



Cultivating Care through Ambiguity:

Lessons from a Service Learning Course

Samar Sabie

Department of Information Science
Cornell Tech
New York City, NY, USA
sks286@cornell.edu

Tapan Parikh

Department of Information Science
Cornell Tech
New York City, NY, USA
tsp53@cornell.edu

ABSTRACT

Given the focus of professional graduate ICT programs on technical and managerial skills, pedagogical engagement with external organizations tends to be transactional and artifact-centered. This inhibits the students' ability to understand social, technical and ethical issues in context, or to develop affective relationships with users and other stakeholders. To address this, we designed a service learning course that partnered students with non-profit organizations to help with their technology challenges. The service project was deliberately left open-ended to force students (and partners) to tackle important questions around project scoping and impact. By drawing parallels to soil care practices, we explore how "care time" emerged in this context, and how the incorporation of ambiguity galvanized students, community, and faculty to make time to navigate it. This led to non-tangible yet vital outcomes such as overcoming social limitations, building symbiotic relationships, and enacting acts of care necessary for more ethical orchestration of technology.

CCS CONCEPTS

• Social and professional topics → **Information technology education**

KEYWORDS

Service Learning; Relationality; Care; Community Engagement

ACM Reference format:

Samar Sabie and Tapan Parikh. 2019. Cultivating Care through Ambiguity: Lessons from a Service Learning Course. In *2019 CHI Conference on Human Factors in Computing Systems Proceedings (CHI 2019)*, May 4–9, 2019, Glasgow, Scotland, UK. ACM, New York, NY, USA. 12 pages. <https://doi.org/10.1145/3290605.3300507>

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than the author(s) must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from Permissions@acm.org.

CHI 2019, May 4–9, 2019, Glasgow, Scotland, UK.

© 2019 Copyright is held by the owner/author(s). Publication rights licensed to ACM.

ACM ISBN 978-1-4503-5970-2/19/05...\$15.00.

<https://doi.org/10.1145/3290605.3300507>

1 INTRODUCTION

Technological development is one of the primary drivers of contemporary political economies. Within its arena, there is a deliverance of "restless futurity" that privileges novelty, emphasizes productionism, and cultivates a sense of urgency to act now and fast to catch a future that is being "written in the present" [13]. This dominant mode of techno-innovation mirrors the "anticipatory" state of our daily lives, shaped by attempts to manage the unknown ahead, inhibit its "states of uncertainty", and build "the best possible future" [2]. The present is therefore a tumultuous worksite for cultivating capacities and resources, compressed in favor of a grand future of a happier "us", enmeshed in safe, healthy, accessible, prosperous, optimized, and more equitable societies.

Technological advancements do more than promise to enhance our lives and tickle our fancies; they perpetuate the pervading "Thou shall not regress" imperative [66] committed to "the speculative extraction of future economic value" in a "progressivist, productionist and restless mode of futurity" [56]. But in their sweeping propagation, tech innovations can also produce "unnerving, unfair, unsafe, unpredictable, and unaccountable" outcomes [64] such as implicit bias [51], algorithmic manipulation and opaque politics [12,21,63], impregnable "black box" systems [5], invasive monitoring and control [38], and unbalanced accountability [20]. This begs the question of how to responsibilize the "innovate or perish" tech paradigm so that ethical implications on human lives are considered.

One high-leverage strategy could be to focus on students in professional graduate programs, who already are or will become the leaders of this exhilarating yet concerning trajectory of techno-futurity. However, students in short and costly graduate programs typically have very little time to engage their technological learning in real-world contexts, or cultivate relations, relatedness, and care towards a wide range of worlds their work will impact "in order to make a difference" [55]. As a result, when these professional degree holders move on to "change the world",

their relational sensibilities typically lag behind their technical mastery. After all, making time to enact care, interdependence, patience, attention, attunement, and maintenance towards target users seems obscure and inefficient in the context of streamlined notions of productivity, success, and innovation of the field.

To address these limitations, we designed a service learning course titled “Remaking the City” that asked these students to apply their knowledge and skills to help real-world local non-profit organizations. We were motivated by the work of Science and Technology Studies (STS) scholar Maria Puig de la Bellacasa on human-soil relations [56], where she weaves a strong case for augmenting productionist logic with making time for *care*; an increasingly popular framework within ICT discourse [39,67,72]. In this paper, we report on our experience with the course, focusing on the importance of the design principle of ambiguity in creating space for students and the partnering organizations to navigate their relationships and understand the value of care in their own terms. The paper’s main contribution is translating the relational notion of care, typically applied in ICT research contexts, to a pedagogical context through the deliberate introduction of ambiguity. The tensions to be discussed illustrate that it is neither easy nor natural to introduce such a framework into professionally-oriented HCI graduate programs that rarely go beyond user (and product) centered design. We further contribute an analogy to holistic soil care practices from STS to make it easier for readers and students to concretize the notions of contradicting timelines, harmful consequences, interdependence, and collective flourishing that we found valuable for our analytic framework.

2 RELEVANT WORK

2.1 Service Learning

Service learning is a project-based teaching technique where students apply what they learn in class at local agencies to promote positive change [1,25]. In addition to the potential community benefits, service learning has been shown to create a more positive learning climate [58] and help students develop professional skills such as collaborative work, project management, and leadership [32,52]. On a more interpersonal level, service learning nurtures a sense of civic engagement and citizenship [11,14,42,44], self-efficacy [6,26], critical thinking and problem solving [27,45], practical knowledge application [69], trade-off analysis [50], contextual awareness [14,44], career exploration [69], and role finding within a larger context [22]. Furthermore, service learning

transforms the course into a social activity through which students find meaning within the context they engage in, connect to social networks [23], develop empathy and humility [29,59], and feel empowered to be a part of society [49].

A prevailing challenge in tech service projects is that they typically require time to concretize and deploy beyond the course timeframe [28,40]. Unless elaborate constructs are applied to ensure continuity [68], there is an “asymmetry problem” [61], with students gaining skills but the community not benefiting. Furthermore, there is a concerning assumption that “ICT is ultimately a social good and hence providing free ICT consulting is by definition a social good as well”, which Connolly cautions against, calling for a more critical and relational approach to the paramount complexities of technology and society [15]. Our work adopts this critical stance to service learning, by engaging the question of how systems and institutions sustain social problems and injustice, and focusing on “developing authentic relationships in the classroom and in the community” as one way of addressing asymmetry [43].

Scholars have found that foregrounding academia-community relationships through service learning reveals the tensions of *doing for* vs. *doing with* and the challenge of balancing real impact with pedagogical goals [42]. Involving students in this discussion concretizes, augments, and even challenges what they learn as they directly grapple with the forces, biases, uncertainty, and unexpected circumstances [10]. Hayes and Cuban capture the gestalt of such service learning experiences with a “border crossing metaphor”, both physical and demographic, where “self, knowledge, and culture” are constructed [30]. They note that unlike highly-structured modes of learning, ambiguity and complexity can arise when real communities are brought in. But “rather than seeing this as problematic, suggesting the need to give students more structure or direction”, we must “appreciate and value ambiguity and uncertainty as opportunities for different types of learning from service...[and] constructing new kinds of knowledge and relationships that go beyond what we or they may have anticipated.” In that sense, “knowledge is always partial, continually being created and recreated in response to new ideas and experience.”

Our work echoes many of the positive outcomes, sentiments, and challenges reported in the literature. But it abandons the interventionist approach of technology and the “deficit-oriented” view of the community [16], focusing instead on how students and community organizations find shared meaning by facing ambiguity and negotiating relationships. Furthermore, we highlight through

qualitative analysis the often-omitted perspective of community organizations on technology service projects, and how technology served as a “hook” for stimulating a collective conversation on care, solidarity, accountability and situational awareness.

2.2 Participatory Design and Infrastructuring

Participatory Design (PD) facilitates direct collaboration between users and designers in contexts beyond formal enterprises and institutional structures, including activist, hobbyist, and non-profit community groups [18]. Such groups often lack the resources and capacity to successfully design, implement and deploy technological solutions. Furthermore, their projects often relate to a wide range of stakeholders who may not be fully represented during the co-design process [8]. PD scholars advocate “infrastructuring” [19] to address these limitations and the overarching ethical implications of co-designing tech ecosystems in community contexts. Le Dantec and DiSalvo define infrastructuring as “the work of creating socio-technical resources that intentionally enable adoption and appropriation beyond the initial scope of the design” [17]. This approach emphasizes the potency of relationships within intricate social spheres in driving tech-infused outcomes [34], recognizes their role in supporting “ethics in practice” [39], prioritizes “socio-material working relations” over artefacts, and broadens the notion of innovation beyond products to include “a principle, an idea, a piece of legislation, a social movement, an intervention, or some combination of them” [8].

In applying this expanded, relationally-charged approach to design, Le Dantec and Fox narrate the work it takes to build and mend relationships with the academic institution’s proximate community [37], Bødker and Kyng speak about building partnerships for a new impactful form of PD [9], Agid theorizes the relational practices emerging in her work as a designer with a social justice organization [3], and Light and Akama explore the nuances of interdependence when intentionally “co-designing ongoing future societal relations beyond the immediacy of designing objects or services during project time” [39]. Our work translates these frameworks of relationship-building from design and research contexts towards the goal of training future ICT practitioners. We show in a pedagogical setting what it takes to infrastructure social-material relationships, deal with their ambiguities and nuances, and enact care for local communities.

2.3 ICT and Care

Prior literature includes care as one of the perspectives students acquire and demonstrate through service learning

[59]. The theoretical lens of care is also increasingly adopted in ICT discourse [39,46,48,67,71,72]. Maria Puig de la Bellacasa posits care as affective enactment, an “ethico-political obligation” [54], and a relational ontology; “to care about something, or for somebody, is inevitably to create relation” [55]. She invites us to attune to the care permeating everyday relations and make “care time” for what matters, be it in biological, sociotechnical, or scholarly contexts [57]. By foregrounding involvement, affect, interdependence, care time, relationality, and repetitive adjustment, nurturant relationalities can emerge as alternatives to the aggressive temporality of profit-driven techno-scientific innovation [56]. Care supports “continuity of life”, affirms “a moral relation” to the cared for [33], and its “slowness” nourishes co-existing ecologies not running at the speed of innovation-driven capitalist economies. In this sense, care time offers “glimpses into a diversity of timelines that, despite being made invisible or marginalized in the dominant timescape, can challenge traditional notions of technoscientific innovation” [56].

Light and Akami build on Puig’s rationale of caring “as intrinsically relational, situated inside interdependency” within the context of participatory design [39]. Toombs et al.’s ethnographic inquiry of the “sociality of hackerspaces” elucidates how the culture of independence, techno proficiency, and neoliberalism in such spaces is counterbalanced by implicit and explicit acts of care, with “hidden-but-enacted” interdependence that deepens the hackers’ relationship with the broader community [67]. Zegura et al. advocate social good through the practice of “care-oriented data science” that valorizes “collective tinkering” from the community [72]. From ICTD, Wong-Villacres et al. examine how care helped reconcile online-offline disaster relief efforts [71] while Karusala et al. reveal how caring behaviors create a sense of interdependency and community at an underserved learning center in India and how to extend that with technology [36]. In academic settings, Atkinson-Graham et al. probe care dynamics emerging throughout their careers as graduate students with advisor, collaborator, and research subject/object encounters. When understood as sensitizers to what is subjectively important, actions of reflection, tension, assurance, puzzlement, engagement, withdrawal, and self-interest then become facets of “how to care” [7]. Finally, Martin et al. argue that care can emerge out of anxiety and uncertainty as much as by positive intentions [41].

Our work translates this relational notion of care from research to a pedagogical context. Research allows longer timeframes with subjects trained in ethnography and focused on research outcomes. It is therefore difficult to adapt this framework to pedagogical contexts given

constrained timeframes and different incentives. We probe how to make care time when time has a high premium, such as in busy and expensive graduate programs, mirroring the high pressure and output-driven work environments that students will encounter in the future. We show how dominant pedagogical “timescapes” can team with timelines of care towards the community even if that renders student output “unproductive” within the dominant innovation logic.

3 Background and Motivation

Soil care practices inspire us to see an analogy in how techno-innovation focuses on the cultivation of novel artefacts and intellectual property through the application of venture capital the way food production harnesses soil’s fertility to intensify crop yield. In both, furious productionism eliminates interdependent relations in order to maintain an uninterrupted production trajectory. Puig de la Bellacasa draws our attention to the dangers of the eradication of this interdependence which in the case of soil, includes seasonal rain, bustling predators, and fluctuating biota conditions. By (1) ignoring “the complex diversity of soil renewal processes”, asynchronous with tight capitalist timeframes, and (2) invisibilizing its wealth of organisms with off-farm testing and entomological potions, soil is reduced to lifeless substance, its biota aggressively eradicated, and future food outputs jeopardized [56].

Similarly, real communities are often dismissed in most technology development paradigms, being compressed to personas, stakeholders, prototypes, and other design abstractions. This is because external dependencies, such as probing common assumptions about technology at real sites of digital divides, can induce delays, complexities, and uncertainty transgressive to the tight timeframes of implementation and monetization. As a result, deep engagement is not recognized as valuable in training contexts given the marketable technical and managerial skills that students must acquire.

Indeed, within the applied/professional master’s programs at our institution, it is normal for students to take 6-7 courses per term, work on assignments until the early morning hours, continuously prepare for job and internship applications, as well as work as research and teaching assistants. Such an intensely productionist approach does not leave future practitioners enough time to fathom their “accountabilities to the worlds that [they] co-construct” [41]. Cultivating an ethos of care for the community therefore seems as subordinated as slowing

down food production to the natural rhythm of the soil habitat.

3.1 Making Care Time through Engagement

Puig de la Bellacasa and other soil scientists [24,31] advocate making food production practices more responsible by giving farmers the time to develop a feeling for the soil, to appreciate its biology and conditions through manual sampling and testing, long-term observation, and working with its natural ecological cycles. Through “co-mingling with its substance”, “commitment, concern, and empathy” and an appreciation for natural soil dynamics develop [70]. As a result, fertility is improved, output is increased, and production is sustained in the long term [56]. Analogously, we see the need to cultivate an intrinsic sense of care in future ICT practitioners towards communities through similar co-mingling, with the hope that trainees show “commitment, concern, and empathy” towards the users of their future systems. But embodied immersion in societal spheres is not as straightforward as the haptic engagement of farmers with the soil and its fauna with apple corers and basic microscopes. For one thing, a relationship already exists between farmers and soil. Fostering symbiotic community relationships is typically not part of most students’ academic training, especially those focused on technology. Care through direct engagement, be it in soil or pedagogical contexts, shifts relations from obliviousness, defiance, or control to that of interdependence, attention, and maintenance.

3.2 Situated Engagement

Puig de la Bellacasa sees soil for what it really is: a community right underneath us, lively, vibrant, and teeming with life. She calls on humans to become members of this community, rather than mere consumers of its natural capital. Analogously, there are living communities directly “beneath” campuses: diverse, human, and lively, with robust social capital of their own. University students typically relate to them through compulsory spatial consumption: sharing streets, communal facilities, transit hubs, and zip codes, but not necessarily through pedagogical bridges. With such bridges, this shared physical reality, co-mingling, and inevitable collisions could incentivize various forms of collaboration, allow “thoughtful and protracted observation”, and give students the chance to “experience the specific ‘schedules’ happening within the arrangement of life cycles” [47] in their institution’s proximate community. We believe that such active forms of situated membership can carve more opportunities for busy students to make time to learn to

enact care through tech interventions and carry that with them in their future practices.

Our prior ICTD research in India, Sub-Saharan Africa, Central America, and the Middle East helped us relate to how the physical and social detachment from these sites made it hard to sustain projects or gauge their positive or negative impact in the long term. By situating work in our own communities, everyone can work together to envision, implement, and sustain new technologies, services, and delivery models that we are collectively held accountable for. Community members and leaders can then grab us on the bus, street, supermarket, park, or doctor's office, and ask "What's going on here? Why is this not working the way it should?". This forces us to dedicate "attention and fine tuning to the ... rhythms of an 'other' and to the specific relations that are being woven together." Furthermore, this approach positions us not as external technology designers and implementers, but "as attentive members of a specific ... community" [56]. Our pedagogical approach to tech that privileges an open-minded, humble, and attentive perspective is further shaped by our personal involvement with the community by residing on the island and engaging in various activities such as co-teaching a digital humanities unit at the local middle school, hosting a civic design summer program for youth, serving with the residents' association, and organizing events to bring together academic and community insights on relevant topics, among others.

4 REMAKING THE CITY

Remaking the City is a master's level service learning course that we taught to engage students in service learning projects with local community partners.

4.1 Background and Context

Our institution's new campus started operations on August 1st, 2017. It is situated within a large metropolis, on a narrow 3.2 km-long island encompassing affordable and luxury residential developments, schools, shops, restaurants, parks, a bank, a postal office, and a long-term care hospital. A community affairs director was stationed on the island during the planning and construction of the campus, holding regular office hours in the art gallery. Over these three years, members of the community expressed trepidations, curiosity and anticipation of what the island-university relationship might look like. Their primary concerns included fear of continued gentrification, increased load on transportation and other infrastructure, too much outside attention that would jeopardize the calm and intimate vibe of the island, and highly transient student

populations that come and leave without contributing to the community.

The campus is located on the south end of the island, close to the ferry terminal, tramway, and subway station. Island residents speculated that these transportation options would act as "a vacuum", sucking students to other parts of the city to eat, shop, or otherwise hang out. Several residents mentioned that they were concerned that students would not visit the north part of the island where the majority of community lives and most organizations and businesses are located.

Admittedly, our context is unique: a new high-profile campus on a small island within but apart from a busy metropolis. We have not concealed the qualities of our location because the specifics *matter* – and are intrinsic to describing our subjective position in this research. We were also inspired and cautioned by Le Dantec and Fox [37] about some of the corrosive dynamics academic institutions could enact on their proximate communities. In our case, the university had already displaced a large public hospital that provided long-term rehabilitative care to low-income patients. Our goal was to ameliorate some of the disruptive impact of our presence, by supporting students in becoming "confidants", "advocates", and "collaborators" [37], and by facilitating knowledge exchange and care between the two populations. This is because to "become of the community" requires a collective ethos, as societal relationships entail many individuals, each with their own notion of belonging. Furthermore, the outcomes of engagement and partnership are "secondary to the issue of *how* we [intend] to work with the community" [37]. The essence of "building rapport" is in the process itself, akin to the way care emerges in ordinary moments such as cultivating soil [56], working in a hackerspace [67], or conversing with a mentor [7].

While there were a few faculty and staff who lived on the island, our roughly 500 students (more than 75% of whom live on campus) constituted the vast bulk of our human capital. Most of these students are enrolled in one to two-year professional master programs, requiring five to seven courses per term. Many are also employed as teaching and research assistants, and intern during the summer to address the high financial costs of attendance. 50% are international and tend to travel home or explore the rest of the city and region during downtime rather than mesh into the local community. Given these demands on their time, it is difficult for students to collectively negotiate societal membership and shared temporality with the community, and to be cognizant of the need to co-construct alternatives immediately outside campus while simultaneously working towards global impact.

4.2 Course Goals and Partnerships

One of the course goals was to understand the unique technological challenges faced by small civic organizations and the role technology can play in service delivery in urban contexts. Most technology ventures focus on serving individual consumers or large organizations, leaving smaller organizations in the lurch. We reached out through our community affairs director to several such organizations on the island during the summer of 2017. Eventual partnering organizations included the local municipal body, historical society, garden club, dance theater, senior center, and art gallery. Some partners had more than one project and worked with multiple student groups. One student group worked independently with a variety of retail and food vendors on the island.

4.3 Activities and Timeline

Remaking the City was defined by open-endedness in terms of project scope, nature of deliverables, and level of technical innovation expected. To ensure that this ambiguity did not result in a lack of accountability to the course or project partners, multiple constructs were embedded to (1) create opportunities for students and partners to encounter and navigate this ambiguity, and (2) strike a balance between learning, service, impact, and affective engagement.

4.3.1 Service Component: Teams of 2-3 students were asked to “commit up to 5 hours per week to support their partnering organization’s technology needs.” We left the actual requirements open to encourage students and partners, each with unique needs, resources, skills, and interests, to individualize their collaboration. By avoiding overly prescriptive requirements, our goal was to foster mutual dependency in navigating this ambiguity. Examples of service projects included creating a Google map of green spaces on the island, introducing maintenance personnel to a cloud-based GIS service, designing a new website, prototyping web literacy cards for seniors, and helping an organization migrate to Google Apps email hosting.

4.3.2 Speculative Design Component: Six weeks before the end of the course, students were asked to start thinking about a plan for a project, technology or initiative that would impact the island or a specific community on it within 3-5 years. Two of the student teams chose to work with their existing partners to come up with this proposal. The final deliverable was a presentation and report with a low-fidelity prototype and implementation plan.

4.3.3 Meet and Greet Mixer: This informal event was organized during the first week of class (also the first official week of campus) at the island art gallery (also a project partner). Partners pitched their organizations’

history, mission, whom they serve, and where they needed help (better mapping, mobile GIS, remote access to elderly patients, updated websites, etc.). Students had the chance to chat with these organizations before deciding which they wanted to work with. The conviviality of this symbolic comingling at the island’s mid-point, with food, art, and impromptu conversations on life and technology, prompted a sense of togetherness, warranted independent care initiatives, and exposed fertile ground for emerging collaborations.

4.3.4 Weekly Critical Reflections: Students were asked to post weekly reflections on the course blog addressing the activities they did with their partner, their perceived utility, the resulting outcomes/design artifacts, emerging needs, obstacles, and tensions, and how their vision and ideas aligned with their partners’. Reflections helped students tie their “constantly evolving perceptions, beliefs, and knowledge” [59] with the class material. It was also an opportunity to articulate the troubles they were facing in navigating ambiguity, get feedback from us and their peers, and to ensure accountability to the course goals and to their partners. We discussed the blog reflections once a week in class, exchanging advice and suggestions, and connecting student experiences to broader themes explored in the course.

4.3.5 Semi-weekly Project Share-Outs: Every 2-3 weeks, project groups shared their progress with the whole class or in smaller groups. The unique and open-ended nature of each project necessitated a forum for students to vent, hear other articulations of “progress”, demonstrate value being delivered to the partners, and discuss various nuances of building relationality.

4.3.6 Guest Lecturers: Island residents active in civics, politics, and business came as guest speakers to address a variety of topics including island governance, urban planning, “civic” technology, the island’s historical significance, and the campus planning and construction process. This bolstered the multi-faceted community engagement in the course and helped students understand and navigate the rich historical, economic, and socio-political dynamics of the island they increasingly encountered through their service projects.

4.3.7 Lectures and Readings: Material covered in the course lectures included guidelines on managing community relationships, participant observation, user research, participatory design, and urban studies covering salient issues such as race, immigration and gender. We also conducted several design exercises envisioning new technological possibilities for the island including local currencies and interactive Internet kiosks. Through discussion and small group meetings, we emphasized care,

impact, partnerships, patience, mutual benefit, and persistence over rushed technical interventions.

4.3.8 Other Events: During the first week of class, the president of the local historical society (also a project partner) took students on a walking tour of the island, which for many students was their first time venturing north on the island. Students also engaged with the community by organizing a food fair on campus, attending local townhall meetings, and pitching their speculative designs at the end of the term to an audience including island organizations and residents.

5 METHODOLOGY

This paper is based on both authors' firsthand experience teaching the course and interacting with students and organizations, analyzed through Charmaz grounded theory approach, and interpreted through the lens of *care*. The first author was a teaching assistant for the course, and the second author was the lead instructor. The findings are derived primarily from the qualitative analysis of 10 in-depth semi-structured interviews conducted in January 2018 with 5 (out of 23) students and 5 (out of 6) partnering organizations. Interviewees were organizational leaders or board members with whom students had worked directly during the term. The limited student participation can be attributed to some of them graduating immediately after the course, and their overall busyness with classes, specialization projects, and job hunting. Interview questions for both included why they chose to participate, their expectations, challenges faced, perceived benefits, and recommendations for the course.

The interviews were audio-recorded and transcribed. All participants gave their consent to be audio recorded. The first author (who was not directly involved in grading or establishing partnerships), initiated the interview invites, coordinated scheduling, and conducted the interviews. Interviews ranged in length from 25 to 120 minutes. The first author and a research assistant transcribed interview audio recordings and imported transcripts into QDA Miner Lite. Charmaz grounded theory approach was applied to inductively code the interview data. The first author read each transcript, assigning a code to every sentence (open coding), focusing on sentiments, actions, and timeframes that capture meaning making between students and partnering organizations. Example codes included "partner indecisiveness", "enjoyed talking to partners", "gauging meaningfulness to community", "inviting students to feel at home", and "hard to anticipate timeframes". Once consistent codes began to emerge, we drafted the first round of codes and tentative categories such as "ambiguity

causing anxiety", "non-tangible gains", and "border crossing". Thematic analysis was further supported by our observations, local media coverage, the final course presentations and reports, and 130 student blog posts. We did not code this data as we were highly familiar with it through grading, frequent discussions with the students and research team, and re-visiting for paper writing. Instead, we used a constant comparative method to simultaneously compare codes and categories with uncoded data and refine accordingly. We also discussed emerging codes and themes with the research team and colleagues. After three iterations, the core theoretical idea of "care through ambiguity" began to emerge and was further refined along with the codes.

6 FINDINGS

6.1 The Compounded Ambiguity of Service

Students generally found the design project easier to navigate as it did not require working with partners (only two out of 10 groups continued to work with their partners on the design project), and it emulated processes typical in their curriculum: visioning, stakeholder analysis, requirement elicitation, and pitching. On the other hand, the intentional open ended-ness of the service component was found to be much more challenging, for both students and partners. While partners were excited by the course and its potential, interviews showed that they did not know what to anticipate, how much to trust students, what to make of this initial collaboration, or what could be expected from a 5-hour weekly commitment. As one partner noted, *"I don't think I've ever worked with that large a group on something that was so completely wide open."*

9 out of the 10 service projects started with need-finding and participatory project-scoping. Such need-finding further compounded the natural uncertainty associated with real-world rather than "boxed" and "highly-scripted" classroom problems; *"I never try something like [that], we don't have specific needs and we are trying to find the needs not only from them [the partner] but also people who we are targeting"* one student recalled.

Ambiguity was also nurtured by the students' sensitivity towards their partners, privileging the latter's needs over more technologically sophisticated projects that might better augment their CV and skills. This implicit act of care was commonly referred to in student interviews: *"you can't go hey this is my tool kit, this is all I can do. You have to be open right? So, we were very open minded about it."* It was also reciprocated by the partners, who worked hard to include the students' abilities, ideas, preferences, and "excitement". As one partner put it *"we needed to come to*

some kind of understanding about where each of us is coming from.”

While partners put in time and effort, they were not willing to commit material resources such as licensing fees, web hosting fees, or hardware purchases for trust and funding purposes. Such constraints crippled the ambitious proposals students pitched, making them experience a looming sense of ambiguity and uncertainty as they could not address the partner needs using their familiar knowledge, skills, and training. Even non-ambiguous technological interventions, such as adding a donate/shop feature to a website or switching to a mobile-friendly GIS platform, were not straightforward to implement due to infrastructure constraints (e.g. organization volunteers unable to learn “newer” platforms such as WordPress), data gaps, and bureaucracy, thus impelling cycles and cycles of need finding and solution scoping transgressive to well-defined homework problems.

In general, we tried to nurture a collective interest in impactful rather than novel ideas. This was supported by lecture material, the partners’ passion for their work, and the students increased sense of accountability towards their new community. Ideation and prototyping cycles were like a “*tug of war*”, as a student phrased it, with all sides involved tempted at times to jump into implementation, but ultimately hunting for practical ideas that would truly benefit them and the community. For example, while user research revealed that a voice-activated ride sharing app might be great for seniors, one team ended up proposing a less “innovative” set of paper-based web literacy cards that were more practical, and would provide definite and immediate value.

6.2 Navigating Ambiguity through Interactions

Many projects remained in the aforementioned state of flux two months into the semester. Partners were accustomed to that, and even found it refreshing; “*I love the organic ‘lets just wing it’ and see what happens*” a partner noted. Still, many students reported feeling a sense of anxiety as their projects did not appear to be making “progress”; “*it caused me more anxiety just not knowing what was going on...we felt we didn’t know what we were doing so we need to figure something out*”, a student recalled. “*As things went along, it goes pretty messy*”, another student declared.

Nearly all teams reported in interviews or blog posts a commitment to regular weekly meetings, primarily in person. These meetings continued despite the extremely hectic schedules of students and partners. One partner described how she at times forgot about the meetings or had to tend to urgent matters, but students were happy to chat with other personnel or community members or

follow her around and talk as she got things done around the organization. A self-described “*socially-awkward*” student who felt their partner did not take them seriously at the beginning commented on how their partner grew more “*excited*” with each meeting.

It was through these repeated meetings that both sides reported that their relationship gradually morphed into oneness. Typically, