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COMMUNICATION DESIGN QUARTERLY

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Communication Design Quarterly

CDQ Editors

In Memoriam: Dr. Halcyon Lawrence

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On October 29, 2023, Dr. Halcyon Lawrence passed away, and our academic community lost one of its kindest, most caring, most brilliant members. She was always cheerful and energetic and willing to work with anyone who sought out her mentorship, and she made an indelible mark on SIGDOC and *Communication Design Quarterly* (*CDQ*). While peer-reviewed academic publications aren't typically a venue for pieces like this, I felt it was important to begin this first issue since her passing with a brief remembrance of how important she was to so many of us within the SIGDOC and CDQ communities.

Before discussing how Halcyon shaped our community through kindness, I first want to spend a moment acknowledging how brilliant she was. Halcyon was an excellent researcher whose work will have impact for years to come. This brief remembrance is not the place for a full accounting of her research (*CDQ* will be devoting a special section in a later issue focused on her research), but I'll mention one of her pieces that has stuck with me since I read it (and that I've assigned in multiple classes): her chapter "Siri Disciplines" in the book Your Computer is on Fire. Halcyon was always a champion for marginalized individuals, and this chapter presents a clear and incisive argument that we need a more equitable, socially just approach to the development of voice assistant technologies. She showed how voice technologies like Siri often excluded individuals who spoke non "standard"—read mid-Atlantic "white"—English. In my opinion, that chapter is just about as perfect as a piece of research can be. She makes a passionate, political call for a more equitable design future, and she does so through an extensive grounding in existing research and a close analysis of contemporary technologies. So yes…Halcyon was one of the kindest people in our community and willing to help others at a moment's notice. But we shouldn't forget that she was also a brilliant researcher who has left behind work our community will continue to build upon far into the future.

On July 1, 2023, Halcyon became the Vice Chair (VC) of SIGDOC, the organization that sponsors *CDQ*. She had already made an indelible mark on SIGDOC before becoming VC through her work as the 2021 conference program co-chair, her service on the SIGDOC advisory board, her role advising the 2022 and 2023 conference committees on technology issues, and her significant work to promote our Design Justice program. Even before assuming the official VC position, her boundless energy and willingness to help was so notable that our Executive Board presented her with an Excellence in Service plaque at SIGDOC's 2022 conference, a recognition we created specifically to acknowledge how far above and beyond Halcyon had gone in her service work. After becoming SIGDOC's VC, she pushed to expand our Design Justice program, which is a microcosm of her career-long dedication to social justice and design. The SIGDOC EC is currently planning how best to honor her memory at future conferences, but we all know that no amount of recognition can fully capture how much Halcyon impacted so many of us.

This brief remembrance is focused on just a small piece of Halcyon's rich, bountiful life. I realize that even by limiting my scope to her work with SIGDOC, I still could never capture even a sliver of her impact on our community. But my voice is just one among many, and I encourage all of you who knew Halcyon (or wish you had the chance to know Halcyon) to visit her We Remember page where so many people (including many members of SIGDOC) have left memories of how Halcyon's kindness and intelligence affected each of them.

I'm going to conclude with a brief recent memory of my own because I have not been able to stop thinking about it since I found

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out about Halcyon's passing. In late September 2023, I hurt my back and was diagnosed with a herniated disc. While many people have been kind to me since my injury, Halcyon's kindness and caring were unique. Between the time of my back injury and her tragic passing, no one—not even my own mother (who calls me a lot)— called, texted, and emailed me more frequently to check on how I was doing and ask how she could help. That's just the kind of person she was. So many people who knew her have a story just like mine, and the SIGDOC and *CDQ* communities will never be quite the same without her.

ABOUT THE AUTHOR

Jordan Frith is the editor-in-chief of *Communication Design Quarterly* and the Pearce Professor of Professional Communication at Clemson University. His most recent book—Barcode—was published as part of the Object Lessons series in 2023. His primary research focuses on mobile media and communication infrastructure. He is the author of 6 books and more than 40 journal articles in a variety of disciplines, including communication studies, technical communication, media studies, and geography. He has also published in public venues like Salon, Slate, and The Conversation and edited multiple journal special issues.

Advocating for Student Users: Comparing PDF and Canvas Webpages as Digital Readings

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ABSTRACT

This article reports on a mixed-methods study, comparing HTML and PDF documents as digital course readings in the learning management system Canvas. Our findings suggest that ideal file formats for digital readings would support a student's ability to focus on the reading and are convenient to access in their busy lives. However, what makes a file format preferable to users varies not only for different students but also for the same student in different contexts. Thus, a single file format is unlikely to be perceived by students as offering ideal usability. Our findings led to two major takeaways: 1) Provide readings in multiple formats and 2) Teach students about format affordances so they can make more informed choices.

CCS Concepts

Human-centered computing

Keywords

Usability, Learning management systems, Educational technology, Readability, Pedagogy, Accessibility

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INTRODUCTION

Technical communication is a field that, among other things, advocates for users. In fact, the Society for Technical Communication asserts in its Technical Communication Body of Knowledge that "a key role of technical communication is to serve as the primary user advocate" (Society for Technical Communication). For technical communicators who teach, a core user group for whom we should advocate is students. We should design course materials, such as syllabi, grading rubrics, and readings, to be appropriate for user (i.e., student) contexts, constraints, goals, and preferences.

To support such efforts, our research team of two technical communication professors and an accessibility coordinator conducted a mixed-methods study. This study aimed to test student preferences between two digital course reading file types—PDFs and HTML pages—within their Canvas course websites. We investigated the research question, "If students were provided course readings in both PDF and Canvas webpage formats, which would they click on? Which format do students prefer and why?" One method used web analytics to track student clicks over a 16-week semester. The second method involved interviewing students regarding their reading contexts, constraints, preferences, and habits.

Our research team began this project highly focused on affordances of the file formats. For example, Canvas webpages reconfigure line length according to the width of the browser window, so perhaps students who read on their phones would prefer Canvas webpages. But PDF files can be downloaded, so perhaps students with unreliable wifi access would prefer PDF files. In other words, we expected that many students would have or develop strong, conscious preferences for a particular file format based specifically on affordances of that format. What we learned was much more complex. Students seemed to barely register the specific file formats, perhaps because they were unaware of many of the respective affordances of Canvas webpages and PDF files. But students were intentional and targeted in their reading habits, navigating dynamic constraints that affected which format they perceived to be preferable in a given context. Our findings suggest

that the ideal file formats for digital readings are those that support a student's ability to focus on the reading and that are convenient to access—but also that what makes a reading convenient or helps students to focus varies across students and even across reading contexts for a particular student.

In the section that follows, the literature review, we discuss scholarship relevant to usability testing and instructional technologies. Next, we describe our research methods: web analytics and interviews. We then present our findings, describing student click patterns (PDF files versus Canvas webpages) and drawing upon interview data to interpret those patterns. We conclude by presenting two major takeaways of this research, as well as describing how it lays the groundwork for future research.

LITERATURE REVIEW

Little research investigates the use of PDF files in university courses, even though PDF files are the most common file type for digital course readings (Huntsman et al., 2018). The problem is that while any format can offer a poor reading experience, PDF files, especially when the result of photocopying/scanning, regularly offer poor reading experiences. Many PDF files represent text as an image that can be blurry and hard to read, not to mention unable to be copy/pasted into reading notes—sometimes even after receiving an Optical Character Recognition (OCR) scan. Further, such images of text are unreadable by screen-reading devices used by people with blindness, chronic migraines, dyslexia, and other conditions.

Specific challenges with PDF files can include the following:

> *Display Problems*: A large number of PDF files are not responsive, which means they do not automatically adjust to different screen sizes. This makes PDF files difficult to read on mobile devices. U.S. Internet users who are most likely to go online exclusively or almost exclusively using mobile devices include people of color, youth and young adults, and people who live in low-income households (Anderson, 2019). Many university students are members of at least one of these groups. This means students are likely to be accessing PDF files from course websites using small-screen devices unsuited to displaying these documents.
>
> *Download Problems*: PDF files are delivered inconsistently on different browsers and can disrupt the online reading experience—sometimes opening in a new tab or downloading to the student's desktop, taking students out of the course learning management system (LMS). Students with lower levels of technological literacy may not know how to access their PDF readings from the course LMS: when they click, nothing seems to happen.

Research has demonstrated that typically PDF files offer a worse reading experience than HTML on the web. In fact, usability experts Nielsen and Kaley claim that PDF files are "unfit for human consumption" (Nielsen & Kaley, 2020), reiterating an argument that Nielsen (1996) has made for over 20 years. Library research came to similar conclusions regarding the accessibility of files in article databases (Konicek et al., 2003; Stewart et al., 2005). None of these criticisms are discussing course websites, but, despite the applicability of these problems to university course readings, little research has compared PDFs to alternative formats as course readings.

One alternative to PDF files is to provide digital readings as Canvas HTML webpages. For those unfamiliar with Canvas, it is an LMS similar to Blackboard, in which instructors and course designers can house their syllabi and assignments online and provide a digital portal for students to submit their work. LMSs are often used in online and in-person courses. The general experience of Canvas webpages is text-based. Of course, instructors could put an image file in Canvas that was inaccessible, and PDFs can be designed to be more accessible. However, it is more often that a PDF presents problems that a default HTML document in Canvas simply does not. It is perhaps no surprise, then, that a pilot study investigating student course-reading preferences (PDF files vs Canvas HTML pages) in two classes (N=36 students) found that more than 70% of students preferred the Canvas webpages to PDF files (Noyes, 2019).

To be clear, the PDF file format may offer affordances such as the ability to download the file for offline viewing or a better print experience. Canvas HTML pages, on the other hand, generally provide a more usable and accessible default reading experience for students and instructors. The default structure of the Canvas HTML page (headings, paragraph, etc.) is signaled to screen readers, and the line length will resize for mobile phones and zooming. An instructor can also edit a Canvas HTML page quickly and easily. By default, the Canvas editing experience has built-in guardrails that don't allow some types of inaccessible practices that are commonplace in PDF files. For example, PDF files may not include any accessible text and no coded structural headings (e.g., H1, H2) that will enable someone using a screen reader to recognize different sections, while every Canvas page by default has a heading coded at the top of each page, an important feature for assistive technologies. However, in contrast to the usability of a PDF file, reading Canvas HTML pages requires an online connection and access to the Canvas LMS.

While the different affordances of each file format are important, an affordance is useless if users are unaware of it. Thus, another relevant issue is how familiar students are with the various affordances of each file type: PDF files and Canvas webpages. Prior research, such as that of Daer and Potts (2014) and more recently of Harper (2021) has demonstrated the folly of assuming that students are expert users of educational or professional technologies just because they may be social media experts. As Harper noted, educators should not assume that just because students "use technology as a personal tool to curate their lives… that these students have superb technology skills" (p. 144). Rather, her research and that of Daer and Potts (2014) has challenged myths that assume technological expertise based solely on a user's age, making the case that students need to be taught digital media technologies and best practices.

Added to the challenge of negotiating with students' lack of familiarity with affordances of file formats is the problem that instructors might not know of the different affordances either. It is not uncommon for a higher education teacher to inherit a syllabus and readings from another professor who previously taught a class. This might include a host of course readings that were scanned from books or old PDF files that display only as images. Coupled with a heavy workload, many higher education instructors simply won't have the time to make such readings accessible, even if they do have knowledge of how to make a PDF file more accessible

or have the ability to transfer the text to a Canvas HTML page. Still, to give students the most usable and accessible experience, TPC instructors should guide students in exploring, practicing, and using the range of technological affordances that can make instructional technologies a better fit for students' preferences, devices, and constraints. Therefore, to begin working toward this process, we designed a study to investigate student click behaviors when presented with two file formats as digital readings: one format more likely to be familiar to students (PDF files) and one more likely to be novel, at least in the context of course readings (Canvas webpages). We chose not to teach participants about the affordances or constraints of each file format in order to prevent introducing bias into their click behaviors.

Different types of usability testing have been applied to course development research (Bartolotta et al., 2017; Warner & Hewett, 2017). For example, Bartolotta et al. demonstrated how beneficial usability testing can be to online teacher training, which in turn is important to professional development in technical communication program administration. They argued that testing the usability of a course can "speak volumes as a result of a user engaging with it; working to understand it; and navigating it in search of information, meaning, and additional tools and resources" (Bartalotta et al., 2017 conclusion, para 1). In other words, if we're going to be user advocates, let's advocate for students.

For this study, conducted at a land-grant state university with over 20,000 students, we used the ISO definition of usability: "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use" (International Standards for Organization, 2018, 3.1.1). In this study, the product is digital readings for university courses, the specified *users* are students in those courses, and the specified *goals* include preparing for and participating during class. The specified *contexts* include all environments in which students read for class, from their dorm room to their workplace to the public bus, under conditions that vary from quiet and private to loud and frequently interrupted. Rohrer (2015) has recommended using multiple methods to get at different aspects of usability for the same product: e.g., exploring both behavioral considerations (what do users do?) as well as attitudinal considerations (what do users think?). The web analytics method recorded one particular user behavior: When presented with two versions of every reading, without which did users click on? The interviews explored user attitudes and preferences, soliciting student perceptions of all three qualities of usability—effectiveness, efficiency and satisfaction—in students' reflections on file affordances and constraints in the contexts of their actual reading habits. In this way, our mixed-methods study investigated not only what students did (their click patterns) but also what they thought (their perspectives and preferences when reading for class).

METHODS

Method 1: Web Analytics

In Fall 2021, we provided online course readings (245 total readings) in both PDF and Canvas webpage formats to 539 undergraduate students in 26 courses and monitored their click patterns throughout the semester. We secured IRB approval for the study (IRB Protocol #12010), which required a Memorandum of Understanding with the university's Assistant Vice President of Academic and Instructional Services to enable us to intervene in students' learning environments by providing links to every digital reading in two formats: PDF files and Canvas webpages. To avoid potentially influencing student behavior, we did not inform students of this intervention; neither did instructors inform their students why every reading was provided as both a PDF file and a Canvas webpage.

To access a sizable undergraduate population that varied by major, we recruited instructors of general education courses taught in Fall 2021 whose courses included at least four digital readings. To mitigate any effects of order (i.e., possible tendency for students to click the first link just because it appeared first), for every participating course, the order of links alternated: all readings were provided in both formats, with half the readings listing the PDF link first and half listing the Canvas webpage link first, as represented in Figure 1.

Figure 1: *Students and Format Clicks — All Users*

Canvas already tracks student clicks and file downloads, and author 3 has access to this information in his position as digital accessibility officer at Utah State University. With IRB approval, he accessed the following web analytics data for every participating course:

- Number and proportion of student clicks on digital readings provided as PDF files and as Canvas webpages
- Proportion of clicks on the file format that was listed first
- Number of students with 66% or more of their clicks on Canvas webpages
- Number of students with 66% or more of their clicks on PDF files
- Number of students with more mixed clicked patterns
- Number of PDF downloads versus number of PDF previews within the LMS
- Click patterns over time

We cleaned the data to eliminate noise such as accidental double-clicking—e.g., two clicks on the same link less than a second apart—and clicks originating from a source that did not list both file types—e.g., a Canvas announcement in which the instructor linked only to the PDF file of a particular reading. We also had to discard from our analysis less than 600 clicks originating from the Canvas mobile app. This is because we did not realize that the web analytics for the mobile app tracked only student clicks on Canvas webpages and not clicks on PDF files—preventing us from being able to compare clicks on each file type. Even though the discarded data was less than 7% of the overall clicks, this creates a research limitation in terms of understanding students' mobile-reading patterns. This limitation creates an opportunity for future research that focuses on students who use mobile devices to access their course readings.

Method 2: Interviews

To better understand the web analytics findings, we interviewed a total of six students, two from each group:

A. Students whose click patterns focused all/mostly on Canvas webpages

B. Students whose click patterns focused all/mostly on PDF files

C. Students whose click patterns were more evenly mixed

To identify potential participants, we sorted students into groups by click patterns, setting 66% as the minimum threshold for the PDF and Canvas webpage groups. In other words, when considering student clicks on only digital readings (not clicks on any other links in the course website), students with 66% or more clicks on Canvas webpages were categorized in group A. Students whose total number of clicks on digital readings was 66% or more on PDF files were categorized in group B. And students whose clicks were 34–65% Canvas webpages and 34–65% PDF files were categorized in group C. We sorted groups A and B by percentage with most-focused click patterns first (e.g., zero clicks on PDF files; 14 clicks on Canvas webpages) and the mixed group with the most balanced patterns first (e.g., 12 clicks on PDF files and 12 clicks on Canvas webpages) and invited students to participate in interviews starting at the top of each list until we successfully recruited two students from each group. Table 1 shows the click patterns of each interview participant:

Group	Pseudonym	Percentage of Clicks	Number of Clicks
Group A: PDF files	Pete	88% PDF files	3 clicks Canvas; 22 clicks PDF
	Priya	94% PDF files	1 click Canvas; 16 clicks PDF
Group B: Canvas webpages	Carlos	100% Canvas pages	30 clicks Canvas; 0 clicks PDF
	Candi	100% Canvas pages	38 clicks Canvas; 0 clicks PDF
Group C: Mixed	Myrtle	50%	13 clicks Canvas; 13 clicks PDF
	Marcus	51% Canvas pages	29 clicks Canvas; 28 clicks PDF

Table 1: *Interview Participant Click Patterns*

Interviews were conducted via Zoom and ranged from 17–20 minutes long. We used Zoom's auto-transcription feature to create an initial text transcript, which was compared to the video recording and corrected before the videos were destroyed. Every interview addressed the following topics:

- Reading behaviors: e.g., print the file and read it on paper, listen through a device reader, read directly on screen using a laptop
- Reading contexts: e.g., in public, noisy environments like a coffee shop; in quiet public environments like a library; in quiet, private environments like a dorm room
- Reading preferences: i.e., factors that make a digital reading format for university courses good or desirable

The interviews were conducted primarily to provide rich snapshots of students' reading habits to help us interpret the web analytics patterns and understand how particular contexts and factors may affect the ways students engage with digital readings for university courses.

FINDINGS AND IMPLICATIONS

Proportion of Total Clicks

The proportion of total clicks on PDF files versus Canvas webpages was relatively balanced: 48.22% on PDF files and 51.77% on Canvas webpages (Table 2).

Reading Format	Total Number of Clicks	Percentage of Clicks
PDF File	4003	48.22%
Canvas Web Page	4297	51.77%

Table 2: *Overall Clicks for Both Reading Formats During the Entire Semester by All 539 Students in All 26 Participating Classes*

These results lead to multiple questions. Why was there a relative balance in overall clicks? All the readings were presented in both formats (PDF and Canvas webpage), alternating which format was presented first. Do these results mean all or most students clicked on the first link they encountered, and therefore the results are relatively balanced? Are there different reading scenarios, contexts, or needs that lead students to click on one file format over the other? We present additional findings below to address these questions, but the interview participants do contextualize the overall proportion of clicks and can help us interpret this relative balance in student selection of PDF files and Canvas webpages as course readings. The potential reasons for this balance go beyond a static preference of one file type over the other; rather, students make deliberate choices based on multiple contextual factors.

Interview participants said that the ability to maintain and retain focus was a major consideration when choosing how to access course readings. When describing their habits in reading for class, all six interviewees raised the topic of focus, a pattern we found significant because our interview protocol did not introduce this topic. Students also talked about choosing a reading format based on convenience, though what made a particular file format more convenient than the other depended on specifics of student reading contexts.

While the format does matter to students, their course-reading preferences related to multiple factors beyond just affordances of the file formats. In other words, the interviews can help us interpret the relatively balanced overall click pattern (48.22% PDF; 51.77% Canvas webpages). It is not primarily because different students have different static preferences in file formats. Rather, we learned that individual students are employing different reading strategies in response to contextual factors that make one file format seem more convenient than the other at that moment or that help the student to maintain their focus on the reading under their current circumstances.

For example, Pete (88% PDFs) remarked that he would often get distracted while reading, so the format that best helped him remember where he was when coming back to the reading was important:

> A lot of times I'll start thinking about other things and start getting distracted or thinking I need to do a lot of other stuff and then I real-

> ize, 'oh, I also need to do this reading and then I'm not doing it at all.' I just find my thoughts wandering. And then I have to remember where I'm at.

Pete also noted that he doesn't read at home because it's too easy to get distracted there. For similar reasons but with different conclusions, Myrtle (mixed selection; 50% each) said she reads at home or the library in order to avoid distractions: "It's kind of my own space and so I don't get bothered as much so I can focus better." Carlos (100% Canvas webpages) felt that his ability to focus on the course readings was affected by the device he used to access the reading (e.g., laptop, tablet, phone, etc.) but not necessarily because one device was more usable than the other. Rather, he associated specific devices with certain kinds of usage, explaining that he uses his laptop for school and his phone for entertainment and socializing. This distinction helps him stay focused. In brief, Pete, Myrtle, and Carlos, when asked how they choose and read course readings, each pointed to factors related to the ability to retain focus, discussing factors outside of the file format affordances, such as reading location and device used to access the reading—factors that help contextualize the overall click data.

Pete and Myrtle each commented that they often did not finish a reading in one sitting and would lose their focus between reading times. Myrtle works at the university library and tries to get homework and course readings done during downtime. She doesn't like PDFs because if the reading gets interrupted by a patron, she has to close the PDF immediately without manually noting her place in the reading. When she comes back, she has to scroll through the PDF to find her place. However, the same experience can happen in Canvas, as Candi (100% Canvas webpages) noted: "sometimes reading it on the [Canvas] pages can be annoying because sometimes you'll leave the tab and go back, and it'll have restarted you back at the beginning of the document." Comments like these suggest one possible interpretation for the variation in overall click data: students perceive each reading situation differently and think that one format is a better option for a particular situation. However, students are not experts on each file format. Such comments show that while we designed the study to measure for students' perceived affordances and constraints of the different file formats, interviewees continually mentioned particular contextual factors outside of the formats themselves—from professional work responsibilities to devices used—as having influence on their format choices.

Past technical communication and digital pedagogy scholarship advocated that instructors provide course content in a variety of modalities (Bourelle et al., 2015; Shipka, 2011). However, providing content in multiple modes—for example, course readings in both text and audio versions—does not automatically offer a better experience for everyone (Jarrett et al., 2013; Phillips & Colton, 2021; Zdenek, 2015) and can significantly increase the workload of an instructor. If students find one mode to be low quality, such as text-to-speech audio, that mode goes unused. For example, interviewees have found listening to course readings to be a poor experience. Marcus (mixed selection; 51% Canvas webpages) noted he would be interested in listening to course readings if he had control over reading speed, but only Priya (94% PDF files) actually listened to some of the course readings. She did not like the "robotic" voice and said that she would not use the Canvas feature but instead a free text-to-speech website when listening to readings.[1]

Candi (100% Canvas webpages) also mentioned not liking the "sound of the voices" in text-to-speech software. Carlos and Pete each made the case against listening to course readings in general because they had trouble focusing on the reading when listening to it. Each explained that if he did choose to listen to a course reading, it would be so he could listen while performing another activity. However, they both thought this compromised their ability to focus on the reading and retain the information. From Pete:

> I find that when I do listen to it, I'm just kind of doing it to get it out of the way, and if I actually need to pay attention and take notes, then I'm actually not engaged, and I end up having to reread it anyways.

Thus, while text-to-speech versions of course readings appeal to some students, and the technology is improving, their perception of the text-to-speech feature currently offered by Canvas would need to be improved (e.g., variable speed control and improved quality of voices) to produce a mode that they believe supports their ability to focus and offers a convenient, usable option. Importantly, students would also need to be explicitly taught about those improvements and how to access the text-to-speech mode.

Other factors related to convenience, such as perceptions of time management and efficiency, also impacted students' course-reading choices. Priya commented that time management was always crucial and often led to reading right before a class:

> Whenever I do online readings for class, it would mainly be in, like, my dorm room. Or sometimes it would be, like, the hour before class because I just had a ton of classes going on, you know, and so sometimes it's hard to make time for those readings.

Regarding efficiency, Myrtle mentioned she preferred all of her readings to be located in one place. She likes "one-stop shop" options such as Bookshelf, where digital textbooks for all her different classes are available in one online location. Accessing the Canvas webpages and PDF files alike requires logging into Canvas and selecting the specific course. PDFs open in a preview window or download, and Canvas webpages open in the same browser tab. One might assume that as a result of this desire to have all course readings in one place, students would download all their PDFs into one folder on their computer so they would always have all the readings in one place. However, we did not find that students did that (refer to PDF Downloads section below). Creating such a folder, of course, would require preplanning for future access to readings. With time management being a challenge, perhaps it is little wonder that students did not engage in such a strategy. But if such a one-stop-shop online location for course readings did not have to be created by the student, we can imagine many students taking advantage of that convenience.

Interviewees also mentioned desires for convenience such as when a course reading requires as few clicks as possible to access and when a course reading is easy to find, whether as a link or a file. Such issues of convenience come down partially to design of the class website, of course, and are not affordances of the file

1 As comments about text-to-speech audio being robotic demonstrate, students were not distinguishing among features built into Canvas, features they could access on their own through different software, and features linked from Canvas to the other webpages. These options all seemed part of the same experience to them. This means that some of these comments were more about their general opinions of multiple modes rather than a direct reflection of the experiences they had in the class that was part of the study. This reiterates the need to teach students about file format affordances.

format itself. Relatedly, the interviewees mentioned that at times they would use their phones to read course readings but only if that reading was considered short or easily accessed outside of Canvas. For example, Candi mentioned if the assigned reading was a Shakespeare play, she might just search for it online, outside of the Canvas, and read it on her phone. However, multiple students indicated that they would use their phone for course readings only if their laptop was unavailable or would need to be booted up and thus take extra time to access. In general, if the phone offered a more convenient way to access the reading, they might consider using their phone. But interviewees said they prefer reading course materials on computers because of more convenient features such as searching for a word or phrase.

