. 153-7, https://compositionstudiesjournal.files.wordpress.com/2023/03/jamieson.pdf.

Jenkins, Henry. "Game Design as Narrative Architecture." *Electronic Book Review*, 2004, http://electronicbookreview.com/essay/game-design-as-narrative-architecture/.

Jones, John and Lavinia Hirsu. "Introduction." *Rhetorical Machines: Writing, Code, and Computational Ethics*, edited by John Jones and Lavinia Hirsu, U of Alabama P, 2019, pp. 1-11.

Juola, Patrick and Stephen Ramsay. *Six Septembers: Mathematics for Humanists*. Zea Books, 2017.

Juszkiewicz, Jennifer and Joseph Warfel. "The Mathematical Assumptions within Computational Literacy." *Rhetorical Machines: Writing, Code, and Computational Ethics*, edited by John Jones and Lavinia Hirsu, U of Alabama P, 2019, pp. 93-109.

Juul, Jesper. "Games Telling Stories? A Brief Note on Games and Narratives." *Game Studies*, vol. 1, no. 1, Jul. 2001, https://www.gamestudies.org/0101/juul-gts/.

Kennedy, Ashley. "Premiere Pro 2020 Essential Training." *LinkedIn Learning*, 14 Nov. 2019, https://www.linkedin.com/learning/premiere-pro-2020-essential-training.

Kingson, Jennifer A. "STEM who? The humanities mount a comeback." *Axios*, AXIOS Media Inc., 2 Feb. 2023, https://www.axios.com/2023/02/02/humanities-stem-college.

Kline, Morris. *Mathematics, the Loss of Certainty.* Oxford UP, 1980.

Koob, Nathan. Personal Interview. 25 Oct. 2023.

Kuhn, Robert Lawrence. “Roger Penrose - Is Mathematics Invented or Discovered?” *YouTube*, uploaded by Closer to Truth, 13 Apr. 2020, https://www.youtube.com/watch?v=ujvS2K06dg4.

Kuhn, Thomas S. and Ian Hacking. *The Structure of Scientific Revolutions.* 4th ed., U of Chicago P, 2012.

Lave, Jean and Etienne Wenger. *Situated Learning: Legitimate Peripheral Participation.* Cambridge UP, 1991. *Learning in Doing*.

Leighton, Joy. “CS+X pilot to be discontinued end of spring quarter.” *Stanford News*, Stanford University, 24 Jan. 2019, https://news.stanford.edu/2019/01/24/csx-pilot-discontinued-end-spring-quarter/.

Mahoney, Michael S. "The Histories of Computing(S)." *Histories of Computing*, edited by Thomas Haigh, Harvard UP, 2011, pp. 55-73.

“Making Games Better for Gamers with Colourblindness & Low Vision | Designing for Disability.” *YouTube*, uploaded by Game Maker’s Toolkit, 22 Aug. 2018, https://www.youtube.com/watch?v=xrqdU4cZaLw.

Marche, Stephen. “The College Essay Is Dead.” *The Atlantic*, The Atlantic Monthly Group, 6 Dec. 2022, https://www.theatlantic.com/technology/archive/2022/12/chatgpt-ai-writing-college-student-essays/672371/.

Mars, Roman, host. "The Eliza Effect." *99% Invisible*, episode 382, 2019, https://99percentinvisible.org/episode/the-eliza-effect/.

Massey, Walter E. "C.P. Snow and the Two Cultures, 60 Years Later." *European Review*, vol. 27, no. 1, 2019, pp. 66-74, Cambridge Core, doi:10.1017/S1062798718000595.

Rankin, Joy Lisi. *A People's History of Computing in the United States.* Harvard UP, 2018.

Massimiani, Donata. “‘Sets you apart’: New majors offer competitive job opportunities.” *The Pitt News*, 2022, https://pittnews.com/article/175420/news/sets-you-apart-new-majors-offer-competitive-job-opportunities/.

Maverick, Christopher. Personal Interview. 19 Oct. 2023.

Miller, Carolyn. "Genre as Social Action." *Quarterly Journal of Speech - QUART J SPEECH*, vol. 70, 1984, pp. 151-167, doi:10.1080/00335638409383686.

—. "Genre as Social Action (1984), Revisited 30 Years Later (2014)." *Letras & Letras*, 2015, pp. 56-72, doi:10.14393/LL63-v31n3a2015-5.

—. "Rhetorical Community: The Cultural Basis of Genre." *Genre and the New Rhetoric*, edited by Aviva Freedman and Peter Medway, Taylor & Francis, 1994, pp. 67-78.

