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Unbounded

Integrating real-world problems into an undergraduate information design course

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Design courses teach a broad range of skills to prepare students for the increasingly complex and interdisciplinary situations they will face as designers. This article describes how students in a senior, capstone design course worked on a real-world project, the Communicating Pain Project, under the aegis of their university's Center for Design in the Public Interest. The project combined case-based learning and service learning. In this article we explain how the integration of the center's project into the classroom was accomplished, report on how it worked, and offer some thoughts on its contributions to information design pedagogy.

1. Introduction

As design moves towards more interdisciplinary models of engagement, design education faces new challenges: designers must learn how to meet the needs of varied audiences, how to work on open-ended and complex projects, and perhaps most vitally, how to "be more malleable and willing to surrender creative control and work collaboratively toward a final product and […] focus on process rather than final output" (Blair-Early 2010: 212). Meeting all of these curricular needs can be challenging. In this article, we describe how we attempted to do so by integrating "wicked" problems—defined by Jon Kolko as "difficult to solve because of incomplete, contradictory, and changing requirements" (2011: 96)—into a senior-capstone information design class, DES 159: Design for Understanding. To do so, we invited the class to work on a large-scale, long-term project being done as a cooperative venture between the university's new public-interest design center (the UC Davis Center for Design in the Public Interest, or DiPi) and its medical school. We view this integration of a real-world "wicked" design problem in DES 159 as an interesting pedagogical case study of how to find a middle ground between case-based learning and service learning in order to help students learn to deal with uncertainty, understand user needs, and seek creative solutions from an informed research-based perspective.

2. Case-based learning, service learning, and DES 159

Case-based learning and service learning stand in opposition to the "directed activity method" of pedagogy in which students are provided with "directive instructions" and are "dependent on following detailed rules and

steps in order to successfully complete the tasks" (Lee 2009: 551). Case-based learning and service learning require students to engage with complex problems, often with ill-defined aspects. Through this type of learning students become independent thinkers who can navigate their way through the kinds of projects they can expect to encounter as design practitioners.

Case-based learning has a venerable history, especially in applied disciplines such as medicine, law, business, and design. The National Center for Universal Design for Learning (2014) defines cases as "representations of real-world situations" and explains that they "represent a step before learning-by-doing and are therefore critical when classroom learning is designed to teach knowledge, skills, and practices that will be used in the workplace" (para. 1). Cases are especially useful in helping prepare students for public-interest design work, because they offer students the opportunity to deal with complex situations. Lisa Abendroth and Bryan Bell (2016), for example, structure the *Public Interest Design Practice Guidebook: SEED Methodology, Case Studies, and Critical Issues* around a wide range of cases. Burçak Altay describes the benefits of case-based learning (2014), including "skill development through problem solving" and "conceptual development incorporating uncertainty in the cases leading to expand[ed] student cognitive learning" (p. 141).

While it gives students experience of working through problems, case-based learning has a drawback: cases do not necessarily allow students a chance to work on real-world problems and to know that their work will have an effect on people. Such opportunities are important not only for the motivation they provide (Annerstedt et al. 2010), but also for facilitating transfer of students' learning from the class to their lives and work beyond the classroom (Steinke & Fitch 2014). One way to accomplish this is via service learning.

Like case-based learning, service learning is not a new concept. Ann Forsyth, Henry Lu, and Patricia McGirr (2000) connect it to a "long tradition in the United States of serving disadvantaged communities" and say that it "has been a focus of many innovative academic practices" (p. 237). Service learning offers students opportunities to hone their skills by applying them to real-world situations. This leads to greater engagement because students "are engaged in authentic activities, where course curriculum is applied to address the needs of communities" (Bates 2011: 352). It also helps students learn to work in an interdisciplinary fashion and practice communicating about design ideas with non-designer community members (Bates 2011).