Importantly, this response reinforces TPC research that has argued we should not assume that students will know how to use educational technologies or that they will understand the benefits of one file format over another (Daer & Potts, 2014; Harper, 2021). For example, a person can search for words or phrases in most phone browsers, but multiple interviewees didn't know this was possible. Similarly, Marcus said he preferred PDF, but his selections were actually mixed. When he learned this, he said that he probably clicked on the Canvas webpage readings because they would appear within Canvas: "because [if] I had to pull it up real quick, it was just right there in the module." However, the links to the PDF files were also "right there in the module." These two examples demonstrate how a lack of knowledge can easily influence a student's perception of whether one file format is more usable than another and that such a perception may be based on inaccurate or incomplete understandings of the file formats. This finding is valuable for interpreting the balanced click patterns in the web analytics data: many students have intentional reading habits (including file format selection), but such habits may be built on incorrect presuppositions.

Therefore, the relative balance in overall click patterns may initially appear to be a simple thing: a little less than half the clicks were on PDFs, and a little more than half the clicks were on Canvas webpages. We might assume on its face that the web analytics data means it does not really matter which format is used for course readings because half the clicks were on one and half on the other. But the interviews suggest that much is going on beneath the surface for students when they are accessing their readings and that many of these factors are things instructors cannot predict or control.

Author 3 is a digital accessibility officer with more than a decade of experience with LMS support at Utah State University (USU). He has access to all USU Canvas course websites and has improved the usability of hundreds of courses. He confirms that the status quo at USU is for most digital course readings to be provided solely as PDF files. Introducing a new option—in this case, Canvas webpages—certainly disrupted the habits of many students: i.e., when the students were offered two choices, instead of sticking with the status quo, more than half the clicks on digital readings were on Canvas webpages.

Overall, we learned in the interviews how intentional many students are in their reading habits, even as they might not completely understand the affordances and constraints of each format: just because they might read one format over and over does not mean they are rabidly supportive of that format. Similarly, those students who have mixed selections are not necessarily clicking on links randomly. Such nuances are why it is so important to look below the surface of the reading-selection patterns. The overall click patterns, which imply balance in preference, do not tell the whole story of comparing PDF files to Canvas webpages. As discussed in the next section, when honing in on the data, even more nuanced patterns emerge, reflecting format preferences.

Order of File Formats

As mentioned above, the relatively balanced number of overall clicks led to multiple questions, including, "Do these results mean all or most students clicked on the first link they encountered, and therefore the results are relatively balanced?" Answering this question is important because it helps us understand student choices and that those choices can turn into habits even if students are not consciously reflecting upon those choices. One way to address this question is by filtering the data for students with high numbers of clicks on course readings throughout the semester. In other words, if we filter the data for students who click the most often on digital course readings throughout the semester, do we start noticing any shifts in the patterns of clicks? In short, yes. Restating this question another way, as students became more familiar with the course readings provided as both PDF files and Canvas webpages, did they continually select the first one listed or begin to develop patterns (possibly habits?) of selecting one file format over the other? As tables 3–5 show below, when we filtered the data for students with high numbers of clicks on digital readings, click patterns began to favor more clicks on the Canvas version of readings; again, this wasn't because the Canvas webpages were listed first. Students began clicking on Canvas webpages regardless of order.

Format Listed First	% of clicks on that format
Canvas	60.11%
PDF	56.95%

Table 3: *Impact of Which Format was Listed First*

Table 3 shows the percentage of clicks on a file format when that format was listed first. When Canvas webpage course readings were listed first, they were selected 60.11% of the time; when the PDF file was listed first, it was selected 56.95% of the time. The data suggest that the order of the files does have an impact on student selection, with a slight majority of clicks being on whichever format was listed first. It is not a strong majority, though, and many students deliberately chose one format over the other no matter the order (discussed in detail in the next section).

Format Listed First	% of clicks on that format
Canvas	62.58%
PDF	54.48%

Table 4: *Impact of Which Format was Listed First for Users with at Least 10 Clicks*

Format Listed First	% of clicks on that format
Canvas	64.43%
PDF	51.67%

Table 5: *Impact of Which Format was Listed First for Users with at Least 20 Clicks*

Table 4 shows that students with at least 10 clicks on course readings over the semester selected the Canvas webpages 62.58%

when that file format was listed first. In comparison, the percentage of clicks on PDF files when the PDF was listed first decreased to 54.48%. This difference in selection percentage increases even more when accounting for students who clicked at least 20 times on course readings (Table 5), with students clicking on Canvas webpages over 64% of the time when that format was listed first, and students clicking on PDFs 51.67% of the time when that format was listed first. We interpret the findings represented in Tables 3–5, then, to suggest that the order of reading formats became less influential on students with higher numbers of clicks on course readings. This pattern suggests that as some students became more familiar with the reading format options, they habituated choosing a certain file format.

With every reading provided in both formats and the order of formats alternating, one might think that students who clicked so consistently on a particular format would have a strong preference for it. Surprisingly, though, even as the six interviewees were conscious of their own deliberate reading strategies, none said they were a strong proponent of one format over the other. And none of the interviewees appeared to just habitually choose whichever format was first. They may not have even realized the formats were listed in alternating order. Pete admitted, "I honestly don't think that I did [notice]." Marcus asked in reference to his selection choices, "Which group was I?" Candi said she thought there were benefits to both formats, though she consistently selected Canvas webpages. Priya said she preferred PDFs (if not strongly) to the Canvas webpages, which did match her selection choices. Carlos noted that he didn't realize there were two course reading options or that they were presented in alternating order: "I honestly had no idea." Nevertheless, before learning which format he selected most often, Carlos guessed he would prefer the Canvas webpages. When he was informed that was correct, he tried to think about why he would have chosen that format consistently:

> I'd imagine that I'd probably do an LMS page just based off of my habit of it, I suppose. I guess I just found a method I liked and just stuck to it, but I honestly did not know that it was more LMS pages than not. [...] I don't think I have anything against PDFs, naturally, but I guess the habit of just the LMS page was nice."

Carlos consistently chose Canvas webpages, even when they were the second link listed. If his selections were habitual, as he surmises, that habit was not based on file order but on file format.

Consistent Clicks on a Single File Format

Although some students did not even notice that digital readings were provided in two formats, many students did consistently click on one specific format throughout the semester—a pattern of behavior suggesting student preference, even if that preference is based on largely unconscious habit rather than on intentional selection due to file format affordances. To identify the prevalence of consistent clicks on a single file format among student participants, we sorted the web analytics data by click patterns.

We organized students into three groups based on their total clicks on readings during the semester:

- Group A: 66% or more on PDF files; students presumed to prefer PDFs
- Group B: 66% or more on Canvas webpages; students presumed to prefer Canvas pages
- Group C: 34-65% per format; students with mixed click patterns

In designating 66% as the threshold for groups A and B, our reasoning was that if students clicked on, for example, PDF versions of readings with at least two out of every three clicks, those were students likely to be developing habits based on file format rather than on file order. This likelihood is, of course, more plausible for students with a high number of clicks.

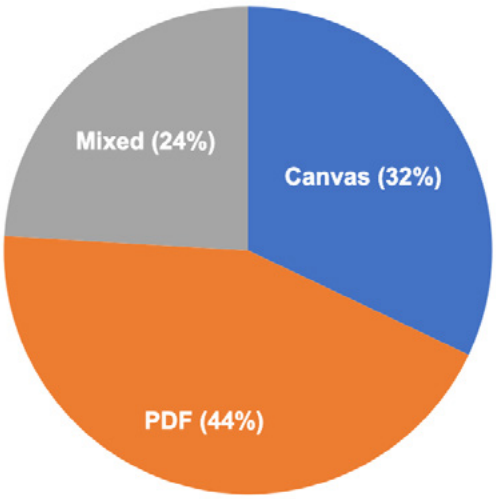

Figure 2: *Students and Format Clicks - All Users*

Figure 2 shows the proportion of these groups when accounting for every student who clicked on at least one digital reading throughout the entire semester: 539 students. The largest group was Group A, students who clicked on PDF files at least two-thirds of the time: 44% (237 students). The next-largest was Group B, those who clicked on Canvas webpages at least two-thirds of the time: 32% (173 students). And the smallest was Group C, those with mixed click patterns at 24% (130 students). Because we alternated the order of reading formats, students who accessed several readings during the semester by just clicking the first link would easily fall within the percentage range of the mixed group (Group C). We interpret the findings represented in Figure 2, therefore, to suggest that the majority of students are reasonably consistent in selecting a particular file format for their digital readings. In other words, the pattern of data suggests that it matters what format instructors choose for digital readings because 76% of students selected the same file format 66% of the time or more. The smallest group was the one with mixed patterns.

However, the click pattern data do not suggest that a single file type is always perceived as more usable or is more preferred by the vast majority of students, and interview data helped to illustrate why. Interview participants described their reading habits and the contexts in which they read for class, revealing how even small differences can make one file type more usable. Myrtle, Marcus, Carlos, and Pete typically take notes: Myrtle jots on paper sticky notes first and then types up her notes in Microsoft OneNote; Marcus takes screenshots with his phone and highlights key passages with

the Markup app; Carlos and Pete pull up a Word document side by side with their reading, typing notes as they read.

Carlos and Pete's approach may seem better suited to Canvas webpages than to PDF files because on Canvas webpages, the length of the line of text reconfigures to fit the width of the browser window. This reconfigurability allows readers to pull up their notes and their reading side by side, adjusting the width of each window to fit the screen without cutting off the edge of the text. For a laptop (Carlos's device of choice), this is true; indeed, Carlos consistently opened readings as Canvas webpages. But Pete typically reads at work in a computer lab where he uses the lab's desktop computers, which have wide monitors. He explained that for Canvas webpages the lines of text can get too long to easily read and that he likes to zoom in on the PDF, making the text larger for easier visibility. With a PDF, he can just zoom in until the text size is comfortable. This makes PDFs more convenient to his specific reading context: Because the line length does not change, that is one fewer factor to adjust. More rarely, Pete reads for class using his laptop. If the PDF text is too small when opened alongside a Word Document, he may open the reading as a Canvas webpage instead. This example helps to explain why even students with similar reading habits (e.g., pulling up notes and readings side by side on a computer) may find different formats more preferable (e.g., choosing Canvas webpages if they read on a smaller screen like a laptop and choosing PDFs if they read on a wide monitor).

We hesitate to fully rely upon proportion of clicks as a proxy for student preference due to the possibility that the behavior could reflect coincidence rather than preference, especially for students with very few clicks. For example, 11 students clicked on digital readings only three times all semester: 2 clicks on a Canvas webpage reading and 1 click on a PDF reading. Do those 11 students really prefer Canvas webpages for their digital readings? Maybe. It is hard to tell. Therefore, we filtered students to include only those with at least 10 clicks on digital readings and again to those with at least 20 clicks on digital readings. This enabled us to compare filtered data to unfiltered: i.e., proportions of Groups A, B, and C among students with enough clicks to suggest intentional format selection compared with proportions of Groups A, B, and C for all students who clicked on at least one reading. Comparing group proportions produced some interesting patterns.

Figure 3 shows the proportion of groups by click pattern, with all students who clicked on at least one reading (539 students) on the left, students with at least 10 clicks on readings (249 students) in the middle, and students with at least 20 clicks on readings (138 students) on the right. One pattern apparent in these graphs is that the proportion of students who clicked on PDF files at least 66% of the time (Group A) decreases as we filter data for higher number of clicks on digital readings. In fact, Group A (PDF) goes from the largest proportion (44%) down to 32% when filtered for students with at least 10 clicks, and down to the smallest proportion (26%) when filtered for students with at least 20 clicks.

To interpret the difference in proportions of Groups A, B, and C when filtering for the numbers of clicks, we can imagine several possibilities. Utah State University has an unusually high proportion of undergraduate students who are married, work full time, and pay for their own education. They are busy. It is possible that some students in Group A with very few clicks just clicked on what is most familiar: a PDF file. Busyness could account for the behavior of some students with 20+ clicks in Group C as well: perhaps they read in short bursts while on the go, clicking several times on each reading before they're able to complete it, and they just click whichever link is listed first. The data showed that among students with more clicks reading before they're able to complete it, and they just click whichever link is listed first. The data showed that among students with more clicks on readings, a greater proportion of them click solely or mostly on Canvas webpages. Canvas webpages are likely to be a less-familiar file type, given the prevalence of PDFs on college course websites. So perhaps many of these active clickers are deeply engaged students who explore the affordances of file types thoroughly and find Canvas webpages to better meet their needs for a digital reading format. The same could be true for many members of Group C (mixed click patterns): they may be making intentional format selections based on fine-grained factors in their reading contexts, such as internet connectivity, screen size, and speed of use (e.g., which device is ready to hand). Given the range of contexts and factors that emerged in the interview data to help interpret the click pattern behaviors, we recognize that the most accurate answer to our research question, "Which format do students prefer and why?" is, "it depends."

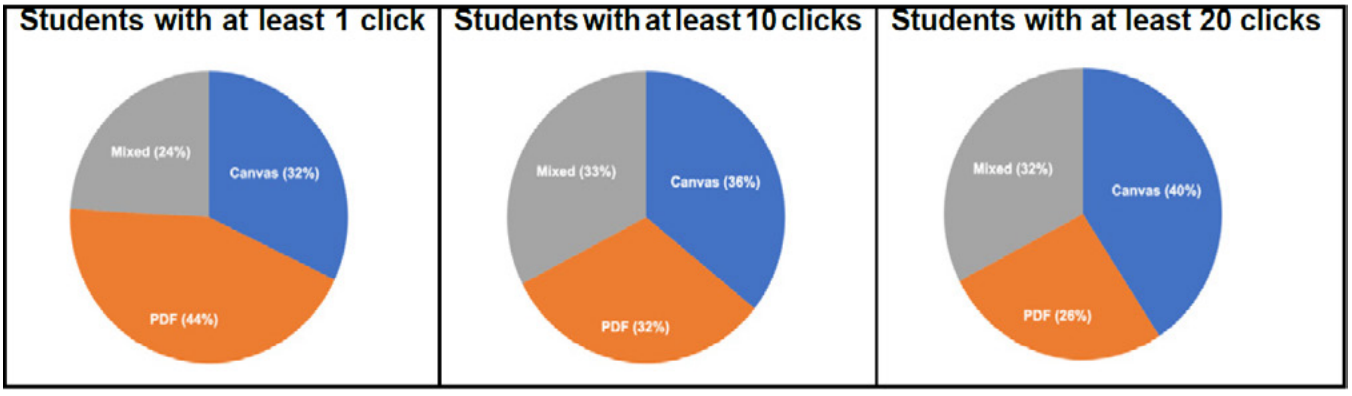

Figure 3: Proportion of Groups A, B, and C

PDF Downloads

Initially, we thought PDF downloads might account for the pattern of Group A shrinking as we filter for students with more clicks on digital readings. In other words, perhaps many students with fewer clicks simply downloaded the PDF version of their readings. After downloading the file, they could continue to access the reading as needed without generating additional click data. However, there were not enough PDF downloads to account for the decrease in Group A as we filtered for students with greater numbers of clicks. Of the 8,300 total clicks on digital readings across all participants, only 358 clicks (4.3%) were PDF downloads. The vast majority of clicks on PDFs were not downloads but rather were file previews within the Canvas interface (91.6% of PDF clicks were previews). Only 82 students (15.2% of students) downloaded any PDF files, most of them (54 students) downloading two or fewer PDFs all semester. So we feel confident that PDF downloads are not the reason for significantly fewer clicks on PDF files among students with more clicks.

This rarity of PDF downloads was surprising, especially in light of the interview data. Several students said that when they read for class, they rarely read an entire document from start to finish without interruption. Myrtle and Pete both do much of their reading for class at their on-campus jobs—Myrtle in the library and Pete in a computer lab—pausing as needed to help patrons and coming back to their place in the reading, as mentioned in an earlier section. These pauses only occasionally are long enough for Canvas to time out; a bigger challenge for these students is locating their place when they return their attention to the reading again.

Marcus, Candi, and Priya said they tend to read in even shorter chunks, opening the reading anew each time and fitting in reading opportunities as possible on the go. They each mentioned specific factors that made file formats easier or harder to use when reading in short bursts. Priya typically downloads PDF readings onto both her phone and her laptop so that she can access readings without wifi access. For example, one of her jobs involves driving to people's houses. If she arrives early and has to wait outside in her car, she'll open a PDF on her phone and do a little reading. Candi reads on the go whenever a moment presents itself: commuting to/from campus on the shuttle bus, popping into a nearby room between classes, and occasionally reading in her dorm room. In her room, she uses her laptop because of its larger screen, but when reading on the go, she uses her phone because it's always with her and doesn't have to be booted up each time. She does not read PDFs on her phone because either the text is prohibitively small or sideways scrolling makes return-sweeps (i.e., the eye movement required to get from the end of a line of text to the beginning of the next line of text) prohibitively difficult. She explained that Canvas webpages do not offer a convenient reading experience either; it's just less bad. Her access times out, so whenever she finds a serendipitous moment to read, she has to log into Canvas or open the app, navigate to the particular course and reading, and then find her place again. Marcus also reads in short bursts: either in the car while his partner drives him to campus or during class. In the car, Marcus pulls up readings on the phone, typically as a PDF. He takes screenshots of key passages as he reads, highlighting text in the Markup app. In class, he pulls up readings on his laptop, often as a Canvas webpage. He offered several reasons: sometimes the class engages with other areas of the course website during class, so he may have Canvas open anyway; his classroom has good Internet connectivity so Canvas webpage access is reliable; use of cell phones in class is discouraged, so he pulls up readings on his laptop; and he uses the search function to locate passages in the reading relevant to the class discussion so that he can contribute. (He explained that it's difficult to use the Canvas search function on his phone.) Snapshots like these from the interview data can help us make sense of click patterns, recognizing the complexity of student reading habits and constraints and helping account for the rarity of PDF downloads.

Click Patterns over Time

There is a long-established pattern of PDF files as the predominant format for course readings, so students were likely to be accustomed to accessing readings as PDF files. Course readings as Canvas webpages, on the other hand, were likely a new experience for many students, so we anticipated it may take some time for students to develop familiarity with this format and determine if they like it better. Therefore, we sorted the web analytics data chronologically to look for patterns. To determine whether student click behavior changed over time, we divided the 16-week semester into four 4-week "months" and compared the proportion of total clicks on each format over time. We found that as the semester progressed and students presumably became familiar with both formats, the proportion of student clicks on Canvas webpages increased each month. During the first month, the proportion of clicks on Canvas webpages slightly outnumbered the proportion of clicks on PDFs (refer to Table 6), increasing each month until the last month when three out of every five clicks on readings were on Canvas webpages.

Reading Format	**Month 1**	**Month 2**	**Month 3**	**Month 4**
Canvas Web Page	50.3%	50.5%	57.5%	60.2%
PDF File	49.7%	49.5%	42.3%	39.8%

Table 6: *Students and Format Clicks Broken up by Total Number of Clicks.*

The month-by-month increase in the percentage of clicks on Canvas webpage content is shown in Table 6. Importantly, Table 6 shows proportion, not number, of clicks on digital readings. As is typical in many college courses, the number of assigned readings dwindled later in the semester. So the number of clicks in the last two months was much lower than the number of clicks in the first two months of the semester, as shown in Figure 4.

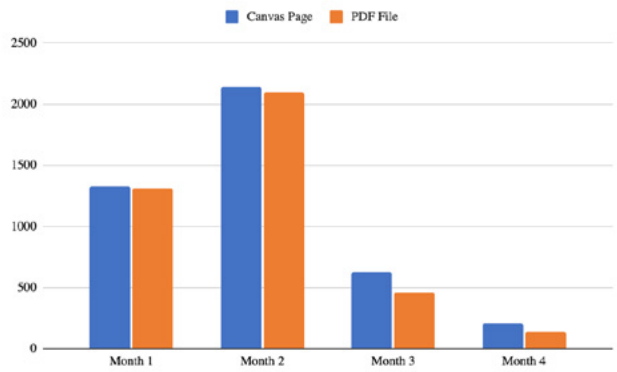

Figure 4: *Number of Clicks by Format by Month*

We find this pattern—increasing proportion of clicks on Canvas webpages over time—to be intriguing, especially alongside the pattern that students with higher numbers of clicks on digital readings were more likely to click on the Canvas webpage format. These patterns together suggest that increased exposure to Canvas webpages might lead more students to recognize when this format is more preferable for their reading contexts.

Conclusions and Future Research

In this article, we have shared findings from a mixed-methods study, reporting on 1) student behaviors when presented with two file format options for readings linked from course websites and 2) student perceptions of what makes digital readings preferable. Rather than fulfilling our expectations that students would select one format as the preferred option based on its respective affordances, study findings were more complex. Interview data suggested that many students may not pay much attention to file formats, at least not to investigate affordances and select one as the "favorite." Rather, students were highly attuned to factors that would help them focus when reading for class and factors that made readings convenient to access and use.

This finding is one major contribution of this article: that the factors affecting focus and convenience—even for a single individual student—are widely variable in ways that make different file formats preferable, depending on context. Admittedly, some factors students identified as relevant to focus and convenience are outside the control of instructors: e.g., reading silently in the same room with friends to avoid the distraction of feeling that you're missing out on social activities. But we also learned that students may be unaware of affordances that could make one file format preferable within particular contexts: e.g., the ability to conduct a word search when accessing Canvas webpages by phone. For this study design, we opted not to review the affordances of each file format with participants to avoid introducing bias into student-click behavior. Given the widespread use of PDF files as course readings, we imagine that many participants may have begun the semester unfamiliar with course readings provided as Canvas webpages. The web analytics data suggest that greater familiarity with Canvas webpages seems to increase its use: e.g., the proportion of clicks on Canvas webpages outpaced clicks on PDF files later in the semester, and filtering for students with more clicks on readings increased the proportion of students who clicked on Canvas webpages at least two-thirds of the time.

These findings—unfamiliarity with some relevant affordances and increased usage of a less-common file format after increased exposure—lead to two major takeaways: 1) Provide readings in multiple formats and 2) Teach students about format affordances so they can make more informed choices in relation to a particular context. Students find themselves reading for class in self-identified ideal contexts (e.g., in their dorm room, free of distractions), as well as less-ideal contexts (e.g., on the shuttle, heading to campus). Therefore, what makes a file format preferable varies not only for different students but also for the same student in different contexts. So a single file format is unlikely to be ideal. But, as Harper (2021) and Daer and Potts (2014) have argued, just because students may have begun using online technologies earlier in life or may be experts in certain social or entertainment technologies, that doesn't mean they are experts in educational technologies likely to be new to them. Therefore, it's important to explicitly educate students about technological affordances, particularly those with any bearing on focus or convenience. First-year orientation for incoming students may be one excellent place to begin such training. At USU there is a 1-credit, introductory-level course on getting the most out of your university education. Such a course would offer an opportunity to train students on affordances of educational technologies such as PDF files and Canvas webpages. Academic probation support and programs for first-generation college students are also good places for introducing or revisiting such training. Finally, instructors can incorporate brief training into their own classes, perhaps following an introduction to the syllabus with a review of Canvas features relevant to course activities such as accessing and engaging with readings. Such reviews could be modeled in brief screencast videos for online classes and in person in face-to-face classes.

This study lays the groundwork for future research in a variety of areas. For example, expanding the number of interviews could not only shed light on additional factors relevant to the usability of digital readings and also help us gauge the generalizability of the initial interview data. As mentioned in the Methods section, we plan to conduct a similar study focusing on mobile access to Canvas that accounts for student use of the app. Such additional studies can guide the application of this research in ways that make the best use of resources and best support students. If future research confirms the importance of supporting student focus and improving the convenience of reading access, such research can help us identify new LMS features to develop or integrate. Such studies, including the one reported in this article, are important for improving learning technologies and advocating for a user group central to TPC education: our students.

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The Usability of an Integrated Smart Home: A Usability Study of a Laboratory-Based Google Smart Home

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ABSTRACT
People continue to buy smart home devices in record numbers, but research shows that some find them less useful. We argue that one reason may be that of usability, not of one device, but of the entire smart home system. Most research concerning smart home technology focuses on individual devices such as the smart home hubs with smart assistants. In contrast, our usability study targets a full smart home set of devices comparable to that of an average living room, where most people would use those devices. Results from our usability study of a Google smart home set up as a living room in a laboratory show that some aspects of the technology are user-friendly, but that usability issues remain significant.

CCS Concepts
Human-centered computing

Keywords
Smart home, Usability, Google, User-centered design, Technology diffusion

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INTRODUCTION
Many articles have appeared during recent years concerning the topic of smart home technology (SHT). Smart home technology was defined by Marikyan et al. (2019) as devices that have interconnection with the Internet of Things, interoperability, monitoring, control, and some "degree of artificial intelligence" that combine to provide "information from the surrounding environment and act accordingly to increase the well-being of people" (139). Some of the benefits that have been claimed by smart home devices include enhanced energy management, improved security, enhanced leisure and entertainment services, and "extended personal independence through healthcare provision and assisted living" (Wilson et al., 2017, p. 73).

According to research provided by Hargreaves et al. (2018), the main purposes for smart home technologies are "making life at home more convenient, providing security, and enhancing entertainment and communication" (p. 76). However, as Brush et al. (2011) have shown, smart home technologies are now forty years old. Despite this, available technology systems have not been widely adopted. Unlike most studies, Brush et al.'s research utilized homes with existing technology and pointed to four primary reasons for lackluster sales, including high cost of ownership, inflexibility, poor manageability, and poor security. This pattern is not dissimilar to other electronic technologies such as computers. As Cortada (2013) has shown, information technologies, including computers, were not widely adopted until they became less expensive and easier to use than their early counterparts. In the case of SHT, much of their failure continues to proliferate because they are still difficult to operate (Fleishman, 2019).

But people do seem to be buying them. According to Lardinois (2018), Google has reported selling a smart Google Home device every second, and as of 2020 more than 200 million smart home devices have been sold around the world (Sterling, 2020). Amazon has stated in 2019 that 100 million products with the built-in "Alexa" voice assistant have been sold (Hartmans, 2019). However, a large majority of those devices are smart televisions and voice assistants. Thormundsson (2022) reported that although

76% of households now have a smart television, only 32% have smart voice assistants and not more than 25% of households have any other type of smart device. So, a large majority of those devices sold are simply televisions and voice assistants, with most people never adding additional devices. Otherwise, many more potential users would report having adopted smart home technology systems. However, it is also likely that a good percentage of users have tried the technology and then rejected it before fully adopting it. Some of this can be attributed to bad experiences (Shank et al., 2022) but the difficulty in using the devices is probably an even larger driver of discontinuance (Knott, 2018).

In this paper, we overview the literature on different non-adoption processes, use, and usability of smart home technology. Then we overview a laboratory-based usability study of a smart home, that is an entire system of connected smart home devices. We present and analyze the results of 30 tasks in this study drawing out conclusions and applications for future work.

Not Adopting Smart Home Technology

Wolverton and Cenfetelli (2019) examined the factors surrounding the decision not to adopt a technology. Their results point to the fact that there are different types of non-adopters based on perceptions among users. Those types include trial rejectors, symbolic rejectors, trial acceptors, symbolic adopters, and adopters. Trial adopters are concerned that learning the innovation would require more time (outweigh) than the benefits they might gain. This perception is based on investigative analysis. Symbolic adopters consider adopting the technology for more emotional reasons. In contrast, trial rejectors try a new technology but tend to reject it based on loyalty to their current technology, while symbolic rejectors are apathetic concerning new technology. Although different variables contribute to each type of non-adopter, in the end, the result is the same unless adoption is undertaken. SHT research (Shank et al., 2022; Wright & Shank, 2020; Wright et al., 2021) has shown SHT users to be particularly similar to the trial adopters identified by Wolverton and Cenfetelli (2019) in that they are interested in SHT but rarely invest the time needed to maximize its benefits and quickly become disillusioned with difficult use.

However, more recently SHT has changed in that it is becoming more and more versatile in its operation. SHT devices can now be controlled using cell phones, voice commands through smart assistants, or in some cases through a visual interface connected to the assistants. Voice control has become a popular smart home assistant feature. Smart home devices are now used to control televisions, listen to music, search for facts, get the news, modify the lights and temperature in a home, order products, set alarms, and monitor health, among others. As their capacity and reliability increases, more are being sold. But research has shown that many users do not use the more complex features of interconnected smart home devices (Wilson et al., 2017; Wright & Shank, 2020). Therefore, acceptance and use of smart home products relies on users' perception of benefits and their concerns about using those devices.

So, what do users want? According to existing research, users want control over their home environment and products that are "designed to be reliable, easy to use, controllable, and easy to over-ride" (Wilson & Hargreaves, 2017, p. 43). At the same time, users want technology to be secure and automation that does not make them overly dependent. Mennicken and Huang (2012) have shown that users are not necessarily awed by technology itself or the "gadgety" features of smart home technology. Instead, most take a more practical approach, saying that they, "do not see a benefit to automation if they could still perform the same task faster or better manually" (p. 150).

Hargreaves et al. (2018) conducted in-home research that points to complex learning demands placed on users as a strong detriment to utilizing smart home technology, saying, "there was little interest in this group in making use of the more advanced and automated features of the systems" (p. 134). Similar findings can be found in other research by Georgiev and Schlögl (2018) who found that insufficient interoperability, complexity, and lack of perceived value all hinder adoption of SHT; and research by Oliveira et. al (2015) that have shown SHT users are often overpowered by complex technology.

Use and Usability of Smart Home Technology

Despite these findings, there have been surprisingly few studies of SHT in lab-based settings, where actual use of SHT can be observed. Home-based studies are certainly valuable, in that they provide a perspective of use from a user's own living environment. However, without the ability to directly observe user interaction with SHT devices, researchers are dependent upon the recollections of subjects who are removed from the moment of use. Therefore, lab-based studies are needed in addition to home-based studies to provide a complete picture of use.

There has been some usability testing of SHT products, but much of this research focuses on health-related applications, especially those focusing on elder care and disability services. Studies such as Lim et al. (2016) examined the role that SHT can play in assisting wheelchair-bound users. Wray et al. (2017) examined SHT as an assistive technology for those living with HIV. Bissoli et al. (2019) proposed and tested an eye-tracking and monitoring system for SHT for those with severe disabilities, while other usability tests have focused on voice assistants for military veterans with brain injuries (Wallace & Morris, 2018).

Other usability studies have also been conducted to assist elder users with independent living. Some of the more recent studies include Dahmen et al.'s (2018) test of a digital notebook SHT device to help those with lapses in memory, Ghorayeb et al.'s (2021) study of elder users' perceptions of SHT, Hu et al.'s (2019) test of seniors' ability to install a pre-packaged SHT system, and Mieronkoski et al.'s (2022) study of SHT to assist with geriatric rehabilitation.

The number of usability-related studies that work with the average adult population is surprisingly limited and rarely focuses on the complete systems that offer the public the most complete range of advantages (multiple devices functioning together). While several studies mentioned above have dealt with SHT in houses, and some recent studies have examined user perceptions after a period of use (Oliveira et al., 2020), there have been few classic usability tests conducted with SHT. Some exceptions include Ur et al.'s (2014) study of user ability to program SHT "if, then" programming and Hu et al.'s (2019) study of a pre-packaged system for older adults. However, those studies did not test complete SHT systems that had been purchased "off the shelf." Instead, they focus on new designs for user control of SHT devices. There has been some usability testing conducted with smart home assistants. For example, López et al. (2017) compared the Natural User Interfaces of major smart home assistants (Alexa, Siri, Cortana and Google Assistant), finding that traditional computing parameters do not

work well for those devices. Likewise, Zwakman et al. (2021) tested the voice usability of Amazon's Alexa, proposing a voice usability scale to be used in evaluating other assistants. Again, those studies focus on one piece of the SHT environment, rather than a system of devices purchased for use together. In other words, they test the usability of smart home technologies, not the usability of integrated smart homes.

The study presented herein is a usability study of a Google smart home, conducted in a controlled laboratory setting. Specifically, we are not studying the usability of one device, but the entire network of devices that make a smart home. In contrast to home-based studies, we have set up a smart "living room" in a behavioral science laboratory to recruit participants to interact with the devices both in familiar ways (i.e., tasks that are typically done with smart home technology at home), but also not with one's own technology. Specifically, to provide the best usability test, we recruited participants with little experience with these devices. Therefore, aside from the insights on Google smart home products in general, our innovated methodology allows for a usability test of the entire suite of connected products in an ecologically valid way, without being biased by people's extensive experiences with the technology.

METHODS

We conducted a usability test (IRB exempt) on an integrated Google smart home set up in a behavioral science laboratory to emulate a living room setting. Our tests included 6 identification tasks, 22 individual action tasks, and 2 tasks to set up complex smart home routines.

Living Room Environment and Smart Home Devices

The tests were conducted in a small behavioral science laboratory room at Missouri University of Science and Technology made to feel somewhat like a living room with a couch, chair, side table, TV stand, coffee table, shelves, lamps, detached "external" door, and wall décor.

Because Google has recently added many new devices to its SHT lineup, we chose to use their technology. Those devices are new to the market and, therefore, pose new usability challenges. Also, because we were attempting to recreate a living room environment, we opted to purchase devices that would most typically be used in that room in a house. The smart home interface technologies included a Google Nest Hub Max, and the participant's choice of a Samsung Phone or iPhone, both in front of the couch on the coffee table. The smart home devices included a Phillips Smart TV, Smart Light Bulbs in 2 table lamps, a Google Nest Thermostat, a Google Nest Doorbell, Smart Door Lock, and Security Camera. The Smart Door Lock was attached to the detached "external" door and the Nest Doorbell and security camera were placed near it to simulate the front door of a house. The Nest Thermostat was mounted with lights near it to simulate whether the air or heat was running. Additionally, a locally installed Wi-Fi system was used to connect these devices and a video camera was placed in the room to video the study.

Most of these devices could be controlled in three ways: using the touchscreen of the Nest Hub Max, using voice commands (which were usually picked up by the Nest Hub Max's microphone), or via the Google Home app which was installed on both smartphones. Certain actions could not be performed by all devices: for example, the door lock could not be unlocked by voice commands for security reasons.

Testing Participants and Procedure

Undergraduate students who take introductory psychology must participate in a certain number of research study hours that semester but are open to any study they desire, are eligible for, and has open time slots. We recruited participants from this psychology research pool by posting our study to it. Potential subjects were asked to complete a screening questionnaire prior to joining the study (Appendix A). We wanted to be sure that we were testing subjects who did not have experience with SHT.

Eligibility was restricted by three questions, to ensure that participants did not have extensive experience with smart home technology. To be eligible to sign up for the study, students had never owned or lived with smart home devices ("*How many different kinds of smart home devices (e.g., Amazon Echo, Google Home, smart outlets, smart thermostat, smart locks) have you owned or lived in a home with?"* must be answered 0), had never set up smart home devices (*"Have you ever connected multiple smart home devices (e.g., Amazon Echo, Google Home, smart outlets, smart thermostat, smart locks)?"* must be answered *No*), and had never used the Google Home app ("*Have you ever used the Google Home app?"* must be answered *No*).

A total of twenty-seven participants signed up and completed our study. However, three of those participants were left out of our analysis due to faulty audio or video data. The total included 23 males and 4 females averaging 21.7 years old (18 to 54). Self-reported racial identification indicated that 17 participants were White, 4 multiracial, 3 Asian, 2 Black, and 1 did not specify. The participants' majors included 6 computer science/engineering, 4 engineering management, 2 English, 2 business, 2 mechanical engineering, 10 from other majors, and 1 not reporting. In addition to restricting the participants to ones with little smart home technology experience, we also asked them several questions about their use of technology to better profile our sample. All 27 of them reported using cell phone and computer systems, and 18 also used gaming systems, 15 used wearable or Bluetooth devices, 11 used smart TVs, 11 used other TV devices, 5 used smart watches, and only 1 used an iPod. The most common apps used by at least four participants were Snapchat (13), YouTube (9), Spotify (8), Instagram (7), Messages (5), and Reddit (4). Three participants reported having used a Google Nest Hub before.

Using university students has both advantages and limitations. Using technology-immersed students at a technology university, mostly in their late teens and early 20s, means that any errors they repeatedly make are most likely coming from poor usability design of the products, not because our sample is technology-illiterate. However, university students are not the typical demographic for owning homes and therefore we could expect differences for older individuals and homeowners. However, this concern is minimal, as we specifically were interesting in individuals who did not have smart home technology experience, meaning it is unlikely that older homeowners who had no smart home experience would be meaningfully different from younger non-homeowners who also did not have that experience.

Eligible participants could sign up for an open one-hour time slot and then came to the lab at that time. One of two research proctors,

a male and a female undergraduate student, conducted the study. Upon arriving at the lab, participants were asked to read and sign a consent form (Appendix E) explaining the study procedures. While data gathering and surveillance from the technology companies are large issues in SHT research in general (Ahanger & Aljumah, 2018; Komninos et al., 2014; Mantas et al., 2011), the nature of our research precluded them from being a major concern. These were not the participants' personal devices; and, therefore, personal information about the participants was not connected to the devices, and they were in the presence of a research proctor and agreed to be videoed, making the research surveillance most salient.

Next, they were asked to complete a pre-test questionnaire that was designed to collect more information concerning their use of technology and current attitudes toward SHT (Appendix B) and were given a choice of Apple or Android cell phone to use for the text. Participants were then asked to perform the set of tasks listed below, based on a script that was supplied to the research proctor (Appendix C).

Finally, participants were asked to complete a post-test questionnaire (Appendix D) which asked them to rate their overall opinions concerning SHT ease of use and to suggest improvements for the SHT. They were compensated with one hour credit for research participation.

Usability Tasks

The first set of six usability tasks were simply identifying six smart home technologies visible in the room: (1) Smart TV, (2) Nest Hub Max, (3) Hello Doorbell, (4) Smart Door Lock, (5) Smart Thermostat, and (6) Security Camera. The second set of 22 usability tasks were individual action tasks (Table 1). Participants were told the three methods to control the equipment: using the Nest Hub screen interface, using voice commands by saying "hey, Google" to the Nest Hub, or using the Google Home app on the smart phone. Some tasks could only be completed with certain methods due to technical limitations and other tasks we restricted to specific methods to focus on that method of control (see Table 1 for details). The third set of two usability tasks were to construct "Wake Up" and "Movietime" routines as described in a handout (Table 2). Routines are essentially command scripts that control multiple SHT devices simultaneously. Both routines were restricted to voice commands by technological limitations.

#	Task Name	Task Description	Methods Allowed
1	TV	Turn on the television.	Hub Voice[a]
2	Netflix	Start Netflix on the television.	Hub Voice[a]
3	Music	Using the Nest Hub, play music through the television.	Hub Screen
4	Volume	Using the Google Home app, change the volume of the television.	Phone
5	Next Song	Play the next song.	Any
6	Favorite Music	Play your favorite artist's music.	Any
7	Remove Weather	Alter the home display of the Nest Hub by removing the weather information.	Any
8	Alarm	Using the Nest Hub, set an alarm for five minutes from now.	Hub Screen[b]
9	Translate	Use the Nest Hub to translate the phrase, "Hello, would you like some coffee?" into Spanish.	Hub Voice[a]
10	Note	Create a family Nest Hub note for a specific time.	Hub Screen[b]
11	Lamp Count	Determine how many lamps are available for individual control within the room.	Any
12	Lamp On Hub	Using the Nest Hub, turn on the front lamp.	Hub Screen
13	Lamp On App	Using the Google Home app, turn on the table lamp.	Phone
14	Lamp Brightness	Set front lamp to 75% brightness and back lamp to 85%.	Any
15	Lamp Colors	Turn the front lamp green and the back lamp orange.	Any
16	Lamp Off	Set lamps to turn off in five minutes.	Hub Voice[a]
17	Doorbell Video	Access live video from the doorbell.	Any
18	Doorbell Voice	Speak through the doorbell.	Any
19	Lock Door	Using the Google Home app, lock the door.	Hub Phone
20	Security Video	Using the Nest Hub, access the video feed from the indoor security camera.	Hub Screen
21	Temperature Check	Check the current temperature of the thermostat.	Any
22	Temperature Change	Alter the current temperature of the thermostat.	Any

Table 1: Individual action tasks

[a] *These restrictions were due to technological limitations. Other restrictions were implemented as part of the task.*

[b] *We restricted these to Hub Screen, but many participants had to use the Hub Voice method to complete it.*

Wakeup Routine	Movietime
Create a new routine and name it “Wakeup.” Edit the “Wakeup” routine to make it: • Activate when you say “Hey, Google, I’m awake.” • Turn lamps to 50% brightness with purple color. • Change thermostat to 72 degrees. • Read the local weather forecast. • Read any calendar appointments for the day. • Tell you if your phone battery is low. • Play the news.	Create a new routine called “Movie Time.” Edit the movie time routine to make it: • Have Nest Hub say, “Let’s Watch a Movie” when launched. • Lock the door. • Adjust the thermostat to 68 degrees. • Adjust both lamp colors to green. • Turn on the TV.

Table 2: Routine Tasks: Instructions for making Routines

Proctoring, Recording, and Coding Usability Test

In general, we followed the testing and proctoring methods outlined by Barnum (2020) and Spool et al. (2008) including the use of Concurrent Think Aloud Protocol (asking participants to explain what they were doing and thinking during tasks), while additionally taking screen recordings of the cell phone in use and videotaping the sessions. However, we also drew from methodology suggested by Portigal (2013) in designing post-test questions for participants, from Hertzum’s (2020) discussion of testing user experience, and from Goodman et al.’s (2012) discussion of results analysis. Screen recordings and videotapes were later used for analysis, including determining time on task, number of errors per task, and the primary interactive method that was used to complete a task when there was a choice (voice, Next Hub, cell phone).

The research proctor sat in the living room area with the participant and directed them through the usability tests beginning with identification tasks, then individual action tasks, and finally complex routine tasks. During the test, the proctor encouraged participants to speak aloud as they performed the various tasks and were available to answer any questions. However, proctors were instructed not to answer questions that were beyond procedural concerns and to stop a particular task and move on if one minute elapsed without any significant progress toward the goal of the task. Due to the complexity of the routine creation tasks proctors allowed participants as much time as they needed to complete the task.

After all tests had been completed, we used Camtasia Studio software to combine the cell phone recordings and video recordings into a single digital file per participant. Those videos were then coded by two research assistants (one who was a proctor) to create a Microsoft Excel file detailing all tasks for all users. That file included whether the task was completed, time on task, the number of errors for the task (defined as any activity that led the participant down a path that could not lead to success).

RESULTS

Identification Tasks

When asked to identify 6 devices in the room, participants only struggled to regularly identify the Hello Doorbell, Smart thermostat, and the Nest Hub Max. The Hello Doorbell was occasionally misidentified as the door lock (6 times) and once mistaken for the thermostat. The smart thermostat was misidentified as the doorbell 4 times. The Nest Hub Max was misidentified as the thermostat 4 times and as the security camera 3 times, but was occasionally not identified at all, with participants reporting they were looking for a “small cylindrical or square device”. When asked what these devices could do, participant 7 compared the Nest Hub Max to an iPad, saying it was “an iPad interface for a Google Home” and “It’s kind of like a tablet but you can use it as a TV as well.”

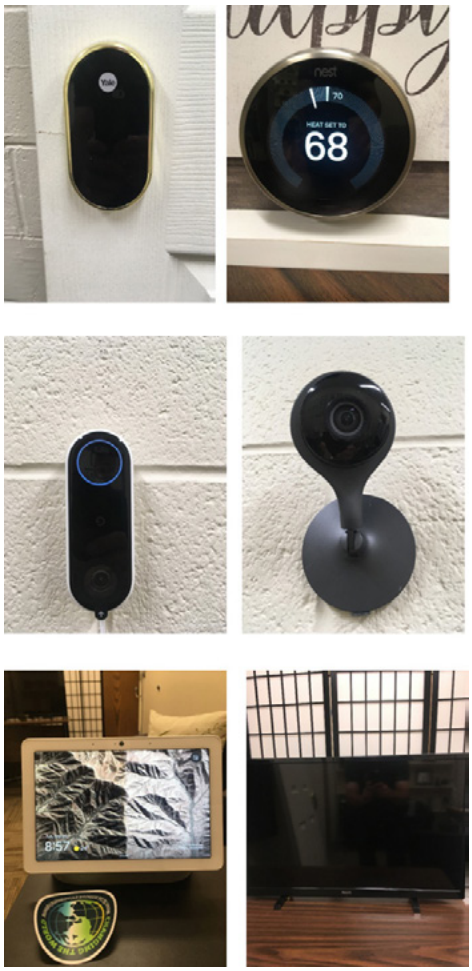

Figure 1: A door lock, thermostat, doorbell, security camera, Nest Hub Max, and a Television

Task #	Comp Rate	Average Time [Range] (s)	#Users with more than one	Avg. # of errors	First device	Finished device	Comments
Smart TV	24/24	N/A	0/24	N/A	N/A	N/A	
Nest Hub Max	10/24	N/A	9/24	N/A	N/A	N/A	Misidentified as thermostat (4x) and security camera (3x)
Doorbell	15/24	N/A	7/24	N/A	N/A	N/A	Misidentified as door lock (6x)
Door Lock	22/24	N/A	2/24	N/A	N/A	N/A	
Thermostat	19/24	N/A	4/24	N/A	N/A	N/A	Misidentified as doorbell (4x)
Security Camera	20/24	N/A	1/24	N/A	N/A	N/A	
1	23/24	47.71 [3-160]	2/24	.46	P(13) V(9) H(2)	V(20) P(3) H(0)	Tried Turning on TV with Home App (3x)
2	17/24	49.46 [5-186]	5/24	.71	V(13) P(8) H(3)	V(17) P(4) H(3)	Voice command issues (6x)
3	24/24	31.55 [4-140]	3/24	.6	H(18) V(4) P(2)	H(18) V(4) P(2)	Played Music on the Hub first (5x)
4	23/24	20.54 [3-80]	0/24	.17	P(23) H(1) V(0)	P(22) H(1) V(1)	
5	24/24	10 [1-75]	3/24	.46	P(14) H(8) V(2)	P(13) H(9) V(2)	Issues with Hub media menu (5x)
6	19/24	55.83 [5-189]	6/24	.82	P(9) P(9) H(6)	V(20) P(3) H(1)	Looked for a way to type chosen artist (12x)
7	0/24	84.12 [0-144]	24/24	2.75	H(20) V(4) P(0)	N/A	Impossible task
8	22/24	36.83 [3-122]	4/24	.74	V(14) H(10) P(0)	V(18) H(6) P(0)	Tried to find on Hub despite being voice-only feature
9	21/24	32 [5-149]	2/22	.64	V(19) H(4) P(1)	V(24) H(0) P(0)	Voice command issues (5x)
10	18/24	49.08 [5-168]	6/24	1.17	V(17) H(7) P(0)	V(20) H(3) P(1)	Voice command issues (6x), accidentally set a personal note (5x),
11	24/24	21.63 [1-72]	2/24	.42	P(12) H(10) V(2)	P(13) H(11) V(0)	Attempted to use voice commands (4x)
12	24/24	15.13 [1-32]	0/24	.14	H(18) V(6) P(0)	H(18) V(6) P(0)	Accidentally controlled both lights at once
13	24/24	12.79 [2-84]	1/24	.25	P(23) H(1) V(0)	P(23) H(1) V(0)	Accidentally controlled both lights at once
14	22/24	26.38 [2-81]	0/24	.29	P(20) H(3) V(1)	P(16) V(5) H(3)	Accidentally controlled both lights at once
15	24/24	29 [4-120]	1/24	.25	P(15) H(5) V(4)	P(14) H(6) V(4)	Accidentally controlled both lights at once
16	22/24	29.88 [3-158]	3/24	.62	V(14) P(9) H(1)	V(18) P(5) H(1)	Tried to find on phone despite being voice-only feature
17	24/24	19.17 [5-73]	2/24	.36	P(9) H(9) V(6)	H(13) P(8) V(3)	Voice commands pulled up a YouTube tutorial (4x)
18	23/24	11.71 [1-123]	1/24	.17	H(15) P(7) V(2)	H(16) P(8) V(0)	
19	23/24	13.58 [5-47]	1/24	.21	P(23) V(1) H(0)	P(23) V(1) H(0)	Opened doorbell menu or camera (4x)
20	24/24	16.58 [5-45]	2/24	.38	H(21) V(3) P(0)	H(21) V(3) P(0)	Incorrect voice commands (4x)
21	23/24	7.09 [2-15]	1/24	.13	H(12) V(6) P(5)	H(13) V(5) P(5)	
22	23/24	6.57 [1-50]	2/24	.09	H(16) P(6) V(2)	H(17) P(6) V(1)	
Wakeup	N/A	440.13 [248-688]	24/24	5.3	N/A	N/A	
Movie Time	N/A	321.19 [121-600]	8/22**	2	N/A	N/A	Far fewer mistakes than first routine

Table 3: Task completion rate, average time, errors, devices use, and comments.

***Routine 2 has two users where the phone screencap cut off.*

Individual Action Tasks

Table 3 lists details about each individual action task; and routine task was classified as having *few or no problems*, *minor problems*, or *major problems*. Each level of problem severity was determined by coding error rates, time on task, TAP comments, and post-test questionnaire comments. That combination of data was critical to determining their classification, because not all errors are the same and the level of user frustration could only be determined through qualitative data. For example, a task which had a relatively high error rate might simply reflect a common error that took little time to resolve and resulted in little user frustration, while a task with a lower error rate might in fact take much longer to complete and result in widespread frustration reflected in user comments. Of the 22 individual action tasks, ten tasks had few or no problems, seven tasks had minor problems, and five tasks had major problems.

Few or no problems

The 10 tasks with few or no problems included:

- changing the volume of the TV using the Google Home phone app (Task 4)
- playing the next song using any method (Task 5)
- determining how many lamps could be controlled in the room (Task 11)
- turning on a lamp with the Nest Hub (Task 12)
- turning on a lamp with the Google Home App (Task 13)
- speaking through the doorbell (Task 18)
- locking the Smart Door Lock with the phone (Task 19)
- accessing the security camera feed with the Nest Hub (Task 20)
- checking the current temperature of the thermostat (Task 21)
- altering the current temperature of the thermostat (Task 22)

When using the Google Home application most of these tasks were completed with only 2 or 3 taps from the main menu using large, identifiable buttons. As a result, these tasks were usually completed quickly and with few errors and user comments concerning these tasks were minimal. Even the one of these with the highest error rate of .45 errors per participant (the "play the next song" task) had fairly benign errors, with the most common being accidentally leaving the menu to control the Smart TV while using the Google Home app.

Minor problems

We considered 7 tasks as presenting "minor" problems. These tasks included:

- turning on the TV (Task 1)
- starting Netflix on the TV (Task 2)
- playing music on the TV through the Nest Hub (Task 3)
- setting the front lamp brightness to 75% and the table lamp brightness to 85% (Task 14)
- turning the front lamp green the table lamp orange (Task 15)
- setting the lamps to turn off in 5 minutes (Task 16)
- accessing the live video from the doorbell (Task 17)

Turning on the TV had a 96% completion rate and caused an average of only .46 errors per participant, yet participants often had to switch methods. Thirteen participants initially tried to complete this task using the Google Home App but only 3 actually completed it using the app, while 20 participants complete this task using their voice despite only 9 trying voice commands as the first method of control. Starting Netflix on the TV had a 71% completion rate and caused an average of .71 errors per participant, with 6 errors being related to the use of voice commands. One participant wanted a virtual remote on the phone to control the TV for this task, a feature that does exist but they couldn't find in the app. Playing music on the TV through the Nest Hub had a 100% completion rate, but caused an average of .6 errors per participant, with 5 participants playing music through the Hub first and a some having issues casting that music to the TV or having difficulty getting out of the Nest Hub's media menu.

Adjusting the brightness of the individual lamps had a 92% completion rate and caused 5 errors, all of which were participants changing both lamps' colors at the same time, with 5 participants saying they couldn't find controls for the individual lights. Changing the color of the lights had a 100% completion rate and caused 3 errors, all of which were participants changing both lights at the same time. Once they realized their mistake participants on these tasks found the individual light controls quite easily and promptly finished the task. Setting the lights to turn off in 5 minutes had a 92% completion rate and caused an average of .62 errors per participant, usually double tapping or tap and holding the lights power button on the Home App. Participants said they were looking for "some kind of timer" in the Home App light menu or the Nest hub light menu. This task could only be completed using voice commands, which some participants used immediately. Most participants who started with a different method of control eventually came to use voice commands to complete the task, but these participants often performed 2 or 3 errors first while attempting to use the Nest Hub or home app. Overall participants had few issues with adjusting or turning the lights on or off on either the Nest Hub or the Google Home app. However, there was confusion when trying to control one light instead of both lights and with not knowing that light timers can only be created through voice commands.

Accessing the live video from the doorbell had a 100% completion rate but with one notable type of error. Four users attempted to complete this task by using voice commands. This method caused the Nest Hub to perform a YouTube search for installation tutorial videos for the Nest Doorbell.

Major problems

We considered 5 tasks as presenting "Major" problems. These tasks included the following:

- playing participants favorite artist on the TV (Task 6)
- removing weather information from the hub home display (Task 7)
- attempting to set an alarm using the Nest Hub (Task 8)
- translating a phrase to Spanish using the nest hub (Task 9)
- creating a family nest hub note for a specific time (Task 10)

Asking participants to play their favorite artist's music from the TV resulted in a 79% completion rate and caused an average of .82 errors per participant, with 5 participants looking through the Nest Hub's music application, 4 looking through the Home App's menus, 3 participants looking through various other Nest Hub Menus, and 3 incorrectly using voice commands. Participants who

did not use voice commands at the start of this task spent a great deal of time swiping through various menus, in particular the Hub Media menu, looking for a way to play a specific song or artist. Four of these participants asked if there was some kind of search bar they could use.

Removing the weather information from the Nest Hub display had a 0% completion rate. While technically possible at the outset of this study, the setting used to complete this task was difficult to find and was eventually removed from the user interface entirely by an update. Even after its removal, few participants navigated to the menu where the setting used to be during their attempts to complete this task. There was an average of 2.75 errors per participant, with 7 participants opening the weather app on the Nest Hub, 7 trying to use voice commands, 6 trying some variation of tapping on the information and 2 opening the home climate controls on the Hub. Seven participants said they were looking for home screen settings and 6 wanted to be able to just tap and remove the weather info.

Attempting to create an alarm on the Nest Hub for 5 minutes in the future had a 92% completion rate and caused an average of .74 errors per participant. Participants were told to only use the touch screen of the Nest Hub for this task, but many resorted to voice commands after being unable to find the option to create an alarm using the Hub's user interface. Participants said they were looking for some kind of clock, alarm, or time feature. Generally speaking, the Nest Hub was difficult to use and caused an inordinate amount of frustration among participants and major usability issues.

Translating a phrase into Spanish had a 92% completion rate and caused an average of .64 errors per participants, with 3 participants incorrectly phrasing the voice commands, 2 asking the hub if it could translate instead of instructing it to do so, 2 looking through the various hub menus and 2 checking the Google Home App. Participants also said they wanted somewhere to type a question and noted an example tile under one of the Hub Menus, but that tile was not helpful for completing the task. These recommender tiles were present during a few of the tests, but when clicked only provided examples of translations of specific phrases into pre-chosen languages.

Finally, creating a family note on the nest hub had a 75% completion rate and caused an average of 1.17 errors per participant, with 6 participants incorrectly phrasing the voice command and 5 setting a personal note instead of a family note. Two participants tried to find an option in the Hub menus to complete this task as well.

Complex routines

For the last two tasks participants were asked to complete were the creation of two "routines": action scripts that allow for multiple actions to occur simultaneously or sequentially with a single command or button press. The two routines featured 8 and 6 individual tasks respectively (Table 2). Two of those tasks were common to both routines. The tasks shared between the two routines, changing the lamp color and changing the lamp brightness, were a common source of errors and frustration. Twelve participants found it difficult to control the lights during the creation of the first routine, and some failed to implement those tasks at all. Common comments included, "I can see the lights but not how to change them" (this was in a sub-menu) and "I wish there was just a button where you can customize routines." Predictably, the routines were two of the most difficult tasks to complete correctly. A variety of errors occurred, mostly because of user inability to correctly navigate the interface and to control minor variables such as light color.

Post-Test Questionnaire Results

Table 4 below shows averages for each of the quantitative questions contained in the post-test questionnaire, where 1=Strongly Disagree and 5=Strongly Agree. Not surprisingly, only a third of participants though creating routines was easy, whereas approximately half of them thought other processes and devices were easy to use. Somewhat surprisingly 70% of the participants still had a high opinion of SHT and only a small number of them doubted their ability to learn to use SHT quickly.

Usability Issues Across Tasks

Several themes emerged from this research. First, most of the tasks, though often confusing at first, can be completed in a relatively short amount of time. Average times for individual action tasks were all under a minute, except task 7 which could not be completed (Table 3). Small errors do tend to be pervasive when completing the tasks but the intuitiveness of this generation of SHT is vastly superior to the equipment we first started working with in 2017. Yet, the maximum time spent by a participant (Table 3) was often an order-of-magnitude higher than the average. This suggested while most people quickly deal with minor errors to complete a new smart home task, some get confused, lost, or start down the wrong path and take much longer to finish (or do not finish). This may be why participants reported better opinions of SHT and believed they could learn it quickly in spite of not always reporting it was easy.

Second, errors in using the equipment were varied, but tended to center on interface confusion. Numerous small errors occurred during most of the tests, but most of those errors were not fatal for the task at hand. Still, confusion concerning which interface to use (phone, hub, voice) was rampant. As stated earlier, many of the tasks can be completed either by using voice commands, the Nest Hub Max, or the Google Home app on the cell phone. However, some tasks can only be completed using one of those methods. Test participants commented repeatedly on this confusion and often chose either the wrong method or a more difficult method than was required. For example, something as simple as turning on the television could be completed easily with a voice command but could not be completed using the cell phone app, while more complex tasks such as creating a routine to control multiple devices can only be accomplished using the cell phone app. Thus, as users struggled to find the appropriate method for each task, their confidence eroded over time. They found it frustrating that they could not simply choose a method of interaction and stick with it. This seems a legitimate complaint, and one that should be addressed. When multiple methods of interaction are available, users assume that their choice of method is based on preference. However, as we have shown, that is not always the case, and, like the participants, we cannot identify a compelling reason for limiting the methods (other than safety in the case of the door lock).

Prompt	Number (Percent) of Respondents to Agree or Strongly Agree
I found it easy to connect to the devices used in this study using the Google Home cell phone app.	12 (50.0%)
I found it easy to connect to devices using the Nest Hub.	12 (50.0%)
I found it easy to control devices using the Google Home cell phone app.	13 (54.1%)
I found it easy to control devices using the Nest Hub.	13 (54.1%)
I found it easy to link multiple devices in routines.	8 (33.3%)
I have a better opinion of smart home devices than I did before this study.	17 (70.8%)
I believe it would take a long time for me to learn to use this technology.	5 (20.8%)

Table 4: Post-test questionnaire results

In general, users defaulted to voice commands in their confusion, but that too proved perilous at times. The AI interface within the Nest Hub often requires very specific wording and phrasing to be effective. Therefore, a poor choice of words or poor diction can often result in failure, even though a voice command should be able to complete many of the tasks. For example, devices must be named when they are added and must be called by their proper name to be controlled effectively. So, a command of "turn on the lamp" may fail, while a command of "turn on the couch lamp" would be successful. Again, most users were able to overcome this setback with time, but the initial confusion was frustrating for them.

Having failed to accomplish the task with a voice command, many users turned to the Nest Hub Max and its visual interface. That, however, proved equally confusing. It should be noted that this is the first version of the Nest Hub Max, so some "bugs" are to be expected. Having said that, visual navigation of features on the Hub screen proved to be confusing and, in some cases, unusable. There is no clear navigational system from the home screen and swiping in different directions yields different results. The lack of a clear navigational system led to additional confusion, frustration, and loss of time. In addition, making even small changes to the Hub display proved exceedingly difficult. Simply removing the local weather display from the home screen proved impossible for every test participant (even before the aforementioned update made it truly impossible) and setting an alarm on the Hub proved to more difficult than it should be. And, because the Hub has a built-in speaker, asking participants to play music through the television often resulted in music being played through the Hub. In general, the Hub proved to be the most difficult interface for accomplishing any of the tasks, and many users attempted to use it only when forced to after their initial attempts. One user referred to the Hub as, "the dumbest thing in the room." Most of their issues were focused on the navigational issues associated with the touch screen.

Third, the Google Home app on the cell phone proved to be a much more intuitive interface than the Hub. There were some navigation issues with the app, such as confusion among users as to how to control individual lights as opposed to all lights, but most errors that occurred using the app centered on navigational confusion that improved as the test progressed. In general, the app was greatly preferred to the Hub, and to voice commands for more complicated tasks. Failures of diction, phrasing, and capabilities with voice commands led to increased use of the phone app as the test moved on. In some cases, participants reverted to the phone app even after being told to use the Hub.

Fourth, more complex tasks resulted in more errors. This was somewhat to be expected, but there was a marked difference in both time on task and error numbers for tasks that involved manipulating devices as opposed to simply activating them (e.g., turning on a lamp versus turning a lamp green). This was especially true when attempting to control multiple devices with routines. It is true that there is a steeper learning curve to controlling multiple devices, but the routine tasks proved to be the most difficult tasks in the test other than those associated with manipulating the Hub display.

RECOMMENDATIONS AND CONCLUSIONS

Comments from test participants revealed that some improvements can be suggested for both the devices and the interfaces:

- Seven participants (29%) mentioned that they would like to see a search bar to help with locating device features and methods of control.
- Thirteen participants (54%) said that they would like more automated controls for creating routines.
- Eighteen participants (75%) indicated that they would like to see the touch screen interface of the Nest Hub Max redesigned.
- Eight participants (33%) said that they would like to see a tutorial added to the interfaces.
- Seven participants (29%) requested better consistency between user interfaces between the Hub and the Google Home app.

Having said that, participants were generally impressed with the capabilities of the SHT devices. They were especially impressed with the ability of the routines to control multiple devices and the ease of activating individual devices. Finally, users were impressed with the voice activation features for both devices and routines, even if they were somewhat "picky" when it came to language and diction. Post-test comments revealed that the most frustrating aspects of the equipment were a lack of feedback when tasks were not completed, a lack of clarity in the cell phone and Hub interfaces, and a lack of help with errors.

This study also generated practical insight for future SHT research. Studying smart home devices in the controlled environment of the lab allowed us to determine what functions would be tested and to

collect and compare data such as completion and error rates as well as the time it took participants to those tasks. The number of devices we had in the lab revealed some points for future researchers to consider when developing their own studies. We found that in setups involving multiple devices such as ours it is essential to have dedicated network hardware for the devices to be connected to. Even with this dedicated hardware, test proctors should be prepared to handle sluggish or potentially unresponsive devices as happened during some of our trials. It is also essential to disable any auto-updating services that may be included on the devices to maintain consistency across multiple trials that may take place over a period of weeks or months. This technology, although functional, is a still moving object. Like many current technologies it changes over time with updates (even though the hardware does not) and more devices equals more problems. While a household with only a smart voice assistant and a television may experience few technical issues, integrated multi-device household systems are more prone to inter-device issues. This is especially true of devices that rely of different interfaces or are manufactured by different companies. And, although updates solve issues, they can also exacerbate issues between devices from different manufactures and different apps.

Even with auto-updates, a laboratory setting offers much more environmental control that studies in the wild, which rely on existing technologies, setup, and physical space. Conversely, the living-room environment of our laboratory made the tasks and interactions more meaningful and understandable to the participants, and more ecologically valid in general. That is, it's possible to line all the devices up in a row and have participants perform tasks with them. It's also possible to task participants with making the door unlock every time one turns down the temperature. However, neither of those are how smart devices play out in real homes. Therefore, we believe studies like ours show the best of both worlds – laboratory control and an ecologically real environment.

Overall, despite the numerous errors and interface confusion, it must be said that this generation of SHT is vastly superior in terms of usability to the last. The Nest Hub Max is in obvious need of revision, but it is also the newest of the devices. Users were, in general, more satisfied with the equipment than they have been in our others' studies with previous generations of SHTs. Having said that, their comments and test results also support the notion that many of them are still trial adopters as identified by Wolverton and Cenfetelli (2019). They are interested in SHT and impressed with its capabilities, but quickly become disillusioned with difficult use and question whether its benefits outweigh the costs associated with learning to operate/troubleshoot it. It remains to be seen if SHT devices and interfaces will continue to improve to a point where these many trial adopters will become true adopters.

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APPENDIX A

SCREENING QUESTIONS

1. Do you own or have you ever lived in a home with multiple smart home devices?
2. Have you ever connected smart home devices for someone else?
3. Are you comfortable using cell phone apps?
4. Have you ever used Amazon's Echo or Google's Nest Hub?
5. Are you currently between the ages of 18 and 23?

APPENDIX B

PRE-TEST QUESTIONNAIRE

Name:

Date:

Thank you for taking the time to participate in our usability test. Before we begin, we'd like to ask you a few questions so that we will have more information about the technology that you currently use.

1. What types of electronic devices do you currently use? (please circle all that apply)
    a. Cell phone
    b. Computer systems
    c. iPod
    d. Gaming systems (Xbox, PlayStation)
    e. Wearable devices and Bluetooth devices
    f. Smart Watch
    g. Smart TV
    h. Television devices such as Roku, Firestick, etc.
    i. Other:
2. What are your primary purposes for using electronic devices?
3. What phone apps (if any) do you most commonly use?
4. What benefits do you think you might gain from using smart home technology?
5. What are the primary frustrations that you have (if any) with the current electronic devices that you use?
6. Have you ever used Amazon's Echo or Google's Nest Hub?
7. Are you currently between the ages of 18 and 23?
8. What's your gender?
9. What's your age?
10. What race/ethnicity do you identify as?
11. What's your major?

APPENDIX C

PROCTOR CHECKLIST/SCRIPT

Read the introduction script (see below):
"Thank you for coming in today. My name is [name]. Your participation will help us learn a lot about smart home technology and how it can be improved. It's important that you understand that there are no wrong answers, decisions, or implementations. We are testing how easily and by what methods people can use this equipment, so if you feel you're not able to accomplish anything that tells us that the equipment is difficult to use. So, feel free to make your own decisions and experiment with options.

Today, you will be working with smart home technology—most of which is manufactured by Google. First, we'll tell you what's in the room. Then, we'll ask you to identify those items and what you may think about them now. Finally, we will ask you to perform a series of tasks to see how efficiently the equipment responds to your needs. We'd also like you to talk to us as you work through the test. This will help us to understand how you are experiencing the equipment.

After the test is complete, we'll ask you some questions about your experience so that we can gain valuable information. We'd also like you to talk to us and share your thoughts and feelings as you move through those tasks so we can better understand what you are experiencing."

1. Continue to encourage thinking aloud during the test.
2. Offer assistance only if the test reaches a standstill or participant asks questions.

APPENDIX D

POST-TEST QUESTIONNAIRE

Name:

Date:

General Questions

1. What was the most frustrating thing about using this equipment today?
2. What was the most pleasant surprise you encountered?
3. What suggestions would you have for improving the Google Home App?
4. What suggestions would you have for improving the devices?
5. What suggestions would you have for improving the Nest Hub?

Likert Scale Statements

1. I found it easy to connect to the devices used in this study using the Google Home cell phone app.
2. I found it easy to connect to devices using the Nest Hub.
3. I found it easy to control devices using the Google Home cell phone app.
4. I found it easy to control devices using the Nest Hub.
5. I found it easy to link multiple devices in routines.
6. I have a better opinion of smart home devices than I did before this study.
7. I believe it would take a long time for me to learn.

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StoryMapping Community Engagement: Reflexive Chorography, Spatial Justice, and the Carnegie Classification for Community Engagement

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ABSTRACT

Institutions of higher education can use communication design to more fully realize the transformational potential of applying for the Carnegie Elective Classification for Community Engagement. In particular, we contend that chorography is one way that institutions can seek spatial justice in conjunction with place-based community engagement understandings. To support this argument, we focus on the location of community-engaged work as a defining characteristic of that work. We further process one year's worth of our home institution's community-engaged work by using a three-step research methodology called chorography, in which we (1) collected community engagement data; (2) designed a multi-layered community engagement map; and, (3) reflexively considered the inclusivity and sustainability of our institution's community-engaged work. Our aim is to use this map-making method to orient our institution to more inclusive and more sustainable community-engaged work.

CCS Concepts

Social and professional topics

Keywords

Critical cartography, Mapmaking, Rhetoric, Civic Engagement, Spatial justice, Carnegie Classification for Community Engagement

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INTRODUCTION

The science and practice of mapmaking—cartography—is a particularly complex communication design activity, and the artifacts produced by this activity—maps—have increasingly been understood in terms of their rich rhetorical function. Decades ago, Harley (2001) asserted that "rhetoric permeates all layers of the map" (p. 37), and this assertion has found support in scholarship that examines the rhetoric of cartography (Barney, 2016, 2017, 2019b; Denil, 2003) and foregrounds maps as visual, material, and rhetorical artifacts (Getto & Moore, 2017; Lucaites & Hariman, 2001; Propen, 2005, 2007, 2011, 2012).

As this growing body of scholarship shows, maps can forge ideologies of inclusion and exclusion (Barton & Barton, 1993/2004, 1993), clarify stories and encourage user interaction with data (Kostelnick, 2007), intervene in policy debates by advancing particular knowledge claims and mediating among competing claims (Propen, 2012), articulate and promote national and international interests (Barney, 2009, 2013, 2014, 2015, 2016, 2019a, 2020), and visualize risk by providing context (Stephens & Richards, 2020) and promoting participation (Welhausen, 2017). Maps "can counter the violence of erasure and express the multiplicity of places" by "weaving together science and story" (Butts & Jones, 2021, p. 3), as well as address environmental problems (Propen, 2012; Stephens & Richards, 2020), health problems (Welhausen, 2015), and community-based problems (Carlson, 2021). Maps can further be used as rhetorically effective teaching and learning tools (Butts & Jones, 2021; Hurley, 2018; Propen, 2012).

In brief, the rhetorical function of any map far surpasses the map's ability to communicate knowledge about territory. Rather, maps marshal design elements to advance claims about the social values and cultural features of a given territory. Rhetorically, then, maps function to persuasively communicate a social landscape, and this point is stressed by critical cartographers, who view maps in terms of their persuasive communicative potential. These cartographers understand that "maps impose their own innovative interpretation of the world, even within the same mechanism of social control that produced them" (Casti, 2015, p. 107). They recognize that

maps possess the potential both to reify dominant social landscapes and also to reinterpret, revise, and resist these same landscapes. Given these twin potentialities, critical cartographers stress that the function of any map is much broader than communicating territorial knowledge. For these individuals, maps are strategic communicative tools, and cartographic emphasis—whereby a mapmaker highlights a particular feature of a landscape—proves "a most effective type of rhetorical strategy" (Casti, 2015, p. 107).

A rhetorically rich conceptualization of maps and cartography, in which maps are understood as creating social space and cartography is recognized as a subjective art, has come to be known as chorography. As defined by Casti (2015), *chorography* means "a cartographic representation that recovers the cultural and social sense of territory within the relation that the individual establishes with a place, expressed by the reality of landscape" (p. 115). In coining the term *chorography*, Casti has drawn upon the Greek term *chora*—a term that is, itself, "complex and unstable" in its ancient meaning (Kymäläinen & Lehtinen, 2010, p. 252)—to push back upon rhetorically reductive and overly objective notions of mapmaking. The term *chora* roughly connotes a place outside of those which are typically known, a "place in process" (Kymäläinen & Lehtinen, 2010, p. 252), or "the wild, open surrounds as yet-unmapped and outside the town's street grid and infrastructure" (Clary-Lemon et al. 2022, p. 57; see also Alford, 2016; Rice, 2007, 2012; Rickert, 2007, 2013; Ulmer, 2008). *Chora*, thus, signals the important communicative potential of places not fully known, of places that "can be described only momentarily and imperfectly" (Kymäläinen & Lehtinen, 2010, p. 258). Building upon this incomplete understanding of place that is signified in the Greek *chora*, the practice of chorography, according to Casti (2015), involves two elements: first, rendering a landscape; and, second, recovering the subject-as-social-actor and the space-as-cultural-community. Together, these elements enable a chorographic understanding of maps as expressing "the value of a societal world adopted in its relentless becoming" and promoting this value through the use of "multiple points of view," "many techniques," and "many languages that combine and intersect" (Casti, 2015, p. 254). In its embrace of multiplicity and social subjectivity, chorography makes space for complex rhetorical inquiry.

In this study, we draw upon chorography to investigate the inclusivity and sustainability of community engagement initiatives at our home institution. Foregrounding the location of our institution's community engaged work, our own complex rhetorical inquiry began with a *where* question—namely: Where does our institution's community-engaged work take place? To answer this question, we used chorography to analyze one year of our institution's community engagement data, interrogating the spatial location of our institution's work alongside understandings of inclusivity and sustainability. Ultimately, we contend that chorography is a way that institutions can seek spatial justice in conjunction with place-based community engagement understandings. To support this argument, this article: (1) surveys disciplinary and institutional definitions of community engagement; (2) details our data collection process; (3) profiles our communication design decisions; and, (4) mobilizes reflexivity to discuss our results.

REVIEWING THE LITERATURE ON COMMUNITY AND CIVIC ENGAGEMENT ACROSS INSTITUTIONAL AND DISCIPLINARY TERRAINS

The term *community engagement* is a contested terrain insofar as varying definitions differently emphasize the *what*, *who*, *why*, *how*, and *when* of community engaged work. Less central to these varying definitions, but perhaps more crucial to the actual work, is the *where* of community engagement. The importance of the *where* of community engagement—that is, the precise location where a discrete instance of community-engaged work takes place—has recently grown with the emergence of the place-based community engagement framework that has been adopted by some institutions of higher education (Yamamura & Koth, 2018, 2019). Just as the place-based community engagement framework focuses on geography (Yamamura & Koth, 2019), so too does our study. Our study emerges from the *where* of community work, amid definitions of community engagement advanced by our institution, the Carnegie Foundation, and the field of technical and professional communication.

In 2018, we were working alongside students, staff, faculty, administrators, city personnel, and community leaders to help refine and better realize what our university defined as community engagement. At the time, author one was working with our university's Office of Institutional Effectiveness and Office of Community Outreach as a faculty fellow and author two was working in our university's Office of Service-Learning as the coordinator of service-learning.

More specifically, we had both assumed roles on committees supporting our university's reapplication for the Carnegie Classification for Community Engagement. This elective classification supplements the basic classifications that the Carnegie Foundation uses to describe institutions of higher education according to their settings, student populations, enrollment numbers, and research profiles (Carnegie Elective Classification, 2022a; Indiana, 2021; Johnson et al., 2017; Saltmarsh & Johnson, 2020; Yamamura & Koth, 2018). Unlike the basic classifications, this elective classification serves as "an evidence-based documentation of institutional practice" pertaining to an institution's community engagement (Carnegie Foundation, 2016). Behind the Carnegie Classification for Community Engagement lies a theory of change that strives for institutional transformation through community engagement (Saltmarsh & Johnson, 2018, 2020; Welch, 2016; see also Eckel, 1998). Here, the idea is that transformative change "comes about through change in academic culture" (Saltmarsh & Johnson, 2020, p. 111), and the application process asks institutions to document aspects of their culture around community engagement that might indicate change. As Saltmarsh and Johnson (2020) explained, "transformation through community engagement comes about through changing the core academic culture of the institution" (p. 111). After having been piloted in 2006, the classification has accepted four cycles of applications since—one in 2008, 2010, 2015, and 2020 (Saltmarsh & Johnson, 2018, 2020; Carnegie Elective Classification, 2022b).

Our institution committed to reapplying for the Carnegie Classification for Community Engagement and renewing its initial 2010 classification as part of its 2015 strategic plan (Western Michigan University, 2015). During the reapplication process, our institutional definition of community engagement aligned very

closely with the definition of community engaged advanced by the Carnegie Foundation. The Carnegie Foundation uses the term *community engagement* to describe "the collaboration between institutions of higher education and their larger communities (local, regional/state, national, global) for the mutually beneficial creation and exchange of knowledge and resources in a context of partnership and reciprocity" (Carnegie Foundation, 2016, p. 1). Further, the Carnegie Foundation states that the purpose of community engagement is to "to enrich scholarship, research, and creative activity; enhance curriculum, teaching, and learning; prepare educated, engaged citizens; strengthen democratic values and civic responsibility; address critical societal issues; and contribute to the public good" (Carnegie Foundation, 2016, p. 1).

As our committees discussed this definition, we became acutely aware of the way in which this definition minimized the importance of location to our institution's community engaged work. In this definition, for instance, we observed a strong emphasis on the *who* and the *why* of community engagement. Emphasizing the public purpose of higher education, the Carnegie Foundation defines the *who* of community as an institution and their larger communities. Likewise, the Carnegie Foundation stresses the *why* of community with an explicit purpose statement that mobilizes verbs like *enrich*, *enhance*, *prepare*, *address*, and *contribute* all in service of "the public good" (Carnegie Foundation, 2016, p. 1). Further, according to this definition, the *what* of community engagement involves "collaboration" and "the creation and exchange of knowledge and resources," while the *how* of community engagement describes activity that proves "mutually beneficial" (Carnegie Foundation, 2016, p. 1). Ever-present, also, in the Carnegie Foundation's framework is the *when* of community engagement, demarking the work of community engagement as occurring in accordance with academic years and aligned with classification and reclassification cycles. For instance, the 2020 reclassification framework tasked applicants with focusing on the community engaged work occurring during the 2017–2018 academic year (Carnegie Foundation, 2016).

While the Carnegie Foundation's definition references the context of community-engaged work, little emphasis is placed on the *where* of community engagement and perhaps understandably so. As a national classification that has recently become international in scope, the Carnegie Elective Classification for Community Engagement seems to tacitly recognize that the work of community-engagement occurs in many different locations across the United States and the globe (Carnegie Elective Classification, 2022b). Defining community engagement in terms of geographic location would, therefore, limit the ability of the elective classification for community engagement to appeal to institutions whose community-engaged work is situated across a wide variety of global geographies.

Although the location of community-engaged work might not serve as a defining feature of the Carnegie Foundation's definition of community engagement, our discussions with our committee members suggested that the location of our own institution's community-engaged work was an essential component of our reapplication self-study. One reason why this focus on location was so prominent in our committee discussions was because our reapplication self-study for elective community engagement classification occurred in conjunction with a master planning process undertaken by the city in which our institution's main campus is located: Kalamazoo, Michigan. The City of Kalamazoo classifies our institution as a neighborhood—one of among 22 neighborhoods in our city—and the Kalamazoo City Planner was one of the community members who served as a committee member. The city's master plan included nearly two dozen map overlays that pinpointed the geographic location of current city amenities and transit paths (City of Kalamazoo, 2017). These maps, as those of us who were familiar with the plan saw, also helped demonstrate sites of future community improvements with the goals of facilitating a connected city, establishing great neighborhoods, and supporting downtown life. The master plan emerged from the City of Kalamazoo's own community engagement efforts, which achieved 4,058 points of contact about the plan through living walls, in-person meetings, online platforms, and surveys (City of Kalamazoo, 2017). Maps were crucial to this planning process.

Besides acknowledging the importance of mapping to the planning process that was undertaken by the city that houses our institution's main campus, our committee discussions about location also echoed much of the work on community partnerships, civic engagement, social justice, and advocacy emerging from the field of technical and professional communication. Particularly important to our reapplication self-study process was a call for researchers in technical and professional communication to move "beyond the buzzword of civic engagement" that was issued by Gonzales and Simmons (2018) during a plenary talk at the Association of Teachers of Technical Writing Conference in Kansas City, Kansas. Situated within the context of top-down administrative initiatives that require faculty and staff to tabulate community-engaged work, the call summoned researchers in technical and professional communication to expand "notions of advocacy both within and beyond academic institutions" and to "more ethically engage in civic engagement" (Gonzales & Simmons, 2018). Gonzales and Simmons advised caution when these administrative initiatives seem implemented only for the attainment of recognition and prestige, for that is when community and civic engagement elide institutional responsibilities to community stakeholders—hence, the need for increased advocacy and increased ethics on the part of researchers (2018).

Offering an example of an initiative that an institution of higher education might potentially implement in a way that overlooks its "layered responsibilities" to its community stakeholders, Gonzales and Simmons discussed the Carnegie Classification for Community Engagement (2018). The speakers elaborated on the problems with poorly implemented, uncritical, and unreflective top-down dictums to attain the Carnegie Classification for Community Engagement by highlighting the immense amount of institutional labor invested in collecting data, clocking hours, and shoehorning "community-based work into sometimes ill-defined categories" (Gonzales & Simmons, 2018). One of the concerns voiced in the plenary talk was that the space opened by the elective classification for community engagement "doesn't necessarily acknowledge the layered responsibilities" (Gonzales & Simmons, 2018) that are crucial to community-engaged work.

As we embarked on our reapplication process, we saw our focus on the *where* of our community-engaged work as one means by which to better represent and reimagine our responsibilities to our community partners. By foregrounding the location of our institution's community-engaged work, we reasoned that we might move toward increasing the spatial justice of that work (Hurley, 2018; Soja, 2010). Spatial justice seeks to remap spaces, places, and locations in a way that promotes equity and rights, fairness and freedom. As Soja (2010) explained, the geographies where

we live and work create and maintain "lasting structures of unevenly distributed advantage and disadvantage" (p. 20). Spatial justice works to establish new geographies and alternative spatial structures that might redistribute advantage. We follow Hurley (2018) in connecting the practice of map-making with the goal of increasing spatial justice. Further, the practice of making maps to increase spatial justice is a practice closely aligned with the complex design work undertaken by technical and professional communicators. Spatial justice is, in fact, explicitly listed among the key theoretical frameworks associated with the social justice turn in technical communication (Haas & Eble, 2018, pp. 13–14); among the goals are fostering "more critical understandings of our responsibilities to the cultures and communities within which, to whom, and about whom we communicate" and of "the relationships between rhetorics, places, power, agency, networks, infrastructures, and institutions—and how space and place have real political and embodied effects on (in)justice and rights" (Haas & Eble, 2018, p. 12).

Our study seeks to answer the call from Gonzales and Simmons (2018) and to "push the boundaries" of our university reclassification initiative by using map-making to better locate our institution's community-engaged work and better advocate for spatial justice. Concomitant with our interest in advancing spatial justice through mapmaking is our aim to bring the inclusivity and sustainability of the geographies of our institution's community-engaged work into a sharper focus. To be sure, our use of mapmaking responds to the need identified by Gonzales and Simmons (2018) in their plenary talk—namely, "the need for sustainable efforts to increase and support diversity not only in the communities we engage with but also in the communities we foster within the discipline." Here, we invoke work from technical communication and community engagement to define geographic inclusivity and geographic sustainability. Geographic inclusivity refers to a goal of increased diversity achieved through spatially just and equitable practices (Jones et al., 2016; see also Yamamura & Koth, 2019). "A focus on inclusivity," as Jones et al. explained (2016), "prompts infrastructural correctives, drawing attention to practices, policies, and processes for decision making" (p. 224). Mapmaking can advance the goal of geographic inclusivity by allowing users "to occupy a deliberate positionality that privileges action and social change without being prescriptive and relying on only passive representation" (Jones et al., 2016, p. 224). Similarly, geographic sustainability can be defined as a goal of increased resiliency achieved through equitable, place-based commitments and durable, high-quality resourcing. Johnson et al. (2017) connected such sustainability with the use of "procedures and technologies that advance programmatic aims and viability in the short and long term when competing for limited institutional resources without compromising the natural environment or ignoring needs of diverse populations" (p. 8). Further, such sustainability functions as a goal in the place-based community engagement framework, and this goal is characterized by stability not only in commitments but also in leadership and funding (Yamamura & Koth, 2018). Mapmaking can advance the goal of geographic sustainability by helping to visualize the distribution of commitments and resources across space. Accordingly, the questions that guide our study are:

- Where in our communities did our institution's engaged work occur?
- How might we increase spatial justice by envisioning more inclusive community-engaged work?
- How might we increase spatial justice by envisioning more sustainable community-engaged work?

In the next section, we describe the methodology behind our data collection, map design, and our reflexive process.

APPLYING A CHOROGRAPHIC METHODOLOGY TO OUR INSTITUTION'S COMMUNITY-ENGAGED WORK

To suggest some answers to our research questions and to more fully consider the location of our institution's community-engaged work, we adopted a reflexive chorographic methodology for our study. This methodology connects the notion of community with processes of socio-spatial remembering (Kymäläinen & Lehtinen, 2010; see also Casti, 2015; Gogan & Harrison, 2018). In particular, our chorographic methodology involved three broad steps: (1) collecting community engagement data; (2) designing a multi-layered community engagement map; and, (3) reflexively considering the inclusivity and sustainability of our institution's community-engaged work. Given the scope of these three steps, our Human Subjects Institutional Review Board determined that our research protocol (#230305) did not require board approval. In the next three sections, we detail each of these three broad steps.

Chorographic Step 1. Collecting Community Engagement Data

The first broad step that we took toward enacting our chorographic methodology was a robust process of data collection and analysis. This process began with the data required by the Carnegie Foundation's reclassification application and was expanded to include partnership information that would foreground the locations of our institution's community-engaged work. This process anticipated the codes we would use to segment and categorize our data and it also involved a sampling plan.

Reclassification self-study data

To receive the Carnegie Classification for Community Engagement, institutions of higher education must complete an extensive application that documents a culture of transformative community engagement. By design, this application guides institutions through a process of self-study and encourages university stakeholders to engage in critical and strategic reflection about their community-engaged work. The application process aims to effect "campus change" (Saltmarsh & Johnson, 2020, p. 108)—that is, the application is designed to help institutions "mark their progress and identify areas for improvement in their commitment to community engagement" (Driscoll, 2008, p. 40).

In alignment with its design as a rigorous self-study process, the 2020 reclassification framework required applicants to collect a significant amount of data. The Carnegie Foundation tasked 2020 reclassification applicants with reporting granular details across three large categories of community engagement activities, which were defined by the Carnegie Foundation as:

Curricular engagement, or collaborations, such as service-learning, that "address community identified needs, deepen students' civic and academic learning, enhance community well-being, and enrich the scholarship of the institution" (Carnegie Foundation, 2016, p. 9);

Co-curricular engagement, or "structured learning that happens outside the formal academic curriculum through trainings, workshops, and experiential learning opportunities," such as alternative breaks or community service projects (Carnegie Foundation, 2016, p. 12); and,

Outreach and partnerships, which, in the former case, apply "institutional resources for community use" and, in the latter case, establish collaborations "for the mutually beneficial exchange, exploration, and application of knowledge, information, and resources" (Carnegie Foundation, 2016, p. 15).

For the category of curricular engagement, the application asked applicants to quantify the numbers of:

- students who conducted community-engaged work
- tenured or tenure-track faculty who conducted community-engaged work
- full-time non-tenure-track faculty who conducted community-engaged work
- part-time faculty who conducted community-engaged work
- courses that involved community-engaged work
- departments that featured community-engaged work.

The reporting spreadsheet further requested calculations of these numbers that included:

- Gross total number
- Change in total number from 2010 application
- Gross total number as a percent of the total institutional number
- Percent change since from 2010 application

Finally, the application sought supplementary descriptions of 30 concentrated areas of community engagement, split evenly across the categories of curricular engagement and co-curricular engagement.

To complete the reclassification self-study, we needed to gather data about the community-engaged work undertaken by our university, across its various divisions—Academic Affairs, Advancement, Athletics, Business and Finance, Diversity and Inclusion, Student Affairs, and Research and Innovation—and within its particular units, including its colleges, offices, schools, departments, and programs.

Placed-based partnership information

To foreground the *where* of our institution's community engaged work, the data that we collected for this study exceeded the scope of the data required by the Carnegie Foundation's reclassification application. Indeed, we requested information from our stakeholders that went beyond numbers of students, faculty, courses, and departments.

We sought key pieces of information that would help us to locate our institution's community-engaged work and to place this work on a map. In total, we requested sixteen pieces of information from our stakeholders, and these pieces of information consisted of:

- Division
- Unit
- Course
- Date
- Institutional point of contact
- Number of university personnel
- Hours per individual
- Partner organization name
- Partner address
- Partner city
- Partner state
- Partner zip code
- Partner country
- 5-word description of project
- Partner URL
- Partner Logo

We envisioned most of these additional data points as sub-coding categories, since each data point could be combined, sorted, or segmented in a way that would produce a unique coding scheme and advance our eventual analysis. Our intent was for these coding schemes to elaborate upon the where of our institution's community engaged work and, ultimately, allow for this work to be located and represented on a map. We anticipated that these additional data points would be instrumental in establishing three specific coding schemes:

- Geographic location, a code that emerged from the partner address, city, country, zip code, and state data points, as applicable
- Institutional location, a code that emerged from the division and unit data points
- Time investment, a code that emerged from a calculation using the number of university personnel and the number of hours per individual dedicated to the particular instance of community-engaged work

Our three-phased data sampling process, which is described in the following section, helped us to secure these sixteen data points for the vast majority of the community-engaged work reported to us. Detailed information for any partnership that was established in confidence—such as the partner organization name or location associated with a number of community-engaged research projects—was not shared with us.

Cross-divisional sampling plan

Our data collection process began in May 2018 and involved a three-phased sampling approach led by author one.

In the first phase of data collection, committee members approached the administrative leaders of units housed in Academic Affairs and Student Affairs. Our approach in this phase of data collection could best be described as "purposive sampling" (Kumar, 2014, p. 244), in that we exercised our judgment as to which institutional divisions could most readily provide the type of information—both in depth and breadth—that we sought. Emails requesting sixteen pieces of information for every instance of community-engaged work were sent to chairs of departments as well as to directors of schools, programs, and offices within these two divisions. We sent follow-up emails to these administrators until a response was received, or until we had sent a total of four emails. If respondents returned incomplete data, committee members would often complete the data set by most commonly finding a URL for a community partner's

website or piecing together a complete address when given partial information for the location of the work. In some cases, committee members would follow-up directly with the faculty or staff member who spearheaded the community-engaged work to clarify the information or complete the data set.

In the second phase of data collection, committee members approached the administrative leaders of units housed in other institutional divisions and requested information similar to that requested in the first phase of data collection. Most times, these units were invited to supply the same sixteen pieces of information that would enable us to craft a robust response to the framework and fully plot the community-engaged work on our map. Other times, these approaches requested different kinds of data that would be used to answer a specific question posed by the Carnegie Foundation in its reapplication framework but that would not yield data for our map of community-engaged work. For instance, one question on the framework asked about university hiring and purchasing practices that demonstrate our institution's commitment to community engagement. To answer this question, we contacted the director of logistical services, a campus unit overseen by our university's division of Business and Finance. The individual we contacted was able to send our committee a list of nine responsibilities that the unit seeks to uphold during procurement. These responsibilities included educating local businesses on our institution's relationship with vendors, offering programs that enhanced local business opportunities, publicizing local vendor opportunities, and encouraging local business.

In the third phase of data collection, we contacted individuals who we learned, during our first two phases of data collection, were involved in community-engaged work during the 2017–2018 academic year. This phase of data collection enacted a method of network sampling that is often referred to as "snowball sampling" (Kumar, 2014, pp. 244–245), in that we followed leads offered by previous contacts in the earlier phases of data collection to identify additional contacts in this phase of collection. For instance, we contacted our institution's Office of Research and Innovation seeking information on community-engaged grants and contracts administered by our university. This office, which functions as its own university division, provided us with two lists of such awards. The first list detailed community-engaged work supported by the division and included research projects focused on the community and community-sponsored projects. The second list contained information for any project classified as a "public service" project by its principal investigator. Using these two lists, we then communicated with the faculty and staff leading these projects to collect additional data for the reapplication and for our map. In this way, communication with one contact to gather data snowballed into communication with dozens of principal investigators, all of whom supplied us with data points.

Together, these three phases of data collection spanned seven months, from May 2018 through November 2018, and yielded 2,848 discrete community engagement activities. The data revealed that our institution's community engagement efforts involved over 1,500 unique community-based organizations and invested over 1.34 million hours into this community-engaged work. Having collected these data, we were prepared to design our map.

Chorographic Step 2. Designing a Multi-Layered Community Engagement Map

The second broad step we took toward enacting our chorographic methodology was designing an interactive map that plotted our community engagement data and allowed users to interact with that data. As our two committees desired to highlight the location of our institution's community-engaged work, designing a map seemed to be an appropriate choice to fulfill this purpose (Clary-Lemon et al., 2022). And, our choice of a digital, interactive map underscored the map's function as a piece of multi-dimensional communication (Alford, 2016).

Committee deliberation

Our design process began with robust inquiry into the affordances of various mapping applications. Our committees discussed a number of mapping projects housed at our institution (e.g., HDReAM, 2016) and, after surveying the technical specifications of a number of different mapping applications (e.g., Google My Maps), chose to use Esri's ArcGIS StoryMaps application to construct our map. Indeed, GIS technology has been understood as a cartographic tool so highly novel that it shifts the focus of mapping from technical considerations to communicative ones (Casti, 2015). Capitalizing on GIS technology, the StoryMaps application allows for the exact coordinates of locations around the globe to be plotted with pinpoint accuracy. The StoryMaps application is also a platform that has been adopted by researchers in the fields of technical and professional communication and rhetorical studies for a range of location-based projects (Getto & Moore, 2017; Malkowski & Klenke, 2020; Stephens & Richards, 2020). With the support of a mapping specialist housed in our university libraries, the expertise of faculty members in our Department of Geography, Environment, and Tourism, and the assistance of an undergraduate technical communication intern, we began composing our map.

Map design

After choosing to work with the ArcGIS StoryMaps application, we used an iterative process to arrive at the final design for our map. The process relied upon prototyping and frequent discussions among various stakeholder groups including our committees, our administrative sponsors, and our campus mapping experts (Gogan & Harrison, 2018). The work of our undergraduate technical communication intern was especially crucial to moving the design of our map forward, as this individual was able to conduct design-focused research and provide us with customized user documentation that met the needs of stakeholders. In its final form, the design of our map prioritized user navigation, comprehension, and exploration.

Navigation. Our first series of significant design decisions involved our choice of one of seven StoryMaps templates. After analyzing all seven templates (see Stephens & Richards, 2020, pp. 13–14) and reviewing samples of each, a deeper assessment of three templates—the Journal, Series, and Cascade templates—was conducted across 24 criteria, many of which involved navigation (Peña, 2018a).

We chose the Series template with side accordion layout as the base template for our map design. This version of the Series template possessed "refined navigability," which allowed for scrolling within input boxes, and "highly customizable" features, which enabled the adjustment of "text font, color, orientation, type and face" as well as the use of pictures and graphics (Peña, 2018b). Further, the side

accordion layout assisted users with navigation by employing both numbers and descriptive text on the on the left side of the screen display to distinguish various map layers.

The buttons featured on this template's accordion-style layout did, however, present an initial design challenge related to navigation. By default, the screen-left navigation buttons included over-complicated formatting and a hovering setting. The formatting and the additional setting impeded user navigation. A sequence of custom HTML code allowed us to address this challenge by removing the formatting and simplifying the setting (Peña, 2018c). Ultimately, this custom code made user navigation easier.

The layout also possesses some standard navigational components that are common to most StoryMaps templates. Most notably, a cursor or a keyboard command enables users to freely zoom in and out of the map. Pressing a graphical icon marked as "+" will transport the user closer to street level, while pressing a graphical icon marked as "–" will move the user's perspective farther away, retracting the view, minimizing scale, and increasing the perceived distance. An additional icon—this one shaped like an a-frame house and serving as a home button—is located between the zoom buttons. With a single click, this button returns the screen to its initial settings and resets the map's scale. These three navigation icons are always available in the top left corner of the map, regardless of where the user's cursor is on the map.

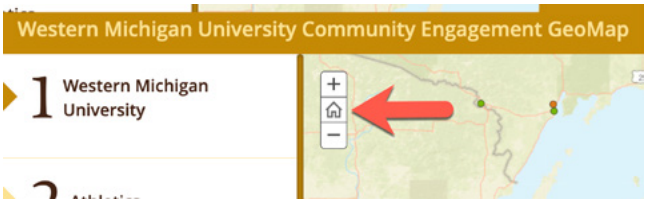

Figure 1: Screen capture of the map's navigational components.

Comprehension. StoryMaps projects have been shown to be particularly effective in crafting "a public-facing message intended for nonacademic audiences" (Malkowski & Klenke, 2020, p. 182). We wanted our users not just to receive our message, but to understand that message. Accordingly, we focused a second series of design decisions on strategies that would promote user comprehension of our institution's community-engaged work. For these decisions, we relied upon the StoryMaps interface as a tool that would allow us to author, publish, and share dynamic stories that might "include maps, narrative text, lists, images, videos, embedded items, and other media" (Esri, 2022).

To begin crafting the story of our institution's community engagement, we populated the map with 2,848 plotted points. Each plot represented the location of one community engagement activity (see Figure 2). Mapped with street-level accuracy, these plots span the globe and are color-coded to signify the university division or unit that undertook the community engaged work. The color-coding scheme capitalized on the interactive map legend to promote user comprehension. The legend can be opened and closed with a single click, and is constantly available to users in the top right corner of the map, regardless of where they are on the map. The legend automatically adjusts to the interactive filtering system, ensuring that users will be able to understand the data points at all times.

Figure 2: Screen Capture Showing Institutional Community Engagement Points across the Globe with Open Legend

Moreover, each plot is linked to a pop-up window feature, the goal of which is to provide users with a quick yet informative snapshot of each partnership. By clicking on a plot, a small window appears overlaid on top of the map view (see Figure 3). This window displays information about both the community partner and the university's dedication to the partnership. Information about the community partner includes a logo, physical address, and a URL. Information about the university's dedication to the partnership includes the associated academic college, unit, and course number, if applicable, as well as the time and personnel committed to the partnership. For example, the pop-up window displayed in Figure 3 includes the community partner name (Fair Housing Center of Southwest Michigan), unit (Public Affairs and Administration), course number (PADM 4000), number of university personnel (six), and number of hours contributed per individual (25). To minimize the window, users click anywhere on the screen and return to the previous position on the map.

Figure 3: Screen capture detailing map data for one local engagement activity.

These pop-up windows also presented us with an initial design challenge. A centrally attractive feature of the Series template was the map's ability to display input boxes that, themselves, would showcase text and multimedia elements. We saw this component as important for providing detailed, easy-to-understand information about specific instances of our institution's community engaged work. By default, however, the template's pop-up input boxes consisted of one open space, and this space contained no substructure within which to organize information. A sequence of custom HTML code again allowed us to modify the pop-up window' structure (Peña, 2018c). As with the other elements of the map, the color of the pop-up window was changed to adhere to our university's branding standards.

Exploration. We further made a series of design decisions to allow map users to explore our institution's community-engaged work from various perspectives and for various purposes. To encourage exploration, we seized upon a "layered approach to communication design" (Butts & Jones, 2021, p. 11). This approach created map layers by stacking data filters and representing that data in a novel way.

We chose to apply 19 filtered layers to our map. Rendered as accordion-style buttons and positioned on the left quarter of the screen display, these filters enable quick data access and allow users to explore our institution's community-engaged work form multiple perspectives. The first layer presents a broad view of the entirety of our institution's community-engaged work during the 2017–2018 academic year. This layer is comprehensive and encompasses all of the engagement plots that appear as color-coded points on our map (see Figure 4).

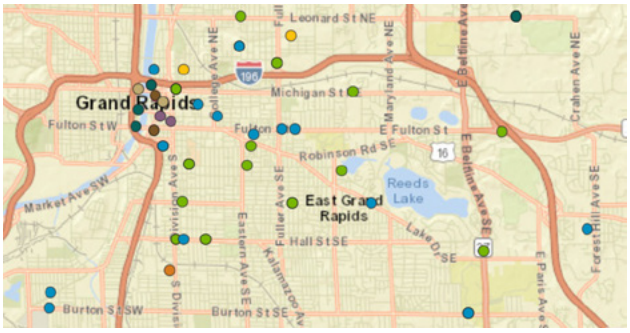

Figure 4: Screen capture illustrating engagement plots as color-coded points.

Subsequent layers narrow the view of our institution's community-engaged work and filter the plots by our institution's major divisions—from athletics to global education, student affairs to information technology, diversity and inclusion to research and innovation. Using a similar approach, eight separate layers each present the community engagement of different academic colleges. Across these layers, community engagement data is filtered by the College and Unit fields with the map only plotting the locations of community-engaged work that meet the specifications of the filter. Figure 5, for instance, captures a view of our map that only displays data from one of our academic colleges. Note, first, that the triangle-shaped indicator adjacent to the number "5" on the left of the screen display appears in a shade of mustard yellow that is deeper in shade than the other triangle-shaped indicators. This deeper shading communicates that layer five—the layer that features data only from our institution's College of Education and Human Development—is displayed by our map. Note, second, that the map displays only cyan blue plots. The color of these plots also communicates the vantage point offered by this map layer, as cyan blue was the color associated with the display for the College of Education and Human Development data points.

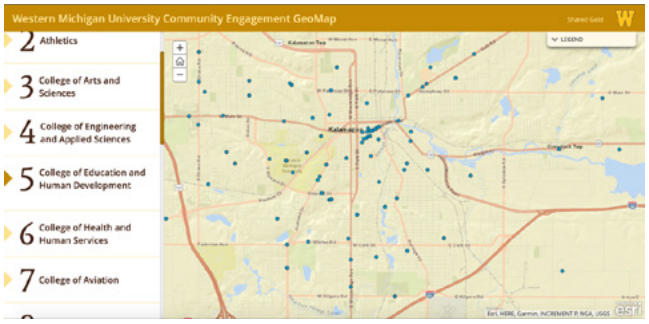

Figure 5: Screen capture of college of education and human development filtered layer.

Another layer displays engagement activities by mapping intensity rather than discrete activities. To show the distribution of total engagement hours across our map, we used a heat map effect. The areas of the map with the most opaque and intense gold color, including metropolitan areas such as Detroit, Chicago, Grand Rapids, and Kalamazoo, are those community locations where our institution invested the most hours of engagement work (see Figure 6). Put differently, this layer of the map represents location according to the total number of hours per partnership per location. As such, this heat map acknowledges that even one plot on the map might mark a significant investment of time in community-engaged work.

