The Invisible Work of the Digital Humanities Lab: Preparing Graduate Students for Emergent Intellectual and Professional Work

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Abstract

This article illuminates the ways that digital humanities labs might foster experiences for graduate students that fulfill what Alexander Reid (2002) postulates as the "central task" of the digital humanities graduate education. We argue that while the digital humanities lab as an institutional economic model does not necessarily promote a focus on graduate student professionalization, it uniquely has the capacity to push back against competing discourses of neoliberal vocationalism, funding and labor precarity on one hand, and technological utopianism and tool fetishization on the other, to train students agile, contextual, and rhetorical mindsets with which to enter technologically-mediated workplaces and lives. To begin, we review the discussion of digital humanities labs in the literature: digital humanities institutional models, how these models are practiced, lab funding, and the resultant position of labs as sites of training for graduate students. From there, we offer a teaching case from the Lab's fall 2015 "Stories from Data" workshop in order to render visible a set of principles to guide professionalization of graduate students in the digital humanities lab. We conclude with reflections on how these principles might alter current discussions of the success or failure of the Mellon Foundation and NEH ODH digital humanities funding initiatives in the United States.

Introduction: The Visible Work of a DH Lab

In *The Big Humanities: Digital Humanities/Digital Laboratories*, Richard J. Lane discusses a number of types of "humanistic labs, centres, projects, and products," but he maintains a striking focus on the possibilities of the digital humanities (DH) lab. For Lane, the digital humanities lab provides an opportunity to bring a Big Science research model to the humanities, which includes a shift to "lab-based" knowledge production [Lane 2017]. Everything is larger: the research teams, the data sets, the duration of projects, the funding — evolution, so to speak, of what we might call a "lab ethos" [Lane 2017]. In addition, the construction of *Big Humanities* as a topic area correlates closely with a shift in philanthropy in higher education, which is "less concerned about creating in-perpetuity funds than solving a large, intractable problem" [Thorp 2010, 145]. DH funders such as the Mellon Foundation will fund projects for impact, which is viewed as highly interdisciplinary, with high levels of engagement, and market-consciousness [Thorp 2010]. The more scientific the model and technical the discourse, the more likely STEM funding may also be available [Thornham 2017]. For this reason, Big Humanities are in great demand, and labs compete for large-scale funding through the constructive and imagineering nature of their grants. Inevitably, the paradigm of funding shapes the kind of work that is done, and the tools and methods that are used. [1]

Of course this is not the only value that institutions see in digital humanities labs. One need only inspect the technologies in a given DH lab to know what kinds of projects in which the lab is participating or able to support. A large, funded project will support the tools and methods needed to get the specific work of that project done. There may even be development of specific packages or software. By contrast, a lab that fits the computing support model will offer a broader range of technologies, tools, and personnel to fit a broad range of DH interests. An example of the former can be found in the humanities college-funded Digital Environmental Humanities Lab at California State University-Northridge, where students under the mentorship of one professor used XMIND software to visualize data related to the [2]

creation of the national park system in order to expose the exclusion of people of color in this narrative [Ruiz 2017]. An example of the computing support model may be found in the press release issued by Bowling Green State University to announce their Digital Humanities Lab:

> "The goal of the Digital Humanities Lab is to encourage and support innovative, interdisciplinary research projects that make creative use of technology," said Colleen Boff, associate dean for University Libraries. "We focus on supporting projects that are enhanced by visualization tools, multimedia applications, and manipulating data acquired through application programming interfaces (API)." [Bowling Green State University 2015]

The press release then lists the training offerings for faculty and students related to the software that supports these kinds of projects. By comparison, a Big Humanities lab, much like a Principal Investigator's (PI's) scientific laboratory, may not necessarily have tools, methods, or training offerings for a wider academic audience at their institution. The DH lab, then, is fairly well-understood as a mechanism for advancing individual research goals, supporting faculty enrichment, striving for institutional alignment with scientific paradigms for enterprise-level research, as well as a hub for postdoctoral and postgraduate training — even in institutions where it is lacking.

However, what do we see when we de-emphasize the institutional and faculty aspirations so often associated with DH labs? The relationship between institutional role and research activity operates amidst other dynamics of research variation, and the DH lab is not uniform across it. As Mary Jo Deegan notes, the literature in DH in the United States (she mentions specifically Gold's edited collections *Debates in the Digital Humanities*) tends to be more focused on theory and more focused on the Modern Languages Association and North America, whereas European DH tends to be more project and practice-focused [Deegan 2014]. The examples of DH labs offered by Claire Warwick tend to be more focused on the practices of large-scale projects [Warwick 2012]. Postgraduate and postdoctoral students tend to be situated as participants on these projects, who learn from PIs on the job. | 3 |

In this article, we consider what invisible or less visible work becomes illuminated when practitioners understand the DH lab as a space for prioritizing graduate student needs. Graduate student perspectives may be sufficiently overlooked in the debates of "what," "why," and "who" is the digital humanities, despite the importance of graduate students to most DH teams reliant upon their labor. Thus, this article examines the ways that the DH lab can foster unique experiences for graduate students that fulfill what Alexander Reid postulates as the "central task" of DH — graduate education [Reid 2012]. More specifically, we argue that the DH lab as an institutional economic model does not necessarily promote a focus on graduate student professionalization, but that it can and should have a profound capacity to carve out space for deep thought in mixed-methods thinking, pushing back against competing discourses of neoliberal vocationalism, funding and labor precarity on one hand, and technological utopianism and tool fetishization on the other. Thus, as a critical and technological space committed to practices and capacities rather than a more exclusive emphasis on scholarly DH, the lab can train students in agile, contextual, and rhetorical mindsets with which to enter technologically-mediated workplaces and lives. | 4 |

DH Lab Models and the Treatment of Graduate Students

It is difficult to discuss the DH lab in a vacuum from the forces that create, shape, and reshape it over time. Here, we will review how the lab as a specific form of DH institution comes into being, with specific focus on funding models and projected inputs and outcomes from that funding. We will consider how the practice of DH in the United States and outside of it may affect the composition of labs and their graduate training. The graduate students who come to labor in the lab are a visible and direct result of the synergistic forces of funding and institutional shaping rather than consideration for the goals and objectives of graduate education. Based on these considerations, we will take a look at how various labs have approached graduate training and education as a part of that institutional model. We then argue that much of that graduate training and education is invisible because it is not tied to these funding models and resultant lab practices. | 5 |

Training (graduate students) in the DH lab

Training offerings in DH labs relate closely to the mission of the lab itself. As with the Bowling Green example, a computing support lab model tends to support general training offerings for the academic community related to "particular types of software or specialist tools" provided by the lab itself [Warwick 2012]. A Big Humanities lab, on the other hand, might offer graduate students the opportunity to work as RAs on a particular large scale sponsored research project, and be trained to support that particular project. These are the two polar opposites, and there can be a blending of these offerings, and other kinds of offerings as well.

The DH lab offers a space for experiential learning that challenges a more traditional classroom environment [Thorp 2010] in that it can be the professionals employed by the lab — often designated as support staff or unaffiliated with a traditional humanities discipline — that stand to offer the most expertise for experiential digital research training for graduate students [Nowviskie 2015]. Yet this same condition raises several questions regarding graduate student education: In the post-tenure university, Who does and should train graduate students, and to what ends? Who are graduate students to become (i.e., paid research assistants on Big Humanities projects, researchers on their own projects, future faculty in disciplines, "alt-ac" research professionals in higher education or industry)? At an institution like Arizona State University, for example, that has seen radical restructuring of its academic programs to as to create space for fostering interdisciplinary work, how do future faculty become effectively trained and usefully integrated into explicitly interdisciplinary spaces? Finally, why might a Big Humanities-focused DH lab participate in graduate student professionalization at all, if not incentivized under its funding model? These questions, answered or not, do much to influence how the DH lab views its mission in the university vis-à-vis its own disciplinary structure, and furthermore raise additional questions about the value of promoting such work and about the possibilities for the DH lab model. It is here where we begin our discussion of our own graduate training experiment that sought to make the work of graduate training visible in our DH lab.