While service learning solves the problem of much case-based learning, that is, it is being abstracted from a real-world context and limited to the confines of the classroom, it is not a panacea. While it can provide clear benefits to students and communities, it also raises certain difficulties. These can include: the need for students to leave campus and travel to other sites, which may not be easy or possible for some; clients who demand too much of students; and, conversely, projects being easier than planned, resulting in students not getting the experience they were supposed to (Huckin 1997). In addition, service learning can demand "substantial time and energy" (Huckin 1997) as the faculty end up "doing potentially time intensive 'juggling' of disparate service learning activities" (Forsyth et al. 2000: 237), such as creating and maintaining relationships with external agencies. Time and energy spent on these activities are then not available for other activities such as working with students. Finally, service learning is sometimes criticized for how student-level work "may burden neighborhoods with low-quality design and planning products" (Forsyth et al. 2000: 237) since students are, by definition, still learning their way into a profession.

The course we describe in this article, Design 159: Design for Understanding, shares many of the goals of both case-based learning and service learning. DES 159

was designed by Susan Verba as an aspect of her public-interest Orphan Projects Design Initiative. "Orphan projects" are artifacts or experiences in our daily lives that do not communicate well and are difficult to navigate, so that we tend to ignore and avoid (interacting or engaging with) them; examples include bank statements, utility bills, prescription bottle labels, butterfly election ballots, emergency room discharge instructions, and so on. The visual and verbal complexity of these documents, graphics, and systems is a barrier to entry for many, especially for older individuals experiencing communication barriers such as vision and hearing loss. In DES 159, students identify and analyze "orphan problems" and explore how good design can benefit the larger community.

Working within constraints that included the time pressure of a ten-week quarter, we found that connecting students to work being done by DiPi offered a good balance: It brought some of the strengths of service learning to DES 159, while minimizing some of the drawbacks, positioning it in a fertile middle ground that Nicolette Lee (2009) dubs the "directed project method" (p. 554). The following sections introduce the Center for Design in the Public Interest; provide an overview of how DES 159 is structured; describe student experiences in DES 159; show how students' work benefited DiPi and the students themselves; and offer some thoughts on contributions to information design pedagogy.

3. The Center for Design in the Public Interest

The Center for Design in the Public Interest (DiPi) at the University of California, Davis was founded in 2014 to bring together interdisciplinary teams to solve community problems through research-based design. DiPi has a three-part mission:

- To solve problems related to public documents, graphics, programs, and systems by creating accessible, people-centered design outcomes both for and with a diverse cross-section of the public.
- To share outcomes—including design tools, methods, prototypes, and best practices—as open-source models for others to build on in order to develop artifacts, communications, and programs that resonate with specific audiences and communities.
- To answer questions about the power and process of design: How might we use design to clarify information, enhance civic participation, and empower individuals to make informed choices? What does democratic design look like?

In the Communicating Pain Project, described next, our core team has partnered with medical professionals at our university's medical campus and at a rural health clinic.

4. The Communicating Pain Project (CPP)

One of the Center's first projects, the Communicating Pain Project (CPP), seeks to address problems related to the experience and inadequate treatment of chronic, non-cancer pain (any pain lasting more than 12 weeks), a condition affecting about 100 million Americans (Institute of Medicine 2011). Because pain is difficult to communicate, and pain perception and communication vary across ages, genders, and cultures, pain communication is considered to be a "wicked" design problem. In the CPP, we are working to engage diverse patient and provider communities in the participatory design of tools to help evaluate and better manage chronic pain. For example, in the last two years we have worked with the UC Davis Medical Center and with Hill Country Health and Wellness Center (a comprehensive care center in rural northern California) to create materials that will better enable provider/patient communication about chronic pain treatment options.

Overall, this project responds to a complex medical problem faced by both patients and clinicians: the subjective nature of pain. Pain is a crisis, and the more severe or confusing the pain, the greater the crisis becomes. Pain is also an "untestable hypothesis" (Fishman 2012: 19), that is, something whose reality or intensity cannot be objectively measured. Furthermore, how people perceive others' pain can be influenced by a number of subjective factors—cultural and individual, affective and intellectual—that can lead to some groups (minority and/or low income men, and women in all groups) to receive less care than they need.

Scholars in medical fields, from psychiatry to surgery, have studied this problem, and our project complements their expertise with our own as we ask what design can do to help. Taking an expansive view of the pain-experience landscape, the CPP team at DiPi is exploring approaches to pain communication by bringing together design, rhetoric, sociology, anthropology, and communication scholars with the patient and provider communities whose needs we hope to meet.