Mina, Lilian W. "Analyzing and Theorizing Writing Teachers' Approaches to Using New Media Technologies." *Computers and Composition*, vol. 52, 2019, pp. 1-16, https://doi.org/10.1016/j.compcom.2019.01.002.

Minecraft. 2011. Version 1.20.2 for Windows PC, Mojang Studios, 2023.

Moretti, Franco. "'Operationalizing' or, the Function of Measurement in Literary Theory." *New Left Review*, vol. 84, no. 84, 2013, pp. 103–19.

Morowitz, Harold J. *The Emergence of Everything: How the World Became Complex*. Oxford UP, 2002.

"Mr. Rogers and the Power of Persuasion." *YouTube*, uploaded by Will Schoder, 17 Jun. 2017, https://www.youtube.com/watch?v=_DGdDQrXv5U.

Munroe, Randall. "Purity," *xkcd*, 2008, https://xkcd.com/435/.

National Science Foundation. "A Timeline of NSF History," https://www.nsf.gov/about/history/overview-50.jsp. Accessed 4 Jan. 2023.

Nemean. "Fast Inverse Square Root — A Quake III Algorithm," *YouTube*, uploaded by Nemean, 28 Nov. 2020, https://www.youtube.com/watch?v=p8u_k2LIZyo.

Nowacek, Rebecca S. *Agents of Integration: Understanding Transfer as a Rhetorical Act.* Southern Illinois UP, 2011.

O'Dell, Kaylin. "Modern Marginalia: Using Digital Annotation in the Composition Classroom." *Computers and Composition*, vol. 56, 2020, p. 102570, doi.org/10.1016/j.compcom.2020.102570.

Olson, Dan. "Annihilation and Decoding Metaphor," *YouTube*, uploaded by Folding Ideas, 31 Oct. 2018, https://www.youtube.com/watch?v=URo66iLNEZw.

—. "Glass Isn't a Very Good Movie - A Spoiler-Rich Vlog," *YouTube*, uploaded by Folding Ideas, 18 Jan. 2019, https://www.youtube.com/watch?v=oi5DsqH1vwg.

Omeka. Version 2.7.1, Omeka, 26 Jun. 2020.

Perkins, D. N. and Gavriel Salomon. "Teaching for Transfer." *Educational Leadership*, vol. 46, no. 1, 1988, pp. 22-32.

Petzold, Charles. *Code: The Hidden Language of Computer Hardware and Software.* Microsoft Press, 1999.

Philbin, Carrie Anne. "Representing Numbers and Letters with Binary: Crash Course Computer Science #4." *YouTube*, uploaded by CrashCourse, 15 May 2017, https://www.youtube.com/watch?v=1GSjbWt0c9M.

Premiere Pro. Version 14.3, Adobe Inc., 26 Jun. 2020.

Putnam, Lara. “The Transnational and the Text-Searchable: Digitized Sources and the Shadows They Cast.” *American Historical Review*, vol. 121, no. 2, Apr. 2016, pp. 377–402, https://doi-org.pitt.idm.oclc.org/10.1093/ahr/121.2.377.

Rankin, Joy Lisi. *A People's History of Computing in the United States.* Harvard UP, 2018.

Rayo, Augustín. “At MIT, the Arts, Humanities, Design and STEM fields forge an essential partnership.” *MIT School of Humanities, Arts, and Social Sciences*, 2021, https://shass.mit.edu/news/news-2021-essential-partnership-arts-humanities-and-stem-mit.

Reed, Aaron A. “1998: Photopia,” *50 Years of Text Games*, 2021, https://if50.substack.com/p/1998-photopia.

Reiff, Mary Jo and Anis Bawarshi. "Tracing Discursive Resources: How Students Use Prior Genre Knowledge to Negotiate New Writing Contexts in First-Year Composition." *Written Communication*, vol. 28, no. 3, 2011, pp. 312-337, doi:10.1177/0741088311410183.

Robinson, Joy et al. "State of the Field: Teaching with Digital Tools in the Writing and Communication Classroom." *Computers and Composition*, vol. 54, 2019, p. 102511, https://doi.org/10.1016/j.compcom.2019.102511.

Rogers, Gayle. Personal Interview. 18 Oct. 2023.

Ruslin et al. "Semi-Structured Interview: A Methodological Reflection on the Development of a Qualitative Research Instrument in Educational Studies." *IOSR Journal of Research & Method in* Education, vol. 12, no. 1, 2022, pp. 22-29, doi:10.9790/7388-1201052229.