A Case Study: The "Stories from Data" Workshop

We consider the affordances and constraints from such a model by offering a teaching case from our own Lab's fall 2015 "Stories from Data" workshop in order to render visible a set of principles to guide professionalization of graduate students in the DH lab. The context for this case study is the Nexus Lab at Arizona State University. During our time employed at the Nexus Lab (as Director and Postdoctoral Fellow), it worked largely within the Big Humanities model: teams sought out large-scale and long-term funding; faculty partnerships for research spanned humanities and STEM disciplines; and upper administration aligned the lab with other units at the University invested in broad-reaching and big-impact work. However, part of the mission of the lab was to operate in a Big Humanities space while at the same time integrating technologies and lessons learned from that activity into graduate student training.

The Stories from Data workshop ran in the Fall Semester of 2015. The curriculum spanned fifteen weeks, beginning in the second week of classes. Hosted in the Lab, sessions took place from 1:00-3:00 p.m. on Friday afternoons. Attendance was free and open to all university staff, students, and faculty. We did not require consistent attendance in order to participate. We believe this contributed to enormous initial interest, from which emerged a steady cohort of staff, faculty, and students. The workshop began with seventy five participants, and after steady attrition, concluded with a group of twelve who remained consistent attendees and participants. Their backgrounds included rhetoric, sustainability, industrial engineering, computer science, and literature.

Stories from Data was an ongoing exercise in connecting participant expertise with the process and tools for decision making with data. In many ways, we sought to provide as much value as possible to participants by using the workshop as a way of codifying into the recognizable skillset of "visualization" the critical thinking, collaboration skills, and mixed methods analysis that unfolds perpetually in the context of interdisciplinary research. While the concept of "interdisciplinarity" can seem esoteric and elusive, the ideas of "visualization" and "data visualization" have a more immediate appeal outside academia and possess crosscutting benefits even within university research.

Our framing principle for the workshop was "People make decisions based on stories from data, not the data alone." Our goals for the workshop engaged the cognitive, cultural, design, and narrative dimensions of visualization: 1) understand the tendencies and capabilities of users; 2) produce visualizations that help us think, not merely present

information; and 3) learn how to tell a story from data that considers visual and non-visual narrative parts.

Generally each session fell into two parts, a presentation/discussion and a hands-on exercise. Each session lasted two to three hours. Consistently, we referred to the audience of visualizations as "users" rather than "viewers" to foreground the idea that visuals are rarely passively consumed.