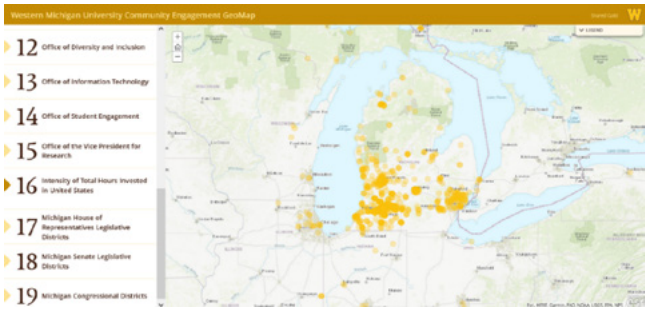

Figure 6: Screen capture showing heat map representation of the intensity of engagement hours.

Two other filtered layers include political district overlays (see Figure 7)—one for each division of our state's bicameral legislature. These layers were added late in our design process as a response to a request from our stakeholders. The overlays allow our stakeholders who work closely with members of our state legislature to display the partnerships undertaken in each legislator's district and potentially advocate for more state support.

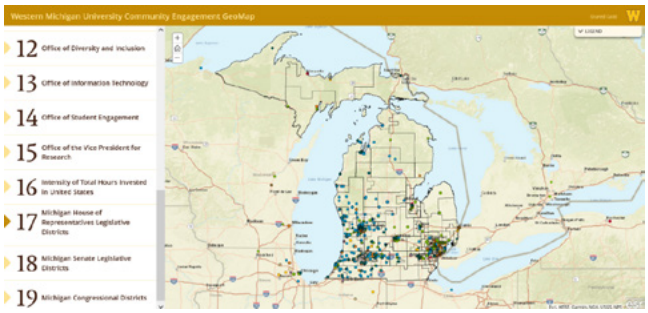

Figure 7: Screen capture showing legislative district overlay for michigan house of representatives.

With our map designed in a way that allows users to navigate, comprehend, and explore one year's worth of our institution's community-engaged work, we were poised to move onto the third step in our methodology. This third and crucially important step required us to mobilize reflexivity and arrive at an understanding of our map that identified ways our institution could increase the inclusivity and sustainability of its community-engaged work.

Chorographic Step 3. Reflexively Considering the Map of Our Institution's Community-Engaged Work

The third broad step of our chorographic methodology required us to use reflexivity to better understand our data by way of our map. As a kind of critical cartographic practice, chorography tasked us with recalling and remembering intentions that informed our map-making, so as to critically exceed intentions and consider social effect (Gryl, 2012; Lehner et al. 2019). The methodology also called upon us to consider the "focal points, themes, and hierarchies" (Clary-Lemon et al. 2022, p. 121) emerging from the first two steps in our process. In this section, we, first, define reflexivity, and, second, examine the map as a future-focused orienteering instrument—a tool designed to increase spatial justice by identifying places where our institution can better improve the inclusivity and sustainability of its community engaged work. Such a reflexive discussion of the results of our mapmaking can be understood as helping our institution "identify potential areas of opportunity" (McKenzie et al., 2016) for improving our community engaged work in the future and moving more toward spatial justice.

Reflexivity

Reflexivity describes an approach to data and representations that critically considers positionality. Reflexivity, as Chiseri-Strater (1996) noted, distinguishes itself from reflection based upon the demand for another: "to be reflective does not demand an 'other,' while to be reflexive demands both another and some self-conscious awareness of the process of self-scrutiny" (p. 130). Reflexivity has been described as a "methodological tool" (Pillow, 2003, p. 176), and its ability to engage researchers, designers, communicators, and cartographers in developing "complex understandings of position and privilege" (Jones & Walton, 2018, p. 250) makes it a hallmark of approaches that seek social and spatial justice (Agboka, 2014; Haas & Eble, 2018; Jones, 2014).

Reflexivity proves especially germane to studies of representations (Pillow, 2003), including narratives (Jones & Walton, 2018) and critical cartographic studies of maps (Del Casino & Hanna, 2006). Reflexivity is facilitated through narrative engagement and encourages the development of "critical insights" that relate self with other and past with future (Jones & Walton, 2018, p. 247; pp. 248–249). As connected to narrative, reflexivity emphasizes the multiplicity of perspective, the relationality of work, and the dynamics of power as relative to different social positionings (Jones & Walton, 2018, pp. 250–251). Reflexivity further serves as "an analytical feature of critical cartography" and it provides chorographers with "a set of tools" that bridge past understandings with "future improvements" (Casti, 2015, xi). Reflexivity gives chorographers opportunities to "raise questions involving the rendering of [map-making's] social significance, possibly by looking at areas traditionally quite alien to its field, such as the language of technical and visual arts" (Casti, 2015, p. xii). The suggestion, here and one that is supported by the work of Jung (2018) and Stephens and Richards (2020), is that a reflexive approach to studying maps connects the field of critical cartography with other fields interested in technical languages and visual storytelling—fields such as technical communication and communication design.

Thus, a reflexive approach to our map underscores not only the cartographies plotted, but also the stories told, through our use of Esri's ArcGIS StoryMaps application. As the final broad step to our chorographic methodology, reflexivity enables us to study the past locations of our institution's community-engaged work and envision a future in which our institution's community-engaged work might be made more inclusive and sustainable.

Toward a More Inclusive Geography of Institutional Community Engagement

By approaching our map of our institution's community-engaged work reflexively, we can assess our institution's past community engagement efforts and identify ways to make these efforts more geographically inclusive in the future. As defined above, geographic inclusivity refers to a goal of increased diversity achieved through spatially just and equitable practices that can be advanced by chorography. Our focus on geographical inclusivity directed our attention toward the positioning of the 2,848 plots on the map with respect to socially established spatial borders such a postal codes, counties, states, and nations. This focus also directed our attention to the relative proximity between these plots, our institution, and socially established borders.

Our map afforded us an opportunity to adjust the scale of our perspective and consider the relative degree of inclusivity demonstrated by one year of our institution's community engagement initiatives. Most immediately and most readily visible at almost any scale, the map shows that our most concentrated community-engaged work occurred in close proximity to our institution's main campus with some community engagement initiatives—such as guest lectures, summer youth camps, and fine arts performances—occurring on our university's main campus. The geographic areas abutting main campus appear saturated with engagement activity from most views of our map. More precisely, the three postal codes that encompass parts of our institution's Kalamazoo campus included 1,346 plots and accounted for just under 50% of our annual engagement activities (see Figure 8). In each of these postal codes, hundreds of instances of community engaged work occurred. Of these three postal codes, the most densely saturated postal code boasted 713 community-engaged initiatives, while the least densely saturated postal code still hosted 281 community-engaged initiatives.

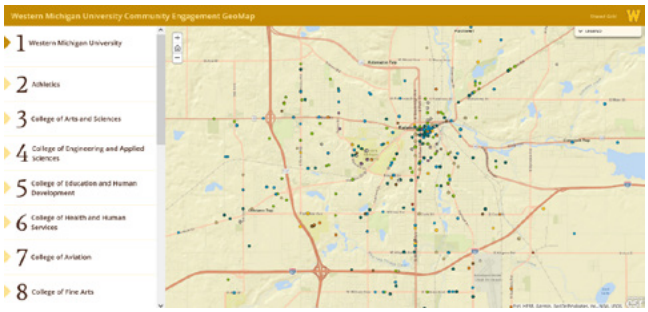

Figure 8: Screen capture displaying cluster of engagement activities near main campus.

While the number of engagement activities in these three nearby postal codes is commendable, the geographical distribution leaves much to be desired in terms of inclusivity. To be sure, the map allows for us to transform our perspective by zooming out farther and locating postal codes and surrounding neighborhoods where engagement activity has been less concentrated. When we do so, we can see that the distribution and saturation of our institution's engagement activities varies considerably. For instance, see Figure 9, which displays a full view of our institution's home county, Kalamazoo. To better emphasize the county's border, which our map displays using a light grey dotted line, Figure 9 marks the county line in red. Of the 13 non-unique postal codes in Kalamazoo County that do not encompass part of our university, one postal code had no community-engaged work occur within its geographical boundaries, seven other postal codes hosted between one and 20 initiatives each, and the five remaining postal codes each averaged around 100 initiatives each. Figure 9 shows that those postal codes more removed from our county's city centers experienced fewer community-engagement initiatives.

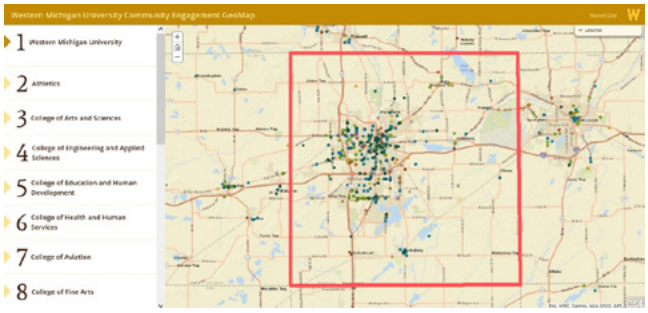

Figure 9: Screen capture displaying distribution of engagement activities in Kalamazoo County.

A similar view of our institution's community-engaged work emerged as we viewed our region (Figure 10) and our state (Figure 11). The map of our institution's community-engaged work suggested that less densely populated areas and those areas further removed from one of our institution's campuses were, in turn, less likely to be the location of a community-engaged initiative. We noticed that the densest plot clusters are within close proximity to our university and its respective branch campuses and, conversely, that the map revealed relatively sparse activity across the remaining locations in our state (see Figure 11). Understood in terms of our state's 917 non-unique postal codes, our university located its community-engaged work in just over 25% (n = 236) of these postal codes. When we gain some distance from postal codes and consider the distribution of our community-engaged work across Michigan's 83 counties, we see that our institution located a community-engaged initiative in at least 64% percent (n = 53) of our state's counties. Although postal codes and county borders signify two different types of spatial configurations—the former, a delivery route, and the latter, a territorial division—the two calculated percentages provide one indication of the range of the statewide geographic diversity of our institution's community-engaged work.

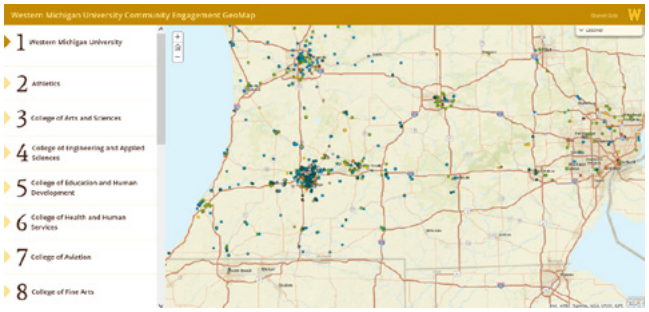

Figure 10: Screen capture displaying regional distribution of engagement activities.

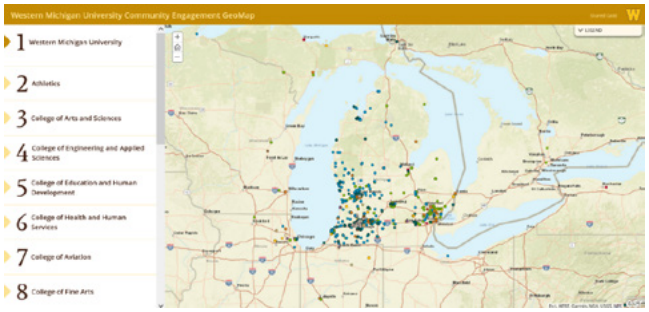

Figure 11: Screen capture showing statewide distribution of engagement activities.

Zooming farther out away from a statewide view and adopting national and global views, we see that plots fall across 29 of the 50 United States, plus the District of Columbia (see Figure 12), and in 15 additional countries (see Figure 13). At these scales, similar complexities regarding plot density and proximity emerge. Visible clusters serve as a visual confirmation of our institution's commitment to engage with particular areas; thus, encouraging the university to remain accountable, responsive, and responsible for activities in these communities. At the same time, the absence of plots in some areas of the map—for example, South America—raise questions about curricular community-engagement programming, resource allocation, and institutional policies that may be impacting the distribution of community-engaged work at the local, regional, national, and global levels.

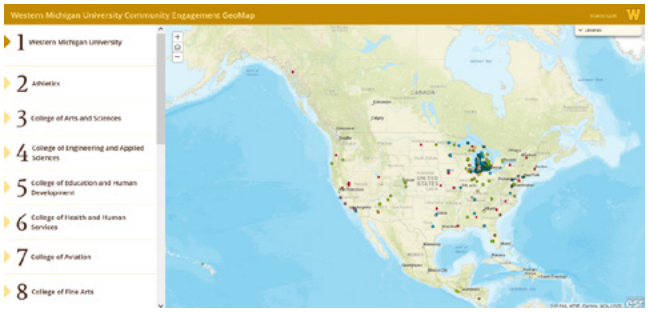

Figure 12: Screen capture showing national view of engagement activities.

Figure 13: Screen capture showing global view of engagement activities.

Toward a More Sustainable Geography of Institutional Community Engagement

By approaching our map of our institution's community-engaged work reflexively, we can also assess our institution's past community engagement efforts and identify ways to make these efforts more geographically sustainable in the future. As explained above, geographic sustainability connotes a goal of increased resiliency achieved through equitable, place-based commitments and durable, high-quality resourcing. Our focus on geographical sustainability directs our attention toward the intensity of resource investment in a given site, the frequency with which one community partner engaged with our institution, and the numbers of university personnel who undertook the community-engaged work or coordinated the community-engaged work for our university.

Viewing the heat map layer of our map of institutional community engagement, we can see the relative level of investment our institution dedicates to particular locations. The average hourly investment by our institution at one location amounted to 860 hours. At just under 300 locations, our institution invested a total of 20 or fewer hours over the course of the year. At the top 20 locations, our institution invested between 4,935 hours and 123,623 hours in one year. Using the 2018 volunteer equivalency rate for Michigan, the labor that our institution committed to these most time-intensive partnerships can be estimated at a value of somewhere between $122,000 and $3,000,000 (Independent, 2018). We reason that, as the hourly investment at a specific location grows larger and more intense, so too does the potential for the partnership to reflect the qualities of sustainability. For the most part, the twenty locations that accrued the largest time investment from our institution cut across institutional divisions and featured a range of curricular, co-curricular, and outreach initiatives that occurred close to our university's main campus. These locations ranged from a hearing clinic to an auditorium, an area hospital to a regional educational office, an educational nonprofit to a religious nonprofit, a design center to a courthouse.

The map further showcases the frequency with which one community partner at one location partnered with our institution on discrete community-engaged projects. By zooming tightly into our map, those locations at which multiple community-engaged initiatives occurred can be identified. These locations suggest the presence of community partners who desired frequent and sustained partnership with our institution. Over 80 of our institution's community partners undertook five or more initiatives with our institution; however, 1,200 locations hosted only one community-engaged initiative. Viewing our map and centering our perspective on the sustainability of our community-engaged work encourages us to take a critical look at these hundreds of locations. Our institution would do well to assess whether these sites can be maintained as locations for community-engaged work in both the short-term and long-term and to determine whether some of these sites might be grown into more sustainable locations for future engagement work. Further, our university might weigh the frequency of the community-engaged work against the intensity of that work to assess sustainability. For instance, one engagement activity involved College of Fine Arts personnel supporting an annual regional competition. Although this community-engaged work occurred once during the year, individuals affiliated with our university dedicated over 800 hours of service and support to this competition.

Geographic sustainability also requires a view of the human resources dedicated to doing the community-engaged work and committed to leading the engagement initiatives. Our top 25 locations at which community-engaged work occurred hosted 100 or more university personnel over the course of the year. These locations have a capacity for large-scale partnerships, the sustainability of which depends upon the interactions between the intensity and frequency of the work and the availability of personnel to engage in that work. In addition to our university needing to maintain certain levels of engagement to sustain these partnerships, our university also needs institutional leaders who will sustain these partnerships through their communication and coordination with site leaders across these various locations. Our map suggests that the institutional leaders of some of our initiatives might be strained. Indeed, the top 20 leaders at our institution oversaw at least 20 community-engaged initiatives each with a few individuals coordinating approximately 150 community-engaged initiatives. Depending upon the exact nature of this coordination, such a workload may threaten the sustainability and quality of our institution's community-engaged work.

For a more specific example of how our map represents our community-engaged work in a way that encourages us to reflexively consider the geographic sustainability of that work, we turn to our international community engagement initiatives. This community-engaged work reached a small number of countries; however, the work exhibited substantial depth, as it involved six of our university's eight colleges and some of our institution's most prominent global learning experiences. In fact, as result of our state's location, more sustained community-engaged work occurs in Ontario, Canada, than it does in ten states of the United States. Consider, further, Figure 14. Information displayed in Figure 14 includes the community partner name (Ashay Patra), unit (InterProfessional Education), course number (IPE 3050/6050),

number of university personnel (eight), and number of hours contributed per individual (20). As many of these national and international engagement activities depend upon the efforts of one or two faculty or staff leaders, the plots further visualize the need for more sustained leadership.

Figure 14: Screen capture detailing map data for one international engagement activity.

One of the ways we used our map to examine the sustainability of our university's engagement activities was to track how many university personnel were involved with international engagement activities. In total, just 12 university faculty and staff members coordinate 27 international activities. Considering the sustainability of our global community-engagement work, this ratio is not optimal. The visual nature and interactivity of the map supplement presentations and reports to key stakeholders, including senior leadership at our university and decision-makers in our community, with the hope of opening meaningful conversations regarding how to both sustain and grow our civic engagement efforts.

CONCLUSION

Chorographic mapping of community engagement initiatives encourages a reflexive approach that more fully embraces the type of comprehensive self-study of community engagement envisioned by the Carnegie Foundation. By using Esri's ArcGIS StoryMaps to design a multilayered, interactive map, we embraced a powerful type of communication design in pursuit of spatial justice. The layers of our map of community engagement placed geographical inclusivity in a productive tension with geographical sustainability. On the one hand, our commitment to inclusivity revealed an unequal and perhaps inequitable distribution of our institution's community-engaged work at many different scales. The plots of our institution's community-engaged work proved denser and more concentrated in some geographic areas. In other geographic areas, the plots were less dense and, in some other areas still, nonexistent. Promoting geographic inclusivity, thus, seemed to highlight needs for redistribution or expansion of our institution's community-engaged work. On the other hand, our commitment to sustainability revealed clusters of our institution's community-engaged work that combined intense resource concentration, frequent engagement, and committed personnel in arrangements that seemed much more sustainable than other instances of our institution's community-engaged work that were missing one, two, or even all three of these components. As we considered ways that our institution could strategically increase the sustainability of its community-engaged work, we were compelled to question the viability of work that was characterized by scarce resources, less frequent engagements, and over-committed leaders. From one perspective, increasing sustainability in the context of limited institutional resources seemed to encourage a selectivity that runs counter to our commitment to inclusivity. Thus, our multilayered map produced a multilayered tension between inclusivity and sustainability that we felt was reflexively generative. We follow Walton et al. (2019) in understanding this tension as one indicative of a positionality enabled by chorography—that is, "as a tool that opens space for connection to others" (p. 80).

To be sure, the generative tension that we experienced as we collected our data, designed our map, and mobilized reflexivity reinforces the stages of the place-based community engagement framework. Defined "as a long-term university-wide commitment to partner with local residents, organizations, and other leaders to focus equally on campus and community impact within a clearly defined geographic area," the place-based community engagement framework spans three phases of exploring, developing, and sustaining (Yamamura & Koth, 2018, p. 21). Chorographic mapping, we argue, enhances the place-based community engagement framework. Chorography allows for an institution to explore existing geographies of community-engaged work, develop strategy based upon geographically informed data, and prioritize sustainability in a way that foregrounds spatial justice. Because of its emphasis on geographic location, the place-based community engagement framework seems to almost necessitate institutional use of a map to orient an institution to a particular place. Put differently, maps and mapmaking seem indispensable to institutional efforts aimed at identifying a particular geography within which to focus community-engaged work.

Beyond highlighting chorography's compatibility with the place-based community engagement framework, we argue that the multilayered mapping that is characteristic of chorography proves particularly effective in bringing institutional attention to spatial interstices of power, policy, positionality, and privilege that continually influence each instance of community-engaged work undertaken by institutions of higher education in the United States. Dynamic intersections of power, policy, positionality, and privilege orient community-university partnerships—sometimes toward mutuality, reciprocity, and relative success; other times toward misunderstanding, division, and relative failure—and our map makes manifest these spatial interstices. Our map navigates many power differentials—including those between the Carnegie Foundation and our home institution; those among our institution's administrators, faculty, staff, and students; those between our institution and our community partners; and, even those among our community partners across private, public, and nonprofit sectors. Similarly, our map traverses myriad policies that influence each plotted partnership. These policies emerge from our community partners, our institution, our government, and the Carnegie Foundation as forms, applications, waivers, definitions, and memoranda of understanding that direct community-engaged activity and mandate certain conduct between partners. As chorographers representing 2,848 discrete community engaged activities, we were further and frequently reminded of our positionality as university insiders who were quite familiar with the quality of some of the partnerships plotted on our map, but woefully unfamiliar with the quality of the majority of the partnerships that we represented on the map. While we were able to speak to our own commitments to responsibly and equitably forging those partnerships with which we were personally

involved, we were unable to speak to the quality of the majority of the plotted points on our map—a piece of communication that was used to communicate the story of our institution's community-engaged work to our stakeholders. We remain acutely aware of this communication challenge.

We also recognize the privilege afforded to us, both as university employees and as mapmakers, to create this map. We used the power-laden practice of mapmaking and navigated existing institutional power structures to enact change. Indeed, the aim of chorography—to render landscape in a way that recovers social subjectivity and the relationship between space and community values—lends itself to our goal of increased spatial justice. Our use of chorography sought to advocate for improvements in our institution's community-engaged work. By foregrounding the where of our institution's community partnerships, chorography enables us to stress the geographic dimensions of power, policy, positionality, and privilege. By plotting past social and geographical spaces, chorography asks us to relocate and reorient toward redesigned future spaces. By visualizing relational dimensions of community-engaged work such as proximity and intensity, chorography encourages us to envision new, more equitable, and more just relations. And, by drawing upon the expertise of technical and professional communicators who demonstrate commitment to social justice work, chorography offers us an important methodology through which we might build partnerships that take action toward enacting these same relations.

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John Scott is a communications professional at Western Michigan University, where he develops and implements student success initiatives. John obtained a bachelor's degree in rhetoric and writing studies and a master's degree in communication. From 2015 to 2019, he served as WMU's coordinator of service learning and facilitated the placement of hundreds of students into diverse community engagement projects each semester. Currently, John tracks student academic performance and proactively engages in outreach efforts to improve retention and graduation rates.

Industry Insight Report: “But who really pays when it’s ‘free?’”: Debunking Publisher Claims About OER in Writing Courses

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If you teach college-level courses, commercial textbook publishers have likely approached you at some point in your career to ask you to adopt something from their collection. Perhaps, after careful consideration as an expert in your teaching field, you’ve even chosen to adopt a textbook from that publisher because you’ve deemed it the best option for your students and your class. The solicitation emails we receive from commercial textbook publishers are a common and expected occurrence in higher education.

A colleague recently shared one such solicitation email with me because of my background in open education. After a brief request to send desk copies of their textbooks for consideration, the email quickly shifted to a series of misleading questions about free materials that not only effectively slammed open educational resources (OER) and other free materials but also seriously underestimated instructors’ ability to evaluate course materials in our own areas of expertise. Though I will preserve the identity of the publisher representative who sent it, in this article, I will respond to each question in that email directly. My goal in writing this is to effectively debunk the inaccurate claims about OER from this publisher and to renew instructors’ confidence in our own assessment and content creation abilities through the many affordances of OER.

Before I answer each of this publisher representative’s questions, it’s important to first define OER. In the strictest sense, OER are freely available educational materials that carry an open license, often through the use of Creative Commons licensing. These materials provide up-front permissions to retain, reuse, revise, remix, and redistribute (the “5Rs” of OER) the materials and derivative works, as long as the original work and creator are attributed appropriately (Tijerina & Arnett, 2023). Creative Commons offers a variety of licenses that make these “5Rs” possible—particularly their Attribution (BY), Non-Commercial (NC), and ShareAlike (SA) licenses (*Creative Commons Licenses*, n.d.). Individual users of OER tend to define it a bit more loosely, however—though research and academic discourse generally defines OER by its licensing, that concept of open licensing is almost never the central focus of practitioners who actually use OER. Often, faculty instructors will consider any freely available and credible resource to be OER, regardless of its licensing. This spectrum of definitions is diverse and evidence of the “social construction of openness” (Chtena, 2019). Faculty and other OER users may fall somewhere in between these, or even slightly outside these definitions. For example, some consider Creative Commons’s No-Derivatives (ND) licenses to be open, though that license doesn’t allow for revising and remixing. Consider these variable definitions as you browse my responses to the following questions posed by the commercial publisher representative. Note that the representative seems to fall a bit closer to the looser definition of OER (and perhaps even a bit outside it), generally questioning all free materials.

Question 1: If citations are used, are they correct and up to date? Who will keep them that way? Remember, MLA and APA styles are frequently updated.

This question holds an underlying assumption that commercial textbooks have more opportunities to maintain citation formatting than open resources. I disagree. Commercial publishers often release new editions of their textbooks every few years or so, and each edition goes through an in-depth production process, which results in a finalized textbook that does not change until the next edition. That finalized textbook then generally carries an All Rights Reserved license which restricts others from making revisions or improvements. So, at best, commercial textbooks might have one opportunity every few years to update their citations. And honestly,

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why on earth someone would make their students purchase a more expensive new edition of a book to save them from misplaced commas on citations is just beyond me.