For students, the CPP offered information design challenges as they sought ways to improve patient/provider communication around chronic pain, including how to describe it, what the treatment options are, and how to increase the understanding of risks and potential benefits associated with prescription medications. Overall, the goal is to create design outcomes that draw patients and providers into "communication as conversation" (Sless 2008: 251) rather than transmission.

5. Design 159: Design for understanding

5.1 DES 159 in its institutional context

The Department of Design at UC Davis offers a BA and an MFA. The BA, which enrolls over 500 students, has an "open track" curriculum, meaning students can choose from different design areas to create their own emphases. Because undergraduates receive a BA rather than a BFA, their education is somewhat less focused on professional and formal training, and more focused on research skills and on situating design within a larger liberal arts tradition. UC Davis is on the quarter system, meaning each class lasts ten weeks.

DES 159: Design for Understanding is one of the department's elective senior capstone courses. As mentioned earlier, by addressing "orphan design projects," the course offers students a chance to engage with the collective redesign of everyday things, such as public documents, graphics, and systems that are confusing to use. In doing so, students learn principles of effective information display, conduct research, and develop design prototypes iteratively. The research aspect of the course includes stakeholder and user-centered primary research, and also secondary research that requires students to pose questions and seek answers in part by investigating existing work.

The quarter is divided into two parts: During the first five weeks, students focus on information design exercises, and during the last five weeks they work on a final project, either individually or in self-selected groups of 2 or 3 students. For the exercises, students are asked to redesign information displays that need improved clarity and accessibility, such as fire safety instructions, emergency exit maps, motor vehicle blood/alcohol charts, food safety labels, and hospital discharge instructions, to name a few. For their final projects, students identify a need that they care about and can help address through a research-based design intervention.

5.2 Course plan

During the first four weeks, students create a "Twyla Tharp box," based on Tharp's idea in *The Creative Habit: Learn it and Use it for Life* that "before you can think out

of the box, you have to start with a box" (Tharp 2003: 78). Students keep a container with all of their research, sketches, studies, and project development materials, collecting "information design examples from everyday life that are faulty or confusing and need to be reimagined. These will become raw material and inspiration for your final project" (Verba 2014). In week 4, the class chooses a few finalists that could work as a 5-week project by vetting ideas against criteria they have developed and discussed in class.

All teams spend two weeks on secondary research, user research planning, and concept development; and three weeks on design development, user testing, revisions, process book design, and final project presentation.

Within this common structure, students were introduced to the Communicating Pain Project (CPP) as an option. The prompt for the final project reads:

> You will work in groups to research and analyze an issue that addresses an "orphan problem" in design. Keep your antennas out for interesting project possibilities by making a list of all the things in your daily life that are way too complicated—places where good design could help by alleviating perplexity and empowering clear choices. The final project grade equals 40% of your grade for the course and includes a final presentation and prototype, plus a workbook designed to demonstrate your design thinking. (Verba 2014)

This prompt is loosely structured to keep the project open ended. The assignment evolves through discussion with the class, just as projects often evolve in professional practice through discussions and meetings with clients, rather than via a tight brief. In this context, students explored potential ideas and created and discussed a "diagram of fears", an activity that gave students a way to explicitly address uncertainties they may face and to discuss possible strategies. Ultimately, six students chose to work on the CPP, and seven decided to work on "Wandering," a project to introduce students to hidden gems on the UC Davis campus.

The CPP is especially challenging and productive for students. This is because the CPP asks students to find their way into a complex problem and to chart a path for a design intervention that includes early prototypes, rather than to solve the entire complex problem. For this, as for other projects, Verba invites students to conceptualize the design process by thinking of it in terms of "sponge-filter-voice"—that is, first, casting a wide net, being curious, taking it all in; then, honing in on a specific path or trajectory through the project, interpreting, synthesizing, and seeing relationships and connections; and finally, realizing a design outcome that communicates a point of view or tells a story. The overall process students follow includes:

- **A mind map**, created by each team, to brainstorm ideas, identify needs, and start tracing relationships between concepts (see Figure 1).
- **Deep-dive research**, during which students ask questions and explore a number of possible "paths" through the project, presenting their results to the class and posting research findings on a shared server. Students engage in both primary and secondary research, with Sarah Perrault attending class and guiding students on how to conduct a literature review, how to focus a "literature" review on visual ideas, and how to frame secondary research around a specific research question.
- **A descriptive exercise**. Students who chose the pain project created word pictures for 9 pain-descriptive words they selected from the McGill Pain Questionnaire (Melzack & Torgerson 1971), and gave each word a typographic visual identity or "voice" in order to communicate that "feeling". This exercise, inspired by Gerstner's *Compendium for Literates*,

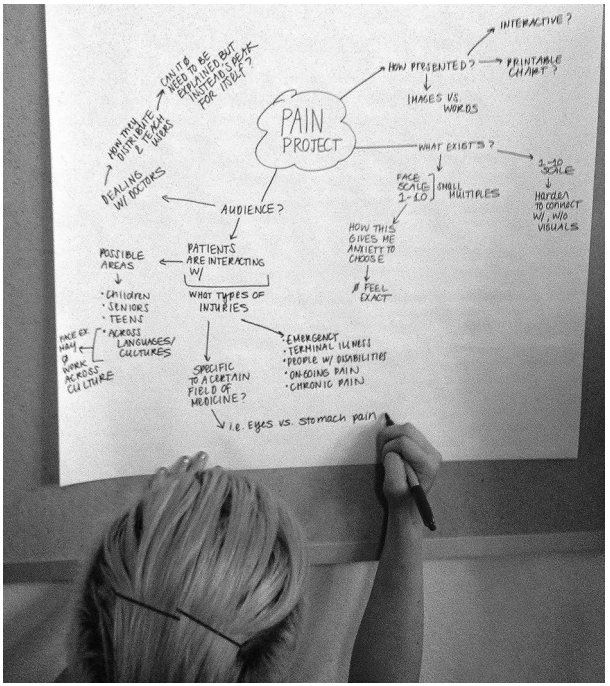

Figure 1. Keaton Kenel's mind map helps conceptualize the context of pain communication problems.

helped students think about how pain is or might be described, how it is relative, and how it varies from individual to individual.
(Students who chose the alternative "Wandering" project did a hand-drawn map exercise depicting places they wished they had known about as new students.)

– **Rough concepts & prototyping** to quickly get ideas into a form that people can interact with and therefore respond to. Students focus on identifying and addressing unmet needs and on why this project matters.
– **An interim presentation**, delivered by each team, to summarize research findings, present early concepts, and receive feedback from the class.
– **User testing**, with a requirement that each team chooses three IDEO Method Card user-centered research techniques related to their project goals and desired outcomes. The cards illustrate 51 empathic research activities and include examples of how each can be applied to a specific project (IDEO 2003).
– **Design revisions** that synthesize findings from user testing.
– Creation and presentation of a **final prototype** and **process book**, with "next steps" on what the team would do to move the project forward if they had more time. Writing and designing the process book give students a chance to reflect on their decisions and their own learning processes.

5.3 Student projects and the CPP

Of the six students who focused on the Communicating Pain Project:

– Team A (one student): developed a personal pain log, "LOGit," to help patients collect data about their pain experience and present it to medical practitioners in a form that can reveal patterns (Figure 2).
– Team B (two students): designed studies on pain communication by working toward a new pain scale (Figure 3). Existing pain scales rely on either the Wong Baker set of "smiley" faces or on a set of words. In both cases, important information about pain is lost, such as its triggers, duration, and quality.
– Team C (one student): explored a tool for visually communicating pain (Figure 4).
– Team D (two students): developed a prototype tablet app to self-assess pain (Figure 5). Here again, the information design challenge was to find new ways

Figure 2. Mandy Chew created the LOGit personal pain log in response to a prompt by her professor that a flip book might offer a useful way for people to track and understand their experiences with pain. An internal medicine MD we work with noted that the book could be useful in helping the doctor understand the patient's pain over time.

of identifying and describing pain to reflect the dimensions not represented in existing pain assessment tools.

5.4 Scaffolding projects

Over the last five weeks, students worked through their projects with support and scaffolding that included:

- Writing their own creative brief, research plan, and summaries,
- Having weekly check-ins ranging from desk critiques (instructor meets one-on-one with each project team) to speed critiques (half the class takes a reviewer role and the other half presents, one-on-one, for a quick rotation of 5 to 7 minutes, then roles reverse) and interim presentations,
- Creating detailed schedules with specific activities and time frames mapped to each phase of the project,
- Documenting their process along the way with photographs and short reflective writing exercises, and
- Seeing the grading rubric in advance, which also serves to help define the parameters of what matters.

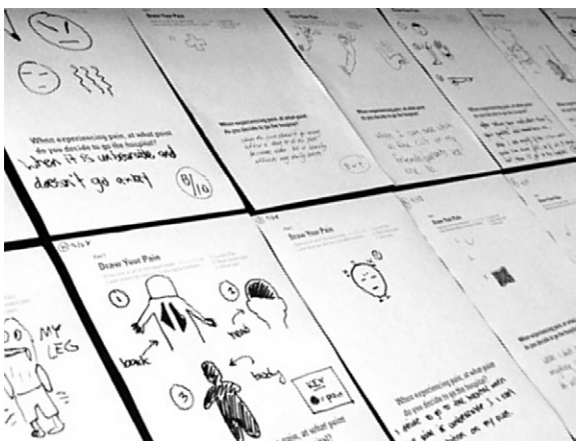

Figure 3. Hand-drawn pain diagrams from Team B's pilot studies involving 21 participants (Daniel Daquigan, Keaton Kenel).

Students are assessed on the depth and breadth of their research and design process, on the strength of their design thinking and prototyping, and on their ability to present their work in a clear and comprehensive manner, both orally and in a written and illustrated process workbook.

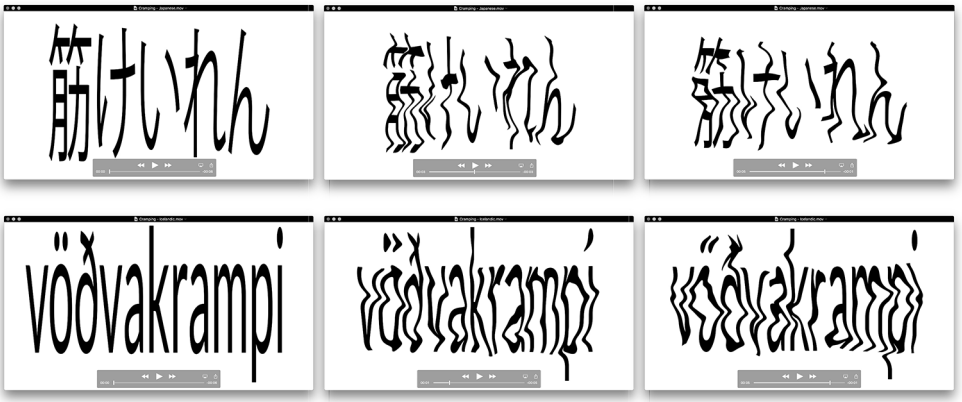

Figure 4. Form studies with animations of pain descriptors such as "cramping" (in Japanese, top, and Icelandic, below) allow users to "choose" where the visual expression best matches their pain (Vivian Ho).

Figure 5. Team D's prototype tablet app encourages users to capture a snapshot of their pain, including how pain impacts daily life, with an intuitive touch interface (Helen Ho, Kristie Wu).

Even with this support, students working on the CPP experienced struggles that were either different from those experienced by their peers or, more often, similar but more dramatic. The next section describes these struggles, and how managing the challenges of the CPP helped prepare those students for their futures as design practitioners.

6. Student experiences with the CPP

Perhaps the biggest challenge CPP teams faced was the project's open-endedness. Open-endedness is common in design work. Kees Dorst (2011) notes that "designers have been dealing with open, complex problems for many years, and the designing disciplines have developed elaborate professional practices to do this" (p. 522). However, design classes that offer only well-structured problems do not allow students to learn these practices through experience. The CPP projects require that students learn to manage the process, and by doing so they allow students to develop a skill which is vital in the field they are about to join.

What we saw confirmed what other studies (e.g., Jaenichen 2010; Riley, Wojahn & Park 2003) report: a higher-than-usual level of student engagement with the open-ended aspects of design not experienced in other classes. In CPP teams, students thought deeply and widely about a complex, real-world problem, one with many different aspects and nuances (spanning expertise across multiple disciplines), and with many possible opportunities for design investigation/ interventions. Students asked provocative and insightful questions, and sought answers to those questions in multiple ways: they conducted secondary source research; did primary research via interviews, surveys, and other user-centered research activities; learned from classmates via discussion, feedback, and reviews; and made experimental prototypes and captured responses to those prototypes from peers and others.

While these activities are expected of all students in DES 159, those working on the CPP faced unique challenges as they engaged in what Lave and Wenger dubbed "legitimate peripheral participation" (LPP), summarized by Mostafa Hasrati (2005) as a situation in which "novice members are given enough credibility to be considered as 'legitimate' members of their target communities and are given 'less demanding' practices to perform to learn the craft" (p. 557) (or, in our case, are given legitimate tasks with extra scaffolding). Legitimacy, Hasrati explains, can come from "being useful" by contributing to solutions that will be implemented outside the classroom or campus context, while "peripheral" refers to the fact that students do not face all the risks, or garner all the rewards, of a practicing designer.

Below we explore some of the ways in which the CPP teams experienced the kind of LPP which aims at integrating real world problems into design education.

6.1 Managing an unbounded research scope

First, students had to learn to manage an unbounded research project. Peter Aeschbacher and Michael Rios (2008) note that "[c]rossing boundaries of discipline and scale is the first step in enabling emergent forms of collaborations to flourish" (p. 86), and compared to other teams (e.g., those working on the "Wandering" project), the CPP teams faced a much larger and less bounded problem space. While other teams worked on creating apps for exploring the campus and mainly researched existing apps, CPP teams had more opportunities for research exploration in the sense that:

a. There were many scholarly articles available, as well as artifacts such as existing pain scales, and

b. The project audience—people who have suffered from chronic pain—was wider than the audience of people who might wander the campus. Their work was therefore more cross-disciplinary, and also spanned a greater range of primary and secondary research.

This is the stage when students move from "sponge" to "filter" in the design process, and it proved challenging. Students were encouraged to identify, sketch, and evaluate multiple potential paths through the project; to research and hone in on specific unmet needs; and to gather as much information as possible—even in the early stages of the process—by talking to stakeholders and potential users. Much of the class time, and many of the class check-ins, were focused on helping students navigate this unbounded research/problem space.

6.2 Managing problems of scale

CPP teams also struggled with the problem of scale. Students needed to navigate an "appropriate" slice of the project: not taking on too much for a five-week timeframe, but instead mapping out the larger project, identifying a manageable piece, situating it in the larger context of the problem, and identifying what still needed to be addressed as next steps in their prototype/proposed outcome. Much of their class time was dedicated to this issue, arising regularly during weekly research and the design check-ins described above. Instructor feedback was especially vital to helping students develop a sense of how much work was "enough." Students also benefited from "benchmarking" (Sless 2008), that is, doing an early evaluation of existing tools, then working to improve, reimagine, and rethink based on this analysis.

At the same time, the CPP teams' broad scope also exposed them to possible solutions. For example, Team B found that the Stanford group's (Jang, MacLean & Heer 2013) approach and methods were a useful guide to understanding how designers impose limits on exploration and engagement in moving a project forward. As they noted in their project book, students were surprised that the study tested prototypes with only eight people. This was because they initially thought that user testing, in order to be valid, would need hundreds of participants.

6.3 Addressing an unbounded audience

In addition to being open-ended, the project was unbounded in potential participants and stakeholders. Students were drawing on work from others whom they might or might not know, and were feeding their own findings and ideas back to an interdisciplinary, non-peer group (that is, the people at DiPi and beyond). These actions are essential to real-world design practice. Alex "Sandy" Pentland (2012), for example, found that in good teams "[m]embers periodically break, go exploring outside the team, and bring information back" (p. 65), and that "[h]igher-performing teams seek more outside connections" (p. 65). Thus, although it is rare for information design classes to include an open-ended project with unbounded potential participants, such conditions are not necessarily rare for professional designers. Those working in medical contexts, for example, are likely to be asked to design for large populations that vary in age, education level, first language, and many other characteristics. Designers who face such lack of clarity while students will be better prepared to manage ill-defined projects in their professional work.