Goal 1: Understand the tendencies and capabilities of users

The first weeks of the workshop consisted of discussing and exploring the capabilities and limitations of visualization users. In this phase of the workshop, we used ineffective visualizations as negative examples. We solicited students to discuss the charts with the goal of understanding the relationship between the data and visual elements, identifying the story produced from the data, and producing recommendations for how to improve each example. For instance, we discussed the world economy voronoi plot (see Figure 1) as visually impressive, but hardly navigable visually. The circular shape of the chart and the irregular shapes of the cells make it difficult to understand the relationship between the data and the area assigned to each country. The voronoi layout also makes the countries with smaller economies crowded and illegible, possibly recreating the perception perhaps the visualization was hoping to remedy. Participants also raised a concern about the use of red and green colors together that would pose accessibility concerns for colorblind users. The group wondered what a bar chart or hierarchical chart might clarify about the data, as well as discussed potential questions that could mobilize a revised visualization in a story: is the goal to call attention to inequity? To power dynamics? To correlations among large economies?
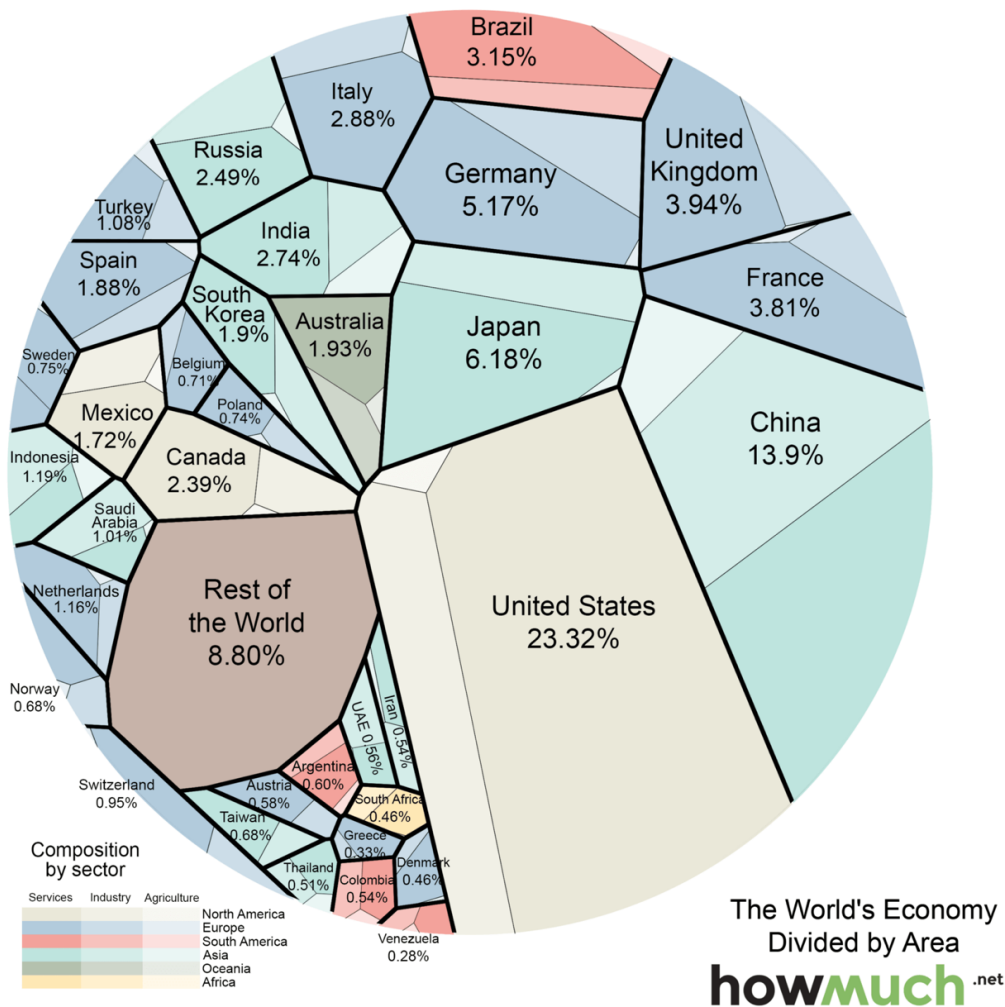
Figure 1. An example of an ineffective visualization discussed in the workshop. From howmuch.net[Amoros 2015]

Additionally, we drew from Jeff Johnson's *Designing with the Mind in Mind* (2010) to highlight perceptual and cognitive limitations that humans face when apprehending visualizations. For example, Johnson calls attention to the limitations of human abilities to recall visual information, making it all the more important to facilitate comparisons rather than recollections. Additionally, once users learn a format and spatial layout, maintaining consistencies across multiple charts — and multiple points in a story — can be seen as a technique for aiding comprehension [Johnson 2010]. Alongside these issues, we discussed other sources of limitations in users, such as pre-existing assumptions — understood as "bias" to some participants and expanded upon as ideological, cultural, and linguistic contingencies by others — and how a user's prior conditioning can affect interpretation and overall narrative.

Goal 2: Produce visualizations that help us think, not merely present information

Drawing from Ben Fry's *Visualizing Data* (2014), the next phase of the workshop emphasized the planning and conceptualization of a visualization as an opportunity to engage, understand, question, and refine data. In this phase, participants spent time evaluating the data from which visualizations were designed. This involved understanding the structure of the data; namely, what constituted an object or series in the data, and what dimensions of the data are available. Conversations about data progressed to form questions about planning visualizations, and the specific insights they mean to enable. In other words, before we can begin visualizing, we have to decide the problem we are approaching.

Defining the problem, and evaluating that definition, is the key area where we encourage the participants to apply their expertise. What data exists and what visual roles it will play are necessary considerations. But what data is missing, or the conceptualization of the problem itself required critical thinking and reflection on participant expertise. During one session, we presented the group with data and charts about the global production and circulation of food from the International Center for Tropical Agriculture's 2015 survey [Khoury 2016]. In this exercise, there were multiple spreadsheet files, each derived from both the survey and some statistical analysis of the survey data. These files by themselves included historical, geographical, agricultural, and economic data; the group had to decide together what kinds of visual problem solving were allowed or silenced by the state of the data.