OER by their more "official" definition that requires an open license, however, vary in their improvement processes. Sometimes they do go through a similar process as commercial publishers—the authors go through a full production process to release a new edition. Sometimes they maintain continuous improvement over time, making changes as they notice the need without republishing as a new edition. Sometimes the authors don't update the resource at all. That last one is likely the situation referred to by this publisher. Here's where their assumption is wrong, though: it really doesn't matter whether the author makes updates on the OER or not because the affordances provided by its open license allows you (or anyone) to *make your own updates* and even share those updates.

Question 2: Have all permissions been cleared? Will students hit paywalls? What is the risk in using materials without obtaining permissions from the rights holders?

This question makes it very clear to me that the publisher representative *doesn't actually know what an OER is*. Remember our span of definitions and recall that regardless of where on that spectrum your definition falls, resources that fall behind a paywall don't fit the definition. An OER is free—that's a fundamental requirement. Furthermore, resources that are illegally shared/made available online do not fit the definition either—open educators aren't interested in pirating materials to save students money. I get the sense with this question that this publisher believes otherwise, though.

Whether you're using a strictly-defined OER with open licensing or a more loosely-defined freely available and credible resource, the permissions are clear. If they carry a clear Creative Commons license (or even other licenses), that license will tell you exactly what you can and can't do with the resource. If there is no license provided, assume that it is All Rights Reserved and that you can therefore only link to it. In either case, it's our responsibility as instructors to comply with those permissions. And as long as we are, there is no risk in using those materials.

Question 3: Who will ensure diversity in your authors, styles, and subjects so that students are exposed to a myriad of cultures, voices, and viewpoints?

I find it very interesting that this publisher is claiming that OER have no regard for diversity when the opposite is true. In fact, the open education community is, much like many of our disciplines, placing a heavy emphasis on diversity, equity, and inclusion. Even if it wasn't, though, is the same true for commercial publishers? I would argue no. Actually, one of the coolest affordances of strictly-defined OER (with an "open" license) is that if our chosen OER fail to provide those diverse voices, we can just go find another one that does and *remix* them—work them together into one stronger open resource. The same is not true for commercial textbooks.

Question 4: How will you ensure your materials meet the outcomes defined by the National Council of Writing Program Administrators (WPA)—the expectations writing teachers across the nation have agreed on? What's your plan for ensuring materials evolve as course curricula and outcomes change?

Here's what frustrates me about this question: OER are most often created/written by instructors—people who teach the courses the OER are designed for. Many of them are people who have either applied for and received some kind of funding to create open resources and/or have so much passion for their field and their students' success that they choose to create it and make it open even without funding. This question makes a claim that instructors who create OER are somehow less qualified to cater their materials to course outcomes than a commercial publisher is. Furthermore, it claims that instructors who adopt existing OER are somehow less qualified to evaluate the appropriateness of their course materials than a commercial publisher is. Both of these claims are *false*. We, the instructors of our courses, are the most qualified people to determine the appropriateness of our textbooks and course materials and to then create our own materials to share openly (if we so choose).

So yes, we will ensure our materials meet the outcomes defined by the National Council of Writing Program Administrators (WPA) the same way we *always have*—by critically evaluating our materials before adopting them, regardless of its cost or license. We will also ensure materials evolve as course curricula and outcomes change the same way we *always have*—by changing our materials, switching our textbooks, and teaching in new ways according to our curriculum and outcomes requirements and pedagogical innovations.

Question 5: What design choices will you make to accommodate students' learning differences and ensure readability (type face, spacing, color combinations)? How will you format materials so that they work properly on different devices, from desktops to smart phones?

Commercial publishers now typically publish their ebooks on their own platforms or through software like VitalSource, and those software are certainly more polished than some of the OER available. I'll give them that. Open education is moving in the right direction for usability, readability, and accessibility, though—and there are some really great platforms currently in use that effectively solve these issues, such as Pressbooks and Manifold, and there are open publishers doing some of the same stuff that commercial publishers are, such as OpenStax. And don't worry, I'll give some great examples for you to peruse yourself at the end of this article.

Question 6: How will you ensure the materials meet the latest accessibility standards?

Anyone with expertise in accessibility and who has evaluated a digital textbook (OER or otherwise) will understand when I say that this question is a funny one to get from a commercial publisher. Don't get me wrong—I know that some of them are doing great with accessibility, particularly in their newer publications. However, and I speak from experience, accessibility is a common issue in *all* textbooks. As an instructional designer who spent a lot of time helping instructors navigate textbook accessibility issues while trying to comply with student disability accommodations, I can confidently tell you that no, commercial publishers do not always meet the latest accessibility standards.

OER are no different. While there are many OER (usually that involved some kind of funding) that do very well with accessibility, it is equally as common to find accessibility issues in OER. I won't lie to you there. *But* remember those affordances we talked about

earlier? *You can fix those issues*. If you have evaluated an OER and determined that it is the best resource available for you to teach your class except that it is not designed with accessibility in mind, you can take that resource, make it accessible, and then even republish it for others to use. That's not the case with commercial textbooks—you would have to report the issues to the publisher and then wait patiently for them to fix it (which may not even happen until the next edition because of those production cycles).

You may be thinking, "but Tiffani, making things accessible retroactively is incredibly time intensive!" And you are absolutely correct. My suggestion for big jobs like that is to seek out funding. Many states and many institutions offer funding opportunities for OER work—you just have to seek it out.

Question 7: What resources will you provide to instructors who lack teaching experience or are assigned to teach at the last minute?

There are a few different models for approaching situations like this, and certainly one of them is to assign a commercial textbook with a plethora of ancillary resources available—often as close to a "course in a box" as you can get. However, there are similar opportunities offered through some OER—OpenStax textbooks are fantastic options for comprehensive open textbook packages. Beyond publishers, though, we are also seeing an increased use of OER to create full course templates specifically for late hires and early career hires—in my forthcoming edited collection *Pedagogy Opened: Innovative Theory and Practice*, composition instructors Jeanne Law and Tamara Powell discuss their work doing just that (in press).

Question 8: How much time will it take to monitor web links to ensure students don't encounter broken links?

This question is another one that I found funny, because similar to the way that not all commercial textbooks are accessible, neither are they all monitored for broken links. And sure, neither are OER. Again, I won't lie to you on that. I've personally found that the most effective and efficient solution to broken links is to allow your readers to notify you of them. Of course, that means that yes, students will encounter broken links. However, and we're going back to those nice affordances of OER here, you can change them right then and there. No extra hoops to jump through with a publisher, no waiting on a new edition. I do it all the time in my own open textbook, *Open Technical Communication* (Tijerina et al., 2020) (yeah, shameless plug).

Question 9: Will all students have high speed internet access? If not, how will they access the materials, and does that disadvantage some students? If students want or need printed materials, will your institution cover printing costs?

It's very interesting to me that this question was added in because earlier in the email, there were questions that focused very much on ebook features like responsive design and hyperlinks. Nevertheless, it's a valid question. The first thing that does need to be addressed here is that "open" does not equal "online." OER do not necessarily have to be accessed online in the same way the commercial textbooks don't. In fact, I would argue that the majority of OER come in the form of Word documents and PDFs as at least one of their available formats—both of which can be downloaded for offline use. If students are taking classes on campus, they can download their resources using institutional WiFi. If they are taking classes online, they have to have some kind of internet access to take the class in the first place—so at a very minimum, they have some way to download files for offline use.

For those wanting printed materials, some institutions will cover printing costs, some won't. For those that won't, there are websites available for printing and even binding resources. For example, Students can take a file to PrintMe1.com and order themselves a copy of a printed and bound version of any document, and OER creators can set their book up for at-cost printing through resources like Amazon Kindle Direct Publishing. My open textbook uses Amazon KDP, and students get a 300+ page textbook bound and printed for less than $10. Is it perfect? No. I didn't put a lot of effort into the design of the printed version. But it's there if students want it.

Question 10: How much time will it take to create these materials—and then maintain them and keep them current and relevant?

This question makes an obvious assumption that choosing OER for your course means that you have to create them. As I've demonstrated in several of these answers, that's not the case—at all. Actually, I would say you should always look into what's already available before creating your own—there's no sense in re-inventing the wheel! However, for those who do choose to create their own, it is a very time-intensive project to tackle. I personally don't recommend doing it without funding to support your time, but as I stated previously, that funding is out there—you just have to find it.

Beside the publisher's obvious assumption, the question also implies that commercial textbooks are current and relevant themselves—which is drastically overexaggerated. At the risk of speaking for the open education community, I think we all agree that one of the major driving factors of our movement is that publisher revision models are *predatory*. New editions of commercial textbooks most often include changed page numbers, very minimal updating, and changed discussion prompts and assignments—it's rare for a new edition to actually be necessary in most fields. They publish new versions so that used editions go out of circulation, effectively forcing instructors to make their students purchase significantly more expensive new editions.

This publisher solicitation email asks the recipient "but who really pays when it's 'free?'" The author of this email implies that you, the instructor, "pay" when choosing OER through invalid assumptions that 1) OER are inherently low quality in a myriad of ways, 2) you don't have the expertise to assess the appropriateness of your own course materials, and 3) you have to create your own OER in order to choose OER. As I've already demonstrated in this rebuttal, all three of these claims are *false*. I'm not here to argue that OER are perfect and the absolute best option for all courses and that everyone should always use OER over commercial textbooks. No, that's not my goal here.

Rather, I hope that you take the following away from this article:

1. The quality of OER is generally equal to that of commercial textbooks, so you should assess the quality of your resource regardless of whether it costs students money or not.
2. You, the instructor of your course, are the most qualified person to assess your course materials and how

appropriate they are for your course—not a publisher. So you should use those qualifications to assess all of your options (OER or otherwise) first, then you can consider the ethics and cost of using those resources.

3. You do not have to create a new OER in order to choose OER for your course. You should assess what's already available and then decide whether you need to revise, remix, or create something new. And if you do choose to create something new, you should seek out funding to support that time.

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APPENDIX: OER FOR COMPOSITION AND TECHNICAL COMMUNICATION

As promised, the following is a list of open educational resources for composition and technical communication courses that incorporate usable, responsive, and accessible design. This list is *not comprehensive.* There are so many more resources out there—this is simply a list of those I already knew about or found in a quick 20-minute search.

Composition:

- Writing Commons (https://writingcommons.org/)
- Writing Spaces: Readings on Writing (https://writingspaces.org)
- Writing Guide with Handbook (https://openstax.org/details/books/writing-guide) by Michelle Bachelor Robinson, Maria Jerskey, and Toby Fulwiler
- Writing and Literature: Composition as Inquiry, Learning, Thinking, and Communication (https://alg.manifoldapp.org/projects/writing-and-literature) by Tanya Long Bennett
- ENGL 1101 — Composition 1 Textbook (https://alg.manifoldapp.org/projects/engl-1101-clayton) by Jennifer Parrott, Matthew Sansbury, Mary Lamb, Sipai Klein, Margaret Fletcher, and Jim Rickerson
- 88 Open Essays: A Reader for Students of Composition & Rhetoric (https://openwa.pressbooks.pub/lwtech88readings/) by Sarah Wangler and Tina Ulrich
- Composition and Literature: A Handbook and Anthology (https://opentextbc.ca/provincialenglish/) by James Sexton and Derek Soles

Technical Communication:

- Open Technical Communication (http://open-tc.com/) by Tiffani Tijerina, Tamara Powell, Jonathan Arnett, Monique Logan, and Cassandra Race
- Technical Communication (https://openoregon.pressbooks.pub/technicalwriting/) by Michele DeSilva, Annemarie Hamlin, Jodi Naas, Chris Rubio, Megan Savage, Billy Merck, and Allison Gross
- Technical Writing Essentials: Introduction to Professional Communications in the Technical Fields (https://pressbooks.bccampus.ca/technicalwriting/) by Suzan Last
- A Guide to Technical Communications: Strategies & Applications (https://ohiostate.pressbooks.pub/engrtechcomm/) by Lynn Hall and Leah Wahlin
- Business Communication for Success (https://open.lib.umn.edu/businesscommunication/) by unknown author
- Consequential Contexts: Principles for Effective Community Engagement in Technical and Professional Writing (https://opentext.wsu.edu/communityengagement/) by Johanna L. Phelps

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A-Proxy-Mate Users: An Industry-Driven, Flexible, Testable, Reliable Model for Selecting Proxy Users

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INTRODUCTION

Anyone interested in beginning a career in User Experience (UX) has probably seen the LinkedIn or Medium posts about "proxy users" that argue, in various ways, why researchers should *not* engage user proxies. This is a moot point. All UX professionals both will be and should be using proxy users. The question is *which* user proxies researchers should be using and *when* researchers should be engaging with them. Not only are proxy users valuable, but with the right approach, they are an essential part of the UX process. In fact, proxy users can even be preferred to direct users despite the loaded nature of the "proxy" concept. We have both encouraged our mentees to consider alternative ways of conducting research outside of academically driven contexts as they prepare to apply for their first entry-level positions.

In this brief article, we summarize the current conversation surrounding proxy users, propose the best process for engaging with user proxies, and introduce a testable model for selecting proxy users. From our experience teaching undergraduate and graduate level courses, this model is valuable for faculty in UX / Professional Communication Programs as well as to researchers who can use it to frame applied research on proxy users.

Before getting into the nuances of why proxy users are considered a lightning rod, we want to step back and make an observation about the foundational principles that inform this conversation. Together, we have extensive experience in multiple academic fields (Psychology, Communication, Human-Computer-Interaction) and various industries (Publishing, EdTech, BigTech, and Aerospace/ Defense). Depending on the academic discipline, researcher's position, and industry context, the ability to adapt an idealized research design to ensure relevant and impactful results while meeting the constraints and needs of a team is vital. The breadth of the constraints and needs means that the impact on research doctrine varies. Yet innovation requires making smart, intentional changes to existing doctrine. We encourage researchers and educators to value this type of flexibility in students and the workplace, and it is the perspective we bring to bear on the proxy users' issue.

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CURRENT CONVERSATION

In large enterprise organizations, it can be difficult to source users directly. This can be due to internal constraints on the project, such as short timelines, lack of resources, geographic distance, etc., as well as external constraints from the target user group, such as disinterest, limited time, a protected status, etc. Many design teams also work in an agile framework which encourages short sprints of 2 to 6 weeks in length with incremental delivery/progress towards the final product at the end of each sprint. Employees inside of the organization are easier to leverage given these constraints. For example, a design team at Autodesk pointed out the value of using carefully selected "internal testers" to validate their brush resizing feature early in their software design (Sy, 2009). By getting usability feedback on mini prototypes from Subject Matter Experts, the Quality Assurance team, and the Help Desk, Autodesk was able to create velocity early and get the right product to market efficiently. Tate (2018), from Mind the Product, highlighted sales teams, managers, consultants, or team members who previously fit the users' persona as other types of user proxies. BLOOMBERG™ (2021), a maker of financial services software, revealed that accessing external finance professionals was challenging due to "highly sensitive market-moving information" and a concern that the company's intellectual property would leak[1]. Clearly, there are

1 BLOOMBERG is a trademark of Bloomberg Finance L.P., a Delaware limited partnership, or its subsidiaries.

numerous constraints that steer UX researchers into utilizing proxy users even when advocating for engaging with only "true" users.

Despite the recurring need for user proxies, many authors (Aberdeen, 2018; BLOOMBERG, 2021; Li, 2016; Tate, 2018) share concerns about bias from these sources of data. Aberdeen (2018) used family members and caregivers as proxies in the design of a memory bracelet for elderly users. They argued that the proxy user data was unreliable and biased since the proxies could not empathize with "users with cognitive, sensory and physical limitations and impairments." Li (2016) has pointed to a YAHOO!® usability study where employees rated YAHOO!'s website more favorably than a competitor; "studies with employee participants will lead to inconclusive results and biased data."[2] As a result of these case studies and industry perspectives, the public discourse around proxy users centers on three claims: i) never use proxies, ii) only use proxies as a last resort, or iii) only use them early in the process (e.g., pilot studies/low fidelity prototypes). While all human subject's data collection involves some degree of bias, we can take actions to acknowledge it and mitigate it (Cresswell & Cresswell, 2023), instead of adopting an all or nothing approach with research. While several techniques for mitigating bias include triangulating multiple data sources (Aberdeen, 2018) and pre-process data during analysis (Krawczyk et al., 2019), in this piece we focus on when and which proxy users will help you achieve your research goals given the constraints.

While most of the aforementioned authors/teams make strong points about the value of sourcing users directly, pushing an organization in that direction can be hazardous for junior researchers or individuals new to a team; Tate (2018) described this as roadblocks and "political churn," and Li (2016) noted the risks of fighting for direct-user studies in a low UX maturity organization (Pernice et. al., 2021).

From our own experience applying for and evaluating candidates for UX Research (UXR) roles, a standard interview question involves explaining what you would do when unable to access the end user. A common question we posed in interviews for EdTech researchers is: "how would you manage a research project with a short timeline to review the usability of a new test prep resource?" The challenge was that the current user base did not include high school students, and we did not have the processes in place to manage recruiting with protected classes (under 18 years of age). In our experience, the lack of access question is not only to examine the real hurdle of how to conduct research without direct access to users, but also, to identify how well the applicant can adapt their methodologies and approaches to relevant industry constraints. When one of the authors was recently interviewing as a UX Researcher, she was asked a variation of the proxy users question over and over again and soon began laughing at the idea of always insisting on direct user research. Not exploring the repercussions of proxy users is a disservice to those seeking to enter the field. Our approach, explored below, is both manageable and can be applied immediately by researchers at any level of an organization; we provide a structured, referenceable model on how, when, and why proxy users should be selected.

A-PROXY-MATE USER MODEL

When considering when to use proxy users, the two considerations of *which* user proxies and *when* to use proxies can be considered throughout the study design. This foundational work will impact the decision for the appropriate user proxies. Firstly, when determining what type of research is being conducted, secondly when considering factors about the desired user population, and then finally when determining which characteristics of the proxy population will be an appropriate approximate fit. This does presume, if not a robust research plan, then at least a loosely defined research plan with explicit goals and an identified desired user population. The first two considerations can be considered in tandem as the study design and the desired user population, additionally there are characteristics of the study which can involve multiple iterations of study design and testing. Throughout the research process, the appropriateness of a specific user proxy can change.

Unlike more traditional sampling methodologies where the researcher targets a set number from the desired group, user proxies are best when done as a mixture. We have found that having a variety of proxy types helps mitigate biases from only going to one type (e.g., sales team) and provides a variety of perspectives to create a more holistic picture. In one recent instance, we were working on updating user personas for an internal, persona-based communication campaign. One proxy user, an employee with less than a year at the company, was interviewed for the new hire persona. She had enough expertise to recall what she needed to know at the time of her hiring, and a literal new hire would have still been in the fog of unknown unknowns. By mixing her perspective with the priorities of leadership in her department, the resulting user persona was accurate and useful for guiding the communication effort.

Flexibility refers to how well characteristics of a study are able to adapt to participants who vary substantively from the desired user population. Some types of studies can be more flexible when accommodating user proxies, and that can be taken into account when designing and implementing research studies. While this is not a comprehensive list of relevant study characteristics, we include it to provide examples of factors which need to be considered when considering which user proxies to target for research. For some of these factors, final studies with the target population will require iterative and preparatory work regarding the user population.

- **Formality**: spectrum from low to high
  - Studies that are more informal (e.g., "dogfooding", guerilla) typically have greater flexibility in deviation from user characteristics than those that are formal (e.g., time on task, error rates).
- **Design phase**: spectrum from early to late
  - Studies that are early in the study design phase have greater flexibility in the user characteristics (e.g., pilot studies, testing laboratory hardware, early Agile development); whereas those late in the study design phase (e.g., pre-launch Minimum Viable Product, post Institutional Review Board screening) typically have less.
- **Analytic data**
  - Studies that gather analytic data (e.g., site analytics, task metrics, biometric measures) have lower flexibility in deviation from the user population.

As part of the study design, after defining the relevant characteristics of the desired user population, the following considerations can be included in the evaluating to what extent user proxies will be necessary. The more factors that apply to the targeted user population, the higher likelihood user proxies will be necessary.

2 YAHOO! is a registered trademark of YAHOO INC.

- **Ease of access**
  - Users are available but challenging to access (e.g., users with limited access to technology);
- **Population size**
  - The size of the desired population is very small or the criteria are narrowly defined creating a very small population (e.g., individuals with specific medical conditions, current Olympic medalists in javelin who throw left-handed);
- **Availability**
  - Users who have limited time or interest in participating (e.g., surgeons, VPs);
- **Restrictions in access**
  - Whether or not there are active restrictions on accessing users because they are protected population (e.g., youth, prisoners) or legal limitations (e.g., government personnel);
- **Danger in participating**
  - In some cases, users face a danger or risk to themselves for participating (e.g., domestic violence, underprivileged populations, risk of outing on a protected class).

The model we have used, and are proposing, considers proxies across multiple factors to ensure we are prioritizing the most relevant for our research. When faced with a situation where there are challenges in researching with the desired user population, proxies can be used as an effective source of data gathering when ensuring they are selected for factors which are close as necessary to the desired population. When selecting proxy users for research, we focus on prioritizing the most relevant factors and deprioritizing factors which have less of an impact on the type of research. The following broad factors can be considered when searching for proxy populations and enable effective data collection to mitigate the challenges and gain the benefits as described above.

- **Recency of engagement with users**
  - Populations who regularly engage with users and can speak about the users' experience (e.g., those training the population on use of a specific tool);
- **Recency of being a user**
  - Populations who were once or will be part of the user population and are familiar with the salient characteristics of the desired population (e.g., recently left a specific position, retirees, future customers);
- **Proximity to specific role**
  - Populations who work closely with the targeted user group (e.g., personal assistants, colleagues in multi-disciplinary teams);
- **Technical expertise**
  - Populations who share relevant technical expertise (e.g., individuals who are familiar with a specific technical topic who do dissimilar tasks);
- **Physical factors**
  - Populations who have similar physical characteristic (e.g., height, weight, color anomalies in vision);
- **Identification with the user's perspective**
  - Populations who have built strong empathy and understanding with the desired user group (e.g., child service advocates);
- **Task similarity**
  - Populations who do similar tasks, outside of the desired domain (e.g., scheduling for medical procedures can be broadly similar).

A recent project illustrates the utility of selecting across these factors. The authors have developed web-based technical support resources without access to direct users. We leveraged various proxies when determining user requirements and evaluating our proposed solutions. The mixture of proxy users from within the company ensured that we had full coverage of different priorities and needs, preventing oversights that can occur when some aspect of the website is not relevant to one group. We selected proxies from individuals who have recently retired from the technical roles, internal subject matter experts, and trainers. This mix guaranteed we had insight from users to understand known workarounds, technically accurate content, and major pain points.

While this model for user proxy selection may seem daunting, we think it is a reliable way to select proxies at different points in the design process. Next, we provide an illustrative example of how these decisions can be made based on our experiences.

ILLUSTRATIVE EXAMPLE

We work in a matrixed organization where UXRs are contracted to a product/project team at various points in the design lifecycle. Depending on the specific needs of that project, the research plan with proxy users will evolve to ensure an optimal blend based on user/proxy availability and access. Recently, we were brought in to support the redesign of an established internal site. The initial scope was to streamline a set of established, but disparate, technical support pages and streamline them into a single access point for various user groups. Over time, this had morphed into including the original technical groups and expanding in scope to include several new user groups.

Given the technical considerations we focused on a multi-thread approach to our research: we scoped the current resources and how they were being leveraged and also examined the desired future scope of usage and users, creating a near-term solution while creating the infrastructure to enable the longer-term and larger scoped solution. This multi-thread approach was ultimately successful in enabling us to adapt to the new user groups as they were added to the scope.

For the first thread, we leveraged direct user data (such as webpage analytics, support tickets, and training Subject Matter Experts (SMEs)). Web analytic data (an indicator data source from direct users) was especially valuable for prompting proxy users to explain or explore direct user's beliefs, actions, and preferences during interviews or walk throughs. This enabled us to have a direct understanding on what users were historically doing with the resource pages, while supplementing that understanding through support tickets and training SMEs.

For the second thread, we leveraged user proxies (such as future users, SMEs who work in proximity with users, and former users) to examine the current gaps, future capabilities required, and which common content is required across the expanded scope. This combination allowed us to overlay the current usage data with the future and predicted needs, also setting us up to determine how a successful redesign should perform. Given the changes we supported we could expect specific data to be reflected in the next

phase analytics. By leveraging user proxies, and mitigating the known biases with multiple sources of proxies and user data, we were able to successfully support the redesign within the Lean-Agile processes, the constrained timeline, and shifting scope of the enterprise collaboration.

CONCLUSION

We acknowledge that this model is not complete and contains omissions and look forward to expanding the model and seeing additional research on more factors for consideration. To maintain the scope and scale of this article, we have intentionally omitted a discussion of several factors on industry research which impact when to use user proxies, which can be added to at a later date. We have focused on more intellectual characteristics, factors, and demands, yet additional work could focus on the structure of tasks and physical characteristics which would be especially pertinent for late-stage usability studies. Another important topic for later discussion involves incentives/disincentives for users participating in a study. There are also certain contexts where a representative or surrogate is necessary to represent the user, such as when there is a language barrier. Lastly, there are situations where a product/service is so novel that there is no realistic way to access the user–base.

We recommend industry continue to use user proxies in their research, leveraging the associated benefits, and mitigating the risks as described above. For those currently not using user proxies, we offer the above factors and characteristic as a model to adapt in their own organizational practices. We invite investigation of the model to further refine the industry's understanding of proxy users and continue the conversation.