All students in DES 159 were expected to reach beyond their groups and the class by choosing three IDEO Method Card user-centered research techniques. The CPP groups, however, were initially worried about needing to talk with medical providers, something that could be difficult to arrange quickly. However, when they

discovered that many people experience chronic pain, the students focused on the patient side of the issue. This experience with audience identification and narrowing took place within a far greater scope compared to the process of peers who were involved only with the campus community.

6.4 Coping with a lack of closure

Another interesting aspect for the CPP teams was that they did not know what effect their contributions might have on the longer-term project. Possibilities ranged from no impact at all to having their work folded into eventual design artifacts. Even within the constraints of the class, the CPP teams generated a broader range of artifacts, and with differing levels of closure, than their classmates. For example, teams working on the campus app project had an easier time launching into developing quick prototypes, possibly because their project was, from the start, more concrete. They moved more quickly towards identifying the final form of the outcome as being an app, and all students working on this ended up creating apps. In contrast, students working on the CPP found themselves facing more open-ended projects. In working to identify a specific path through the project, students focused on issues and unmet needs while remaining open to what form the outcome might take. The form, then, came out of the audience, purpose, and the context of use imagined. One of the criteria on the grading rubric is: "Size, format, and choice of media relate to/reinforce the design concept and purpose." Thus, "finding" (or responding with) the form becomes as important as finding the need.

7. Benefits to the project

In addition to offering the students opportunities for experiential learning, integrating the CPP into DES 159 has also benefitted the CPP. Although not everything students did was of benefit to the project, they moved the project forward on a number of fronts.

7.1 Moving projects forward

Students helped move the project forward in substantive ways, such as discovering articles the DiPi team had not yet found. For example, the team working on a new pain scale (Team B) found articles about the work being done at Stanford (Jang et al. 2013) and found an online pain exhibit (http://painexhibit.org/en/), while Team C found an interesting pain scale tool, a folding pain assessment card (Partners Against Pain 2016).

These articles proved useful to us. They brought to light new information and aspects of the problem, accelerating our literature review and helping us to highlight the most relevant secondary research and share it with other DiPi team members. This understanding of these issues, and of the extant research on pain communication, also helped us when we began working more closely with the medical school, as it enabled us to establish an informed ethos by showing we were familiar with some of the relevant medical literature.

7.2 Creating proofs of concept

The work of the students helped us demonstrate project options by producing work we use, with credit, to engage audiences outside of the design profession. For example, the DiPi team had an idea about a flipbook-style pain tracker that people could use to record their activities and pain levels several times each day. Building on this idea, Team A developed "LOGit," a prototype pain log booklet that, if used consistently, would allow the user to see an animation of changing pain levels (see Figure 2) by flipping through it. We have found this booklet, along with other artifacts created by students and by DiPi, to be

useful in demonstrating the value of information design and of the contributions that a designer's perspective and skills can make.

Such examples helped us form a relationship with the UC Davis Medical Center. The doctors and clinician/researchers we have partnered with are not designers (as one of them memorably informed us shortly after we started working with him). Our relationships were built over time and through discussion, by thinking/brainstorming together, and by entering each other's world to understand common issues, visions, and points of departure. As we worked together to identify possible interventions and to imagine future outcomes, having concrete "before" and "after" examples and design prototypes to address specific patient needs helped stimulate discussion and build common vocabulary and shared ideas.

8. Recommendations

We have four recommendations based on our experience with the Communicating Pain Project.

8.1 Make sure students have choices.

Given the challenges described above, it was essential that students be able to choose this project rather than have it imposed on them. Students chose to work on the CPP knowing they were getting into something open-ended. Students also knew their work might be adapted and incorporated into the Center's designs; giving them a choice to opt out of this was important for ethical reasons. In fact, "opt out" is not really accurate; the prompt in DES 159 was that students come up with a project that involved an issue they cared about, and those who chose the CPP are more accurately described as having opted *in*.

8.2 Choose a project students can connect with.

Aeschbacher and Rios (2008) talk about the need for designers to see themselves as "citizen designers," that is, as "both members and enablers of communities" (p. 86). Students will not have time to enter deeply into another world, so the project should be something they can connect with. Students in DES 159 had not necessarily had experiences with severe or chronic pain, but pain is a nearly universal experience and even those who have never suffered from serious pain know people who have. As Thomas Fisher (2016) says in his discussion of the ethic of care in design work, working from a place of genuine empathy is important for public interest design as it sustains the "designer's attention to the particular needs of [a] population" and keeps projects from falling into a trap wherein "the public sector seems to serve the poor begrudgingly, if at all" (2016: 39).