Ryan, Marie-Laure and Jan-Noël Thon. "Storyworlds across Media: Introduction." *Storyworlds across Media: Toward a Media-Conscious Narratology*, U of Nebraska P, 2014. 1-21.

Ryan, Marie-Laure. “The Interactive Onion: Layers of User Participation in Digital Narrative Texts.” *New Narratives: Stories and Storytelling in the Digital Age*, edited by Ruth Page and Bronwen Thomas, U of Nebraska P, 2011, pp. 35-62.

Sanderson, Grant. “About the Channel,” *3Blue1Brown*, https://www.3blue1brown.com/about. Accessed 4 Jan. 2023.

—. “The Summer of Math Exposition,” *3Blue1Brown*, 15 Jul. 2021, https://www.3blue1brown.com/blog/some1.

—. “2021 Summer of Math Exposition results,” *YouTube*, uploaded by 3Blue1Brown, 23 Oct. 2021, https://www.youtube.com/watch?v=F3Qixy-r_rQ.

Schwartz, Oscar. “Untold History of AI: Invisible Women Programmed America’s First Electronic Computer.” *IEEE Spectrum*, IEEE, 2019, https://spectrum.ieee.org/untold-history-of-ai-invisible-woman-programmed-americas-first-electronic-computer.

Selingo, Jeffrey. “As Humanities Majors Decline, Colleges Try to Hype Up Their Programs.” *The Atlantic*, The Atlantic Monthly Group, 1 Nov. 2018, https://www.theatlantic.com/education/archive/2018/11/colleges-studying-humanities-promotion/574621/.

Sephton, Matt. "Christopher Strachey ‘Loveletters’ (1952).” Matt Sephton, 2010, https://www.gingerbeardman.com/loveletter/.

Shannon, Claude. "A Mathematical Theory of Communication." *Bell System Technical Journal*, vol. 27, no. 3, 1948, pp. 379-423, doi.org/10.1002/j.1538-7305.1948.tb01338.x.

—. "A Symbolic Analysis of Relay and Switching Circuits." *Transactions of the American Institute of Electrical Engineers*, vol. 57, no. 12, 1938, pp. 713-723, doi:10.1109/T-AIEE.1938.5057767.

Smith, Brian Cantwell. “Brian Cantwell Smith The philosophy of computation meaning, mechanism, mystery.” *YouTube*, uploaded by André Souza Lemos, 10 Jul. 2013, https://www.youtube.com/watch?v=USF1H70bRl0.

—. “Introduction.” *Age of Significance*, *Age of Significance*, 2010, pp. 1-45, https://web.archive.org/web/20160308085210/http://ageofsignificance.org/aos/en/aos-v1c0.pdf.

—. “The Foundations of Computing.” *Computationalism: New Directions*, edited by Matthias Scheutz, MIT Press, 2010, pp. 23-58.

—. *The Promise of Artificial Intelligence: Reckoning and Judgment*. MIT Press, 2019.

Snapper, Ernst. "The Three Crises in Mathematics: Logicism, Intuitionism and Formalism." *Mathematics Magazine*, vol. 52, no. 4, 1979, pp. 207-216, doi:10.1080/0025570X.1979.11976784.

Snow, C. P. "The Rede Lecture (1959)." 1959. *The Two Cultures*, Cambridge UP, 2012, pp. 1–51. *Canto Classics*.

Stewart, Mary K. "Communities of Inquiry: A Heuristic for Designing and Assessing Interactive Learning Activities in Technology-Mediated Fyc." Computers and Composition, vol. 45, 2017, pp. 67-84, https://doi.org/10.1016/j.compcom.2017.06.004.

—. "The Community of Inquiry Survey: An Assessment Instrument for Online Writing Courses." Computers and Composition, vol. 52, 2019, pp. 37-52, https://doi.org/10.1016/j.compcom.2019.01.001.

Stillwell, John. Preface to the First Edition. *Mathematics and Its History*, 3rd ed., Springer International Publishing, 2010, pp. xi-xiii.

"The Story of Facade: The AI-Powered Interactive Drama | AI and Games #49." *YouTube*, uploaded by AI and Games, 22 Apr. 2020, https://www.youtube.com/watch?v=POv1cOX8xUM.

Swales, John M. "The Concept of Discourse Community: Some Recent Personal History." *Composition Forum*, vol. 37, no. Fall, 2017.

—. *Genre Analysis: English in Academic and Research Settings.* Cambridge UP, 1990. *The Cambridge Applied Linguistics Series*.

Tan, Xiao and Paul Kei Matsuda. "Teacher Beliefs and Pedagogical Practices of Integrating Multimodality into First-Year Composition." *Computers and Composition*, vol. 58, 2020, p. 102614, https://doi.org/10.1016/j.compcom.2020.102614.

Taylor, Todd. "Computers in the Composition Curriculum: An Update." *WPA: Writing Program Administration*, vol. 20, no. 1-2, 1996, pp. 7-18.

Tolkien, J. R. R. *The Fellowship of the Ring: Being the First Part of the Lord of the Rings*, HarperCollins Publishers, 1999.

Tombro, Melissa. *Teaching Autoethnography: Personal Writing in the Classroom*. Open Suny, 30 Aug. 2016.

Tosca, Susana and Lisbeth Klastrup. "Introduction." *Transmedial Worlds in Everyday Life: Networked Reception, Social Media, and Fictional Worlds*, Routledge, 2019, pp. 1-14.

Turing, Alan. "Computing Machinery and Intelligence." 1950. *The New Media Reader*, edited by Noah Wardrip-Fruin and Nick Montfort, MIT Press, 2003, pp. 49-64

—. "On Computable Numbers, with an Application to the Entscheidungsproblem." *Proceedings of the London Mathematical Society*, vol. s2-42, no. 1, 1937, pp. 230-265, doi.org/10.1112/plms/s2-42.1.230.

"ULS Digital Collections." *University of Pittsburgh*, https://digital.library.pitt.edu/. Accessed 30 Aug. 2023.

Underwood, Ted. "A Genealogy of Distant Reading." *Digital Humanities Quarterly*, vol. 11, no. 2, 2017.

Vee, Annette. "Strachey's Love Letter Generator." *JSFiddle*, https://jsfiddle.net/nettework/6f7abaaa/. Accessed 30 Aug. 2023.

—. *Coding Literacy: How Computer Programming Is Changing Writing*. MIT Press, 2017. *Software Studies*.

—. Personal Interview. 23 Oct. 2023.

Vint, Sherryl. *Science Fiction.* MIT Press, 2021. *MIT Press Essential Knowledge Series*.

Watters, Audrey. *Teaching Machines: The History of Personalized Learning.* MIT Press, 2021.

Weizenbaum, Joseph. *Computer Power and Human Reason: From Judgment to Calculation*. W. H. Freeman, 1976.

Whicker, John H. "'Types of Writing,' Levels of Generality, and 'What Transfers?': Upper-Level Students and the Transfer of First-Year Writing Knowledge." *Across the Disciplines: A Journal of Language, Learning and Academic Writing*, vol. 18, no. 3-4, 2022, pp. 284-304.

Wiener, Norbert. *Cybernetics; or, Control and Communication in the Animal and the Machine.* 2nd ed., MIT Press, 2019.

Williams, Wil. "The best video essays of 2020." *Polygon*, Vox Media, 2020, https://www.polygon.com/22202828/best-video-essays-of-2020.

Wing, Jeannette M. "Computational Thinking." *Commun. ACM*, vol. 49, no. 3, 2006, pp. 33–35, doi:10.1145/1118178.1118215.

Wittig, Rob et al. *The Fall of the Site of Marsha*. 1999. *Electronic Literature Collection*, Electronic Literature Organization, 2006, https://collection.eliterature.org/1/works/wittig__the_fall_of_the_site_of_marsha/index.html.

Wolfe, Joanna et al. "Knowing What We Know About Writing in the Disciplines: A New Approach to Teaching for Transfer in FYC." *The WAC Journal*, vol. 25, 2014, doi:10.37514/WAC-J.2014.25.1.03.

Wolfram, Stephen. "What Is ChatGPT Doing … and Why Does It Work?" *Stephen Wolfram Writings*, Stephen Wolfram, LLC., 2023.

—. *A New Kind of Science.* Wolfram Media, 2002.

Wysocki, Anne Frances et al. *Writing New Media: Theory and Applications for Expanding the Teaching of Composition*. Utah State UP, 2004.

Yancey, Kathleen Blake et al. *Writing across Contexts: Transfer, Composition, and Sites of Writing.* Utah State UP, 2014.

Yeadon et al. "The death of the short-form physics essay in the coming AI revolution." *Physics Education*, vol. 58, no. 3, 2023, pp. 1-13, doi:10.1088/1361-6552/acc5cf.