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AUTHOR NOTE

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Book Review

Bodies of knowledge: Embodied rhetorics in theory and practice by A. Abby Knoblauch and Marie E. Moeller

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A. Abby Knoblauch and Marie E. Moeller's *Bodies of knowledge: Embodied rhetorics in theory and practice* attests to the integral nature of the body and embodiment to rhetorical studies and technical and professional communication (TPC). Responding to Jacqueline Jones Royster and Gesa E. Kirsch's (2012) call to expand epistemological frameworks in rhetorical studies, Knoblauch and Moeller's text examines the integral role of the body and embodiment in rhetorical knowledge-building. Specifically, this text traces the rhetorical complexities of 1) body as "flesh" situated in and influenced by intersectional power systems; 2) embodiment as a contextual, interactive, and intra-active experience between a body and others; and 3) embodied rhetoric as recognizing the body as intrinsic to knowledge construction and articulation (p. 7–9). Grounded in intersectional and interdisciplinary perspectives, this edited collection successfully explores the complexities of the body, embodiment, and embodied rhetoric and offers scholarly, practical, and pedagogical implications for TPC.

TPC has long considered the body and embodiment as integral to documentation, design, and decision-making. Specifically, TPC's recent turn to social justice challenges embodied neutrality by amplifying frequently marginalized embodied experiences and knowledge-making practices (Haas & Eble, 2018). Responding to this social justice turn, TPC scholarship has centered the embodied experiences, perspectives, and knowledges of identities frequently discounted by dominant systems (Agboka, 2014; Baniya, 2022; Bennett, 2022; Colton & Walton, 2015; Gonzales et al., 2022; Itchuaqiyaq & Walton, 2021; Jones et al., 2016; Mckoy et al., 2022; Walton et al., 2019). Offering insight into the rhetorical relationships between the body, embodiment, and rhetorical knowledge-building, this edited collection complements TPC's social justice goals by challenging normative understandings of knowledge construction associated with "white cisgender, heterosexual, middle/upper/class, able-bodied males" (p. 13) through scholarship that represents a "breadth of voices, bodies, and frameworks" (p. 11). Inclusive chapters offer interdisciplinary insights relevant to areas of TPC such as sociopolitical advocacy, technical design, textual studies, academic scholarship, and classroom teaching.

Part I is organized around the theme of "affect, sense/s, [and] permeability" and builds on existing scholarship in embodied rhetorical theory. Sara DiCaglio's "Towards an Olfactory Rhetoric: Scent, Affect, Material, Embodiment" highlights how rhetorics of scent demand that we recognize the body's "vulnerability, interconnectedness, and materiality" (p. 59). She demonstrates the ecological nature of rhetorics of scent through examples like pollutants that impact individual bodies and collective communities. Scot Barnett's "Violence and Beneficence in the Rhetorics of Touch" similarly addresses a gap in embodied rhetorics by building on the work of scholars such as Shannon Walters (2014) which postulates touch as rhetorically generative. Analyzing a museum art installation, *Telematic Dreaming*, this chapter considers how telepresence technologies that facilitate interaction between performers and museum guests can have rhetorically violent implications. Barnett argues that an "ethics of touch" must account for embodied vulnerability and the affective risks associated with touch.

In "Disrupting Embodied Silence," Katherine Bridgman calls for embodied disorientation and indirection to disrupt and critique white, privileged silence and to instead encourage collaboration and coalition between white bodies and people of color. Likewise, Julie D. Nelson's "Embodying History: The Bodies and Affects of Museum Rhetorics" recognizes the power of embodied rhetorics to challenge individual perceptions. Nelson offers a comprehensive overview of affect theory and explains how organizations like the

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International Civil Rights Center and Museum can apply affective and embodied rhetorics to facilitate epistemological practices that challenge oppressive histories and systemic marginalization. Similarly exploring the persuasive potential of embodied rhetorics, Nadya Pittendrigh's "The Role of Intrabody Resonance in Political Organizing" draws from personal experience with anti-prison activism to demonstrate how intrabody resonance, "which involves putting oneself in another's place" (p. 99), can rhetorically shift negative public perceptions towards marginalized populations like the incarcerated. Theories offered by this section would be particularly beneficial for TPC scholarship and graduate TPC coursework centered around public memory, law, embodied usability and user-experience design.

In part II of this edited collection, chapters discuss issues of "advocacy, policy, [and] citizenship." Meg Brooker, Julie Myatt, and Kate Pantelides's "Discomfort Training in the Archives: Embodied Rhetoric in Feminist Advocacy" discusses discomfort training, a process in which bodyminds learn to ignore or suppress "embodied knowledge for strategic means or to purposefully put one's body in an uncomfortable space in order to persuade" (p. 108). I appreciated how this article drew parallels between an archive related to a 1913 demonstration in Washington, DC and the readers' own embodied experiences with a women's march in Nashville, Tennessee. While the archival discussion was fascinating, the most engaging part was the writers' embodied experiences responding to their own discomfort training. Ruth Osorio's "Rewriting Maternal Bodies on the Senate Floor: Tammy Duckworth's Embodied Rhetorics of Intersectional Motherhood" is a stand-out chapter in this edited collection. I particularly appreciated Osorio's intersectional framework attuned to disability and social justice and her application of it to an analysis of Senator Tammy Duckworth's use of her multiply marginalized body to rhetorically argue for including disabled mothers of color in the workplace.

Kristie S. Fleckenstein's "Fannie Barrier Williams's Citizen-Woman: Embodying Rhetoric at the 1983 World's Columbian Exposition" offers similarly persuasive understandings of embodied rhetoric by examining Fannie Barrier Williams's use of animation and reanimation to critique social understandings of African American women; to reshape ideas of both the Black and white citizen-women; and to call for an "ethic of accountability" in which all bodies are influenced by and "answerable" to others. Another stand-out piece in this section, Megan Strom's "Criminals and Victims: The Embodied Rhetorics of Unaccompanied Latinx Children as Represented in Spanish- and English-Language Media" engages rhetorical and discourse analyses to examine representations of unaccompanied Latinx children in US Spanish and English newspapers. While this collection reflects predominantly qualitative research, this piece successfully blends both qualitative and quantitative methods to investigate the trends and sociopolitical impacts of language circulated by US media. The chapters in this section engage deeply with offered examples, allowing readers to effectively contextualize the rich theories presented; they are applicable to academic and non-academic TPC readers invested in areas such as activism, law, and policy.

The final section of the book discusses matters related to "textuality, multimodality, [and] digitality." Collectively, these articles offer important theoretical insights into the role of embodiment for TPC's social justice goals. Vyshali Manivannan's "The Successful Text is Not Always the One that Murders Me to Protect You" critiques through both form and content how standard academic documentation and design conventions draw from and validate oppressive Western epistemological understandings. Manivannan argues that by standardizing the knowledge-making practices of "straight, white, able-bodied, neurotypical men" (p. 188), academic conventions may promote systemic ableism, racism, and homophobia. Challenging these practices through non-conventional documentation choices, this chapter offers embodied insight into the experience of writing with chronic pain and insightfully demonstrates how seemingly neutral documentation practices common in TPC may erase both the body and the embodied writing process.

In "Hooking Up Embodied Technologies, Queer Rhetorics, and Grindr's Grid," Caleb Pendygraft applies new materialist and queer theory to examine the impacts of embodied technologies and how they can influence users' interactive engagement and self-understanding. He analyzes Grindr as an embodied technology that influences user habits and maps their daily engagement in relation to hook-up culture. He explains that while embodied technologies like Grindr may promote connection between users and celebrate LGBTQ identities in digital spaces, such potential is undermined by a systemic capitalist tendency toward "cultural and identificatory exclusion" (p. 214). Such insights demonstrate a need for TPC to critically reflect on the social justice implications of seemingly inclusive digital technologies and applications. Also examining the embodied impacts of technology, Kellie Sharp-Hoskins and Anthony Stagliano's "Matters that (Em)Body" discusses the concept of "digital hauntology" for digital writing studies and urges readers to consider the material and environmental implications of technological networks that contribute to writing products in academia and the workplace.

Another stand-out article for TPC social justice work is Temptaous Mckoy's "Avowed Embodiment: Self-identification, Performative Strategic Attire, and TRAP Karaoke." Building on William Cross's self-identification theory, Nigrescence theory, Mckoy offers a theory of avowed embodiment, or "the act of outwardly declaring/showcasing one's identity through the physical body or strategic attire" (p. 224). Mckoy applies this framework to the hashtag #Tee4TheTrap, associated with t-shirts that celebrate and validate Black lived experiences and knowledges and that are worn by attendees of TRAP karaoke, rooted in the US South and reflecting "traditionally Black, or trap, music" (p. 228). She explains that avowed embodiment involves individual and communal identification, communication, and celebration/resistance of "who they have come to know themselves to be" (p. 224) and requires that participants first accept and avow their Blackness. Such a framework supports TPC social justice work by amplifying frequently marginalized perspectives and experiences and may be applied "to various embodiments in different spaces and times" (p. 232). Collectively, these chapters call for TPC to question and critique the social justice implications of standard knowledge-making practices across material and digital modalities and provide frameworks and methods through which TPC scholars and practitioners may facilitate more socially just practices.

Reflecting a range of theoretical insights regarding the roles of the body, embodiment, and embodied rhetorics in the construction and evaluation of rhetorical acts of knowledge-making, *Bodies of knowledge: Embodied rhetorics in theory and practice* offers vital insight for TPC social justice work. Specifically, this book extends TPC intersectional considerations for the rhetorical, ecological, material, and social justice impacts of documentation and design

practices regarding race, gender, and disability. A limitation of the collection that is recognized by the editors' introduction is a lack of attention to BIPOC and trans perspectives. In addition, more extensive and direct attention to the intersectional and social justice implications of provided theories would strengthen this collective work even further. Although both TPC scholars and practitioners will benefit from the insights offered by this collection, the theoretical focus of inclusive chapters may constrain practical application in industry contexts. Undergraduate instructors using this text may want to scaffold concepts for students who may be unfamiliar with embodied rhetorical theory. Because of the intricate theory offered by this collection, its use in TPC graduate coursework is highly recommended. Specifically, this text would benefit course content that intersects with embodied rhetorics and methodologies, public memory, usability, digital rhetorics, user-experience design, and/or legal rhetorics. Future TPC work might build from the powerful social justice implications of this collection by translating these concepts for technical and professional audiences outside the academy and/or more extensively evaluating the intersectional implications of embodied rhetorics.

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Book Review
UX on the go: A flexible guide to user experience design
by Andrew Mara

Mara, A. (2021). *UX on the go: A flexible guide to user experience design*. Routledge.

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In *UX on the go: A flexible guide to user experience design*, Andrew Mara (2021) provides technical and professional communication (TPC) students and emerging practitioners with an adaptable and compact manual for user experience design (UXD). He explicitly indicates that *UX on the go* is a manual and not an academic monograph: "In order to get the most out of UX on the Go, you are going to have to *use* this book" (p. 11, emphasis in the original). Mara provides step-by-step instructions for UXD processes that comprise project cycles ranging from one- to sixteen-weeks. These instructions are framed around three key principles—"rapidly adjusted project cycles, user-driven decisions, and an action first paradigm" (p. 2)—and support "five core UX capacities"—project oversight, written communication, drawing, verbal communication, and research (p. 12–13). Although *UX on the go*, as an information-dense manual, does not reward long stretches of reading, the text illustrates the ethical utility of a TPC orientation toward UXD and reveals UX's humanistic core for students and new practitioners. *UX on the go*'s usefulness and deeply rooted humanism leads me to recommend it for TPC instructors, students, and new UXD practitioners.

In chapters 1–3, Mara describes how readers can "take an active user stance" (p. 18), form a UXD team, and develop a project cycle. In this section, he uses Aristotelian virtue ethics to illustrate TPC's utility for ensuring that collaboration, research, and design occur in humanistic (Miller, 1979), ethical fashions. He encourages practitioners to engage in just, temperate, and brave actions (p. 20) and uses this Aristotelian framing to remind readers that "each interface you design has the potential to magnify actions by many multiples over time" (p. 20). Mara also uses justice ethics and the guidelines outlined in the *Belmont Report* to argue for writing a "UX Team Justice Manifesto." In this document, team members "investigate ways of articulating what you believe and will do to make the world a better place for others" (p. 21). The emphasis on teaming underscores how TPC practitioners are well suited for fostering collaboration in UXD processes due to the sheer volume of "successful communication a UX project requires" (Redish & Barnum, 2011, p. 93–94). Mara offers directions for team assembly, design studios, team member role cards, stand ups, project profiles and précises, meetups, and UX inventories.

In chapters 4–6, Mara discusses how the newly formed UXD team can begin direct user research. His summary of key UX indicators—e.g., performance, cognitive loads, hedonic and eudemonic goals, and user metaphors—again illustrates the usefulness of his humanistic orientation toward UXD. For instance, he writes, "[l]ocating metaphors is an especially useful practice for a team that uncovers patterns that don't adhere to individual or systemic motivations that you know guide the user" (p. 62). Emphasizing qualitative indicators can help UXD teams avoid the pitfalls of rigid quantitative approaches that promise researchers control but limit possible findings (see Sullivan, 2017). Similarly, Mara emphasizes the importance of contextual observations: "anyone can get out of the office and start talking to users about how they use products like your idea" (p. 82). He also advocates participatory design, which he terms "co-designing" (p. 103): "There is no greater way to involve users in your design cycle than involving them directly into your process" (p. 101). The emphasis on participatory design reinforces *UX on the go*'s ethical bent because, as Salvo (2001) wrote, "in a postmodern age, with a dialogic disposition, it becomes an ethical imperative to increase feedback from users to designers (p. 288). Mara does note that "Co-design often will take a UX Team away from its preconceived notions… so if time and resources are scarce it might not be the most effective use of either" (p. 103)—an explanation for why participatory design lives "at the outskirts of much contemporary interaction design" (DiSalvo, 2018, p. 478). He

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provides instructions for agile ethnography, participant recruitment, informed consent forms, bodystorming, heuristic usability audits, research planning, contextual observations, user interviews, diary and camera studies, task analyses, and user swarms.

In chapters 7–9, Mara focuses on the "messy process" of collecting and analyzing user data (p. 111). He frames these processes in terms of perception—"Both processes of research and perception are ones of confirmation or negation of expectations" (p. 111)—and emphasizes qualitative approaches to working with data. Although Mara touches on some quantitative methods—e.g., eye tracking and sentiment studies—he notes that formal quantitative analysis is beyond the scope of *UX on the go* (p. 128). His pivot away from quantitative analysis—an approach that appears to have enthralled some emerging practitioners (Lanius et al., 2021; Merry, 2016)—is refreshing and a selling point for this book. Mara also offers a narrative approach to data analysis that draws on behavioral psychologist Daniel Kahneman and Aristotle's *Poetics*. Mara provides instructions for benchmarking, A/B testing, card sorting, creating a codebook, analyzing transcripts, ensuring inter-rater reliability, writing concept and usage stories, and generating guided discovery maps.

In chapters 10–14, Mara uses a genre approach to provide instructions for creating a UXD team's deliverables. His instructions for various genre processes and genres' social actions at the organizational level reifies genre's salience, as a mediating concept, within TPC (Miller et al., 2018) and UXD/usability (Spinuzzi, 2001). The commonplace UXD genres that *UX on the go* details include case studies, findings reports, user personas, UI mockups, proto-types, minimum viable products, usability test reports, infographics, and storyboards. Additionally, Mara describes two under discussed genres for UXD teams: PechaKucha presentations and proto personas. PechaKucha presentations are a Japanese slide deck presentation genre that have stringent time constraints (p. 145–147), and proto personas are "speculative thumbnail portraits of user groups…based upon the initial… data" (p. 150). Mara also makes a strong argument for sketching because of its potential to allow for rapid iterations (p. 158) and offers guidance about initial UI sketches, sketch sprints, and digital sketches.

Chapters 15 and 16 detail closing procedures of the UXD cycle and offer strategies for developing organizational UX memory. Mara provides instructions for procedure documentation, task board clean ups, retrospectives, project autopsies, and team reflections. He concludes the manual with novel activities designed to foster further organizational support: interface pageants, pop-up UX, user safaris, and user ecology blueprints. Across *UX on the go*, he complements his exhaustive list of UXD techne with 16 UX challenges and five UX stories. The challenges range from "plant a UX garden," which draws on Eno and Schmidt's *Oblique Strategies* to encourage readers to create a place where UX artifacts can be collected and spark conversation (p. 54–55), to reverse ice breakers, in which team members gather at the project cycle's end to reveal aspects of their personalities that were obscured during hectic design sprints (p. 207). The stories range from client experience architect Adam Copeland's discussion of personas at the Mayo Clinic (p. 156) to Mara's own experiences doing research for an orphaned girls' school in South Sudan (p. 30–32).

UX on the go's weaknesses are twofold but easily rectifiable in future editions: first, a lack of alphanumeric indexing aside from chapter numbers makes navigating the text cumbersome. Second, many of the instructions could use visual illustration (e.g., organizational patterns for UXD deliverables) to complement the textual component. Although Mara does provide helpful figures at points—e.g. "The User-Product Graph" that charts different approaches to user research along the axes of *access to users* and *access to product* (p. 58)—the bulk of the figures are photographs or drawings with little informational value. These do not hinder readers' use of the text but are largely unhelpful for learning UXD.

UX on the go's emphasis on action based on humanistic values is its great strength. The text's attention to the ethical, collaborative, and communicative components of UXD aligns the text neatly with TPC as an academic discipline (Miller, 1979) and makes clear the affordances of a TPC orientation toward UXD (Redish & Barnum, 2011). The easily digestible instructions for the various techne of UXD reinforces the text's utility for TPC instructors, students, and new practitioners alike. For instructors Mara's sixteen-week project cycle (p. 16–17) could easily be used to structure an entire course in UXD. Anecdotally, my TPC students have found selections from the text approachable and helpful. As an academic, I have found Mara's well-cited distillation of decades of UXD/usability materials helpful for tracing various strands within the literature. For novice practitioners, this text provides exhaustive guidance for completing UXD project cycles regardless of preexisting organizational support. And for old hands at UXD, this book may revitalize professional practices due to its robust treatment of various research methods and novel presentation genres. It's a book readers will want to put down so that they can start *doing* UX on the go.

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Book Review
Making matters: Craft, ethics, and new materialist rhetorics
by Leigh Gruwell

Gruwell, L. (2022). *Making matters: Craft, ethics, and new materialist rhetorics*. University Press of Colorado.

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From the opening paragraphs of *Making matters: Craft, ethics, and new materialist rhetorics*, Leigh Gruwell draws our focus to knots, tangles, and tensile strength of the fibers that tie us together: these entanglements are ways, Gruwell demonstrates, of thinking through relation in craft and in rhetoric. Through her careful explication of the relations between rhetoric and making and her insightful case studies of two such contemporary craft infrastructures and movements, Gruwell demonstrates how "craft can articulate rhetoric's material contours, and as such, helps to define the political implications and ethical weight of this materiality" (p. 131). For Gruwell, an attunement to craft in our discipline "focuses our critical attention toward the intra-actions that produce materially bound agents and reframes political agency as the result of those intra-actions" (p. 131). In short: in the context of new materialist rhetorics, craft reminds us that relations constitute a potential for liberatory political action and coalition-building across difference.

Such an orientation toward relationality guides Gruwell in "[examining] how craft might model an ethics and politics of new materialist rhetorics, and [imagining] its possibilities as such" (p. 15). In conversation with ongoing work in new materialist rhetorics, Gruwell argues that craft can "illuminate the interdependence of materiality, power, and rhetorical action" (p. 6) and that as such, craft agency "locates ethical practice in the cultivation of reciprocal entanglements between agents that are both co-constitutive and materially specific" (p. 7). Here, craft constitutes an expansive array of materials, practices, spaces, epistemologies, and communities:

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Gruwell weaves case studies of digital hub Ravelry and cultures of making in and around the 2017 Women's March tightly with accounts of long-standing political craftivist practice, reminding us that "when we acknowledge that making is not just material but also relational, and thus ethical, we create the conditions for new ways of being" (p. 11). Gruwell's case studies contribute to ongoing conversations around what feminist and new materialist rhetorics teach us about struggles for more equitable relations, with an emphasis on local movements and communities that also contributes to how the history and scope of craftivist work is understood. Indeed, Gruwell writes that "craftivism reframes the denigration of craft, and crafters, as a political stance that values the labor and knowledge of historically oppressed peoples" (p. 65) through its focus on "collaborative partnerships and social ties that are typical of crafting practices" (p. 65). As Gruwell demonstrates in later chapters, these types of partnerships and social ties might also inform pedagogy and administration in concert with new materialism and feminist materialist approaches (both themselves a tangle), particularly in the ways that craftivist practice attunes us to emplaced, embodies, and entangled epistemologies.

Though readers of this book will likely take pedagogical inspiration from Gruwell's detailed and compelling case studies of Ravelry and the Women's March, her chapters on rhetorical history and (perhaps most notably) "craft's relative absence from contemporary [conversations]" (p. 131) in rhetoric and writing studies are especially instructive for teachers of writing. While craft has certainly had a long presence in rhetoric and writing studies, Gruwell highlights recent moments of disciplinary history in which craft fell out of favor with those in the field seeking to establish "disciplinary legitimacy" (p. 135) tied to "a reductive view of writing that locates invention wholly within the individual genius rather than within the intra-actions between various actors" (p. 135). That Gruwell argues that "grounding techne in craft is critical [because] craft is uniquely positioned to present alternate modes of writing, writerly subjectivity, and the identity of the discipline itself" (p. 140) is consistent with not only new materialist accounts of writing ecologies, but also ongoing and emergent work in the field focused on digital writing interfaces

and feminist approaches to digitality broadly. Gruwell's case study of Ravelry offers generative opportunities for teachers and scholars of digital writing and rhetoric to explore digital interfaces and infrastructures that give shape to online communities and writing environments, a contribution that, as Gruwell unpacks, brings together our discipline's long history of incisive work on the politics of interfaces and yet-emerging scholarship on the intra-actions among human and non-human actors in digital networks. Her gestures toward the materiality of digital interfaces also offers provocations for scholarship concerning craft around extractivism.

Gruwell's reflexive, reflective orientation toward the often extractive relationship between new materialist rhetorical scholarship and Indigenous epistemologies is another strength of this book, demonstrating the ways that feminist rhetorical methodologies might help support more ethical relations among knowledge traditions, particularly when new materialism's claims on "newness" are inherently bound up in colonial projects that elide existing work that already weaves together agency, subjectivity, and relations among human and non-human actors. Gruwell does this kind of reflective work throughout the text, particularly as she theoretically emplaces craft agency and craftivism while also acknowledging the ways that some white, privileged craftivists can appropriate the material foundations of Black and Indigenous maker communities, their "uncritical tendencies [recreating] exclusionary racist and/or classist power structures" (p. 81). Even in view of this potential for elision, exclusion, or even appropriation; Gruwell argues that "it is still worth examining craftivism's capacities to illuminate the relationship between power and materiality [as it] invites awareness of the degree to which all actors are mutually embedded in and constitutive of material circumstances and maintains that political change can only be achieved through recognizing this mutual material entanglement" (p. 81).

While such mutual material entanglements are often made manifest in the craft pedagogy that Gruwell explores most explicitly in the sixth chapter, the same chapter offers serious provocations for program administration as a site for emplaced material relations—and thus, the potential for meaningful political action and disciplinary identity-(re)creation. Arguing for a shift from a focus on "rhetoric or writing as the result of sovereign subjects" (p. 142) and instead for a deep understanding that "any political outcome results from specific material intra-actions among emplaced and embodied human and nonhuman agents" (p. 143), Gruwell reminds us that craft agency and craft pedagogy demand that we take seriously the capacity of craft to invite students to "participate in the (re)assembling of more ethical rhetorical outcomes" (p. 146). In this chapter, Gruwell argues that a similar outcome might be possible at the level of program administration, where we might consider how to adopt "labor practices that are based in a reciprocal ethics of entanglement" (p. 148).

Where Gruwell's audience likely accepts the proposition that craft and new materialist rhetorics are concerned with what materiality means for ethical relations, her focus on these relations reminds us what is (and isn't) new about new materialist rhetorics. Highlighting that the "revolutionary" capacity of new materialist rhetorics is "the recognition of the transformative power of relationships [towards] the creation of more equitable conditions for rhetorical action" (p. 12), Gruwell argues that feminist rhetorics can teach us much about "how materiality functions as a key location from which power emerges, persists, and may even be upended" (p. 27). As a core intervention of this book, Gruwell presents craft agency as part of an ongoing conversation in new materialist rhetorics, feminist rhetorics, and particularly among Indigenous knowledge traditions: one that "advocates for a reciprocal ethics of entanglement aimed at equalizing power relationships and making social change" (p. 15). With attention both to the deep imbrications of craft and techne in rhetorical history and the strong ties between craft and activist practice, Gruwell's case studies also highlight where craftivism might diverge from and else inform new materialist rhetorics. She reminds us that "just as the materiality of nonhuman objects shapes their rhetorical capacities, craftivism recognizes how the materiality of human bodies is essential to their position as rhetorical agents" (p. 75). Gruwell goes on to distill some of the political potential of craftivist practice—and perhaps craft in rhetoric and writing more generally—this way: "for craftivism, bodies matter because bodies are matter" (p. 75).

Throughout this text, Leigh Gruwell offers provocations for our field to see craft and new materialism differently: she suggests that "recasting new materialist rhetorics as crafts recognizes rhetoric as a material practice that is both structured by power and carries significant ethical weight" (p. 7). Gruwell reminds us not only of who does craft—particularly when communities engaged in craft are so often marginalized and delegitimized by neoliberal institutions—but also of what networks of human and non-human collaboration and entanglement might be illuminated, highlighted, or otherwise emphasized by a focus on craft as a part of our engagement with new materialist rhetorics. Making Matters offers us a chance to understand our work as rhetoricians in relation with one another as a practice of craft: indeed, this work is something we weave together.

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