Figure 2. Participants in the Lab deliberate about the use of agricultural survey data

The group consisted of participants with various expertise in rhetoric, sustainability, industrial engineering, computer science, and literature. By the end of the day's session, the group did not ever reach the point of sketching out or brainstorming possible visuals. Instead, they conducted a lively discussion about the representative limitations of the data in its current state (see Figure 2). A sustainability view challenged the explanatory value of any visualizations that

selectively presented countries, while rhetorical considerations advised against presenting all countries at once in a display that looked impressive but communicated little. Additionally, some were reluctant to show spatial relationships without also showing those relationships unfold over time. At stake in each of these threads in the conversation is how to make a series of representations (first data, then any visualization of that data) relevant and responsible to the disciplinary values of their expertise.

By mid semester, then, the group engaged in practices that saw visualization as a set of practices rather than a digital artifact or set of tools. Before any ink or pixels, there must be a relevant and coherent sequence of inquiries.

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Goal 3: Learn how to tell a story from data that considers visual and non-visual narrative parts

We used the concept of a "story" to invite participation from multiple disciplines and points of view. The workshop had spent a good deal of time and resources emphasizing visualization as a practice of reasoning through a problem, and in the final phase of the semester we circled back to the limitations and biases of visualization users that began the semester. This time, however, rather than use the idea of bias as a way to motivate our understanding of visualization design, we asked participants to consider the cultural biases and prior assumptions of visualization users. Each participant, as part of a final project, was responsible for presenting a data visualization of their making that was part of a broader narrative. The narrative would tell a story about a problem, relate that problem to an audience, and punctuate that story with a visualization that helped its users reason through data relevant to both the problem and the story about the problem. For instance, in working through the global agriculture data from earlier in the semester, one student produced a Sankey diagram (see Figure 3) that diagrammed the total breakdown of global produce by calorie type. In this story, understanding the contours of global nutrition was the problem, and the student chose a small subset of the data with only a handful of dimensions (by crop: total calories, carbohydrate calories, protein calories, and fat calories). From the much larger dataset about global calories and flows among countries and regions, the student was able to tell a straightforward story about the kinds of plant-based calories available globally. The final idea that non-carbohydrate calories are scarcer is clear from the framing of the narrative, the selection of the data, and the visual presentation of the data.
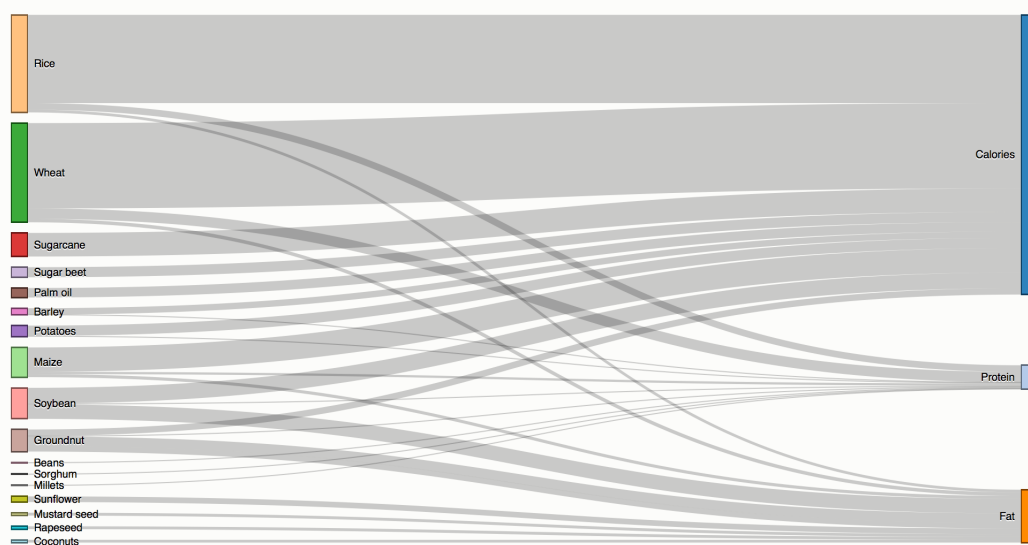
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Figure 3. Aggregate contributions of crops to global calories by calories (sic), protein, and fat. Here "Calories" on the right side erroneously titles carbohydrates. Produced with d3.js in 2015 by Stories from Data student.