8.3 Choose a project at a stage where undergraduates can make meaningful contributions.

To have legitimate peripheral participation, tasks must be "challenging but not defeating" (Hasrati 2005: 560). In our case that meant making sure students had enough guidance to navigate their way through an open-ended project. Pedagogically, we can understand this in terms of Vygotsky's notion of the zone of proximal development in which "Teachers need to offer instruction higher than the lowest level the student is at currently, but not so high that the student fails" (Bourelle 2012: 186). Thus, if a project is too high, it is out of reach; but if we make it artificially low, we lose authenticity. DES 159 students found projects at the invention/discovery stage of the CPP especially inviting, as they were able to generate and test ideas and prototypes that, even though unpolished, could contribute to the larger ongoing project.

8.4 Choose a time or course when you have bandwidth.

Finally, it is important that faculty integrating real-world, open-ended projects into a class have the time and/or extra support needed for the higher-than-usual workload that results. Marlies Baeten, Filip Dochy, and Katrien Struyven (2013) describe how case-based learning works best when introduced gradually and with scaffolding. Also, Verba did indeed find that teaching this took more time and energy than an ordinary project would. The reasons given for this are:

1. She did not find or assign all the readings. Students added readings as they found them (during the secondary research phase), which meant that she was reading, evaluating, and assessing the usefulness of texts for the first time as the quarter progressed.
2. As with other forms of case-based learning, a "wicked" problem works best pedagogically when introduced gradually and with scaffolding, which required more than the usual amount of preparation. The CPP "wicked problem" itself posed a big challenge in terms of finding/choosing a 5-week path or slice through the project, navigating towards an outcome, and not getting lost in the research—e.g., the up-front reading load was more than usual in the research phase.
3. Students needed to make more in-stream adjustments than they would have with a more bounded project, calling for more input and on-the-fly scaffolding from Verba. Ideally this level of input decreases as the teacher models an activity, coaches students, then moves into the background (Hasrati 2005: 39). However, the constraints of the ten-week quarter, combined with the need to scaffold students' movement into case-based learning, mean that with such a complex project there is not enough time for the "fading" stage to happen.

Thus, it is vital that faculty who opts for this kind of project have the time and/or support that they will need.

9. Concluding remarks

Integrating the CPP into DES 159 has been a successful experiment, offering a good balance between case-based learning and service learning. As with case-based learning, students worked in an area their professor knew well enough that she could provide starting points and knowledgeable guidance. This approach offered some of the benefits of service learning, in that students got the benefits of a "'real-world' unpolished experience" (Butcher & Schaber 2013: 573) as they experienced what John Butcher and Friedemann Schaber (2013) term "learning *for* employability through an authentic design task" (p. 573, emphasis in original). Students also gained "valuable exposure to the authentic demands of the profession—negotiating across disciplines and ensuring client expectations were met by the team" (p. 574).

At the same time, students receive more guidance than in service learning, in which they are connected with a site and then, ideally, "left to carry out the rest of the project on their own" (Huckin 1997: 53). Furthermore, this higher level of pedagogical support benefits not only students (who learn more) but also the communities they serve. The CPP projects are put into use only after the professional design staff at DiPi have done another layer of quality control and revision, thus avoiding the problem of underserved communities receiving not-yet-professional quality work (Forsyth et al. 2000).

Although workplace experiences cannot be fully imported or mimicked in the classroom (Bourelle 2012: 184), we nevertheless found that students benefitted from the connection to an evolving real-world project at DiPi. Likewise, the project benefited from this halfway-step of having students work on a real-world problem

within the supportive environment of the class. We hope this approach—connecting a capstone information design course to broader interdisciplinary efforts to solve community problems through research-based design—proves valuable to others who are working to integrate collaborative design experiences into information design pedagogy. This interdisciplinary exchange fits into a larger movement within design practice and education that extends beyond project-specific thinking, connecting design to other fields and domains of knowledge.

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