In the end, some participants excelled at programming, others at design, and still others at the stories and rhetorical positioning of the analytical narratives. No matter what the aptitude, discipline, and interests of the participants, constructing the "story from data" became a multi- disciplinary project where expertise could matter in a venue outside that expertise. An English doctoral student's perspective and craft was just as important to crafting a story from data as a computer programmer or graphic designer. The consistent training about visualization as a critical thinking and communication exercise helped to connect humanities expertise to applicable skills in visualization and data literacy. The idea of thinking through what it means to have an argument seen by other groups provided opportunities to articulate the value of individuals' knowledge and research. The practice of storytelling with data is experience relevant to science, business, engineering, medicine, and more [Dykes 2016].

Principles for Professionalizing Graduate Students in the DH Lab

The Stories from Data workshop provides a teaching case to make visible what the work of professionalizing graduate students *might* look like. This work temporarily suspends the goals of sponsored research and academic promotion. This work moves beyond the poles of teaching tools for machines and software purchased for the DH lab as a support center and teaching tasks for work on PI-driven Big Humanities projects. In fact, this professionalization work rejects easy assimilation into any lab model. It is not a lab during this kind of work, in the sense that specific instruments or a number of experts are there, all working around a common problem or issue. Yet, a DH lab is precisely the place where this professionalization work can take place, as a site of experiential, cross-disciplinary, cross-rank, academic-industry collaboration.

Instead, we argue for centering graduate students and their development as individuals, to prepare them for a wide variety of contingencies in their future career paths. These principles do not invoke a particular set of skills, as the tools and methods used in industry and in academia are just tools, not development of the individual who may use them. As Goldman Sachs banking director Matthew William Barrett said in an interview, "I used to joke that if you can find me someone who has a degree in figuring out patterns of imagery in Chaucer's Canterbury Tales, I can teach him to break down a balance sheet in 30 minutes. What you want is a mind" [Pitts 2010]. The set of principles behind the Stories from Data workshop for graduate students do not derive from a particular digital skillset. "Tools" are not the same as initiation into practice, or experience with the principles of mixed methods work. This set of principles may be applied to a variety of substantive areas.

Principle 1: A DH lab can foster cross-disciplinary conversation and understanding

By nature and design, a DH lab can serve as a space of contact for graduate students from the humanities and STEM disciplines who are approaching issues of shared concern. It is in this way that the DH lab becomes a contact zone, much as Mary Louise Pratt described as "social spaces where cultures meet, clash, and grapple with each other, often in contexts of highly asymmetrical relations of power, such as colonialism, slavery, or their aftermaths as they are lived out in many parts of the world today" [Pratt 1991, 34]. The collision course of the humanities and STEM in the same learning environment forces students to confront not only the epistemological differences between the disciplines, but the way the student's own discipline circulates and is taken up (or not) across the humanities-STEM divide, a divide fraught with competing value systems and cultures. The students can see how they are heard across difference in the academy, and be able to make better sense of their place in the wider world outside of it with the training they have received in their discipline.

This involves, in part, understanding the benefits from being trained in a particular discipline and working with others who are trained according to different disciplinary ideals. Often, it is in collaborating across difference — mixing methods or juxtaposing competing ideas within the same discussion — that it becomes possible to break through a problem. Unfortunately, interdisciplinary collaboration is rarely taught or trained to academics, and as a result, grant-funded research projects across disciplines can fall apart. As Bendix et al. notes, "Thrown into strange company without preparation, ongoing guidance, or long-term professional incentives, researchers fall back onto disciplinary habits and raise disciplinary defenses" [Bendix 2017]. The "strange" company of those across disciplines must then be made familiar for interdisciplinary collaboration to be successful.

This principle aligns with a concept suggested by Patricia Bizzell as she argues how Pratt's contact zone theory may be applied to graduate study. Bizzell writes:

> It would also mean reorganizing graduate study [in English] and professional scholarly work in ways I hardly dare to suggest. I suppose that one would no longer become a specialist in American literature, a "Shakespeare man," or a "compositionist." Rather, people's areas of focus would be determined by the kinds of rhetorical problems in which they were interested. [Bizzell 1994, 169]

We are not suggesting altering a disciplinary program of study for graduate students, but instead, that the DH lab has great potential to enable the kind of work that Bizzell describes should order the focus of graduate study. In fact, the DH lab model for extracurricular cross-disciplinary inquiry has two benefits that altering the curriculum does not. First, it alleviates the concern posed earlier about training academics with a disciplinary identity. Here, we show that cross-disciplinary work in the contact zone of the lab accentuates a graduate student's understanding of their discipline and how it travels. Further, organizing a workshop like Stories from Data with the "rhetorical problem" of how data is visualized and used also fulfills the kind of large-scale problem solving that funders of the labs themselves seek out. In this way, the DH lab alleviates concerns of those anxious about interdisciplinarity while also doing exactly what funders hope the DH will do.

Principle 2: A DH lab can offer experiences that enhance rhetorical, critical, and contextual mindsets while simultaneously building/making/hacking

It is neither new nor controversial to say that the DH lab has the capacity for experiential learning. What is harder to abide is the work of combining that experiential building/making/hacking with rhetorical, critical, and contextual understanding of the very technologies we learn to build/make/hack. As discussed earlier, the strictures of the semester system and the traditional classroom render this work nearly impossible in the curriculum. The workshop setting allowed those who wanted to invest the time to do so. This allowed the workshop to spend its time in lengthy discussion and then hands on exercises scaffolded to lead to the building of data visualizations with several different tools and methods.

The development of rhetorical and critical mindsets, and a greater understanding of the context of the tools we use, often coincided with team-based experiences across disciplines. For example, when the cross-disciplinary team tasked with creating a visualization from the agricultural survey data could not agree on an interpretative approach to the dataset, it revealed that it is much more complicated to collaborate with a tool than to just use it alone. Several students from the course went home to gain a greater proficiency with d3.js, but everyone in the workshop gained a greater intercultural proficiency around the context of use of the tool, a proficiency that will serve graduate students in all disciplines well, wherever they may find themselves in career or life.

Rhetorical and critical mindsets are also developed through the exposure to other disciplinary orientations towards technology. When humanities students critiqued the racial or gendered characteristics of a data visualization, students in STEM — not frequently exposed to cultural concerns — took notice. The reverse also took place, where students in STEM readily noticed that humanities students would be much more recalcitrant when it was time to build, instead reading or talking through the hands on components of the exercises. On the other hand, STEM students were much quicker to build first, question later (or never), which humanities students also found difficult to understand. However, over time, it helped each set to see how certain practices and activities made certain disciplines more comfortable, and how that might translate to the building of technologies and other products and services in the workplace.

Principle 3: A DH lab can render visible systems of power that circulate in their disciplines, in the academy, and in industry

By distancing the lab from both sponsored research and academic advancement (meaning, the workshop was not geared toward either), we aimed to create a workshop that was a space for graduate students to explore the material conditions of their education and employment. Inevitably — and likely because no one in the room was in a position of power over anyone else, as the workshop was not-for-credit and lab professionals were not affiliated with the disciplines

or the tenure stream in the university — discussions became as much about labor in and out of the academy as well as the tools and methods for performing that labor.

Why do graduate students come to the DH lab? When graduate students arrived in our lab, they voiced concerns. Worried about the academic job market, about the kinds of work in industry they feel they may or may not be prepared to do, and about the kinds of menial work they already had, as RAs or as staff at the university. We are not alone, as Nowviskie writes about The Scholars' Lab at the University of Virginia:

> In the Scholars' Lab, we work for the betterment of the individual graduate students who come our way — conscious that they are laboring within larger systems that are broken and that can wound them. We want to broaden then their options and help them build the technical and conceptual skills that will enable their active engagement with the humanities well into its digital future. We hope to render them more capable of constructing new systems and of resisting inappropriate ones, from wherever they may land. [Nowviskie 2015, 126]

In this way, we agree with Nowviskie that "inappropriate" systems exist not just in the academy, but in industry and public life as well, and it is the work of professionalizing graduate students to be able to recognize inequities and injustices in their workplaces and in civic life, particularly as they surround the making, circulation, and use of digital technologies.

Conclusion

In the last several years, several essays have been written about the state of the DH initiative in the United States and its successes and challenges. In 2011, Alan Liu issued a report and a critique of DH. He asked, "Are the digital humanities ready to live up to their responsibility to represent the humanities and higher education as the latter negotiates a new relation to postindustrial society?" [Liu 2012, 11]. Liu's critique stemmed from what he saw as a divide between those who came out of humanities computing, who "lacks almost all cultural-critical awareness" and those working from new media studies, who are "indiscriminately critical of society and global informational 'empire' without sufficient focus on the specifically institutional — in this case, higher education — issues at stake" [Liu 2012, 11]. Many other critiques of the Mellon Foundation-funded American DH initiative have been raised in recent academic trade publications, such as Brennan's recent polemic "The Digital Humanities Bust" in *The Chronicle of Higher Education* [Brennan 2017]. These critiques range from upbraiding a system that would fund particular types of scholarship perceived as lacking the rigor of more conventional forms of critique, to the questioning of the value of methods in DH for textual analysis [Brennan 2017].

The workshop model and its set of principles for professionalization offer an opportunity to visualize a DH that does a different kind of work than what is often targeted in these criticisms. Much of the unrest and debate mentioned above focuses almost exclusively on past or current PI-driven, sponsored research projects in DH. What a workshop like Stories from Data makes visible is how DH might inform a digital future populated with professionals who do different kinds of work, in the academy, in industry, and in public life. The graduate students we trained experienced a curriculum that was skill-oriented, but anchored in a commitment to critical thinking and articulating their own expertise to the skills at hand. As graduate students assessing their professional trajectories and employment prospects, they experienced and interrogated the political, economic, and cultural realities of working with digital technologies, inside and outside of the humanities. They recognize the changing face of the neoliberalized university as well as industry hiring practices that largely reward experience with up-to-date technology tools devoid of the context of use. And, by working as a place for student development, the DH lab had given them opportunities to prepare for both.

Indeed, a key value of this kind of training is that it connects *ways of thinking* in addition to instilling a *specific skill set*. The Stories from Data curriculum has since been taken up in multiple venues on our campus across disciplines and participant groups. It formed the foundations of a subsequent workshop, "Decision Design for Sustainability Approaches," produced in concert with the School of Sustainability at Arizona State University. Additionally, the materials and lessons from the workshop continue to inform and be refined by interdisciplinary, data-driven research and leadership training among humanities doctoral students, STEM students, active-duty military, and student-veterans

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at the Library's Unit for Data Science (co-author Simeone serves as current Director).

Finally, and perhaps most importantly, we hope to mentor graduate students who can render visible to the public how the academy contributes to knowledge production vis-à-vis technology. This is not a new argument; in fact, many digital humanists on large-scale projects echo this call to improve the public's understanding of and engagement in DH projects. [Oh 2013] [Flanders 2013]. Further, on the week of the submission of this article, data scientist and author Cathy O'Neil wrote an op-ed for *The New York Times* titled "The Ivory Tower Can't Keep Ignoring Tech." In this piece, she argues "We need academia to step up to fill in the gaps in our collective understanding about the new role of technology in shaping our lives...It's absolutely within the abilities of academic research to study such examples and to push against the most obvious statistical, ethical or constitutional failures and dedicate serious intellectual energy to finding solutions" [O'Neil 2017]. While controversial in several respects (including her description of how data science is taught in higher education), O'Neil points to exactly the issue Stories from Data is designed to combat — our graduate students can identify and translate their role in exactly this work to multiple stakeholders after they leave the lab, and in a way that communicates their value as problem solvers in the issues of concern that O'Neil outlines here. In the case of the lab, then, the impact on the issues of "math destruction" and data and society is not measured in what is formally studied and published by faculty with the help of graduate students, but the subsequent conduct of participants in the world outside of academia or a home department. This helps DH labs to envision the training of graduate students toward careers in their own right, driven by their convictions and talents rather than labs focusing on what faculty teach or research [Anderson 2016]. As a way of engendering reflective technological practice, the workshop space is designed to avoid replication of any model, either industry-based or academic. No graduate student in Stories from Data is pursuing a PhD in data science. Their work with data — and extracting knowledge from data — is meant to enrich their understanding of storytelling and reasoning with data. Crucially, that understanding includes critique, production, and translation. While we hope that scholars based in universities continue to shed light into the need for more deliberation and oversight when it comes to the power that big data, artificial intelligence, and algorithms hold over the lives of individuals. But it has been our mission that the graduate students we train in the lab — who eventually become professionals and citizens in any number of spaces — meaningfully intervene in those same systems as they continue to challenge our ethics, values, and possible futures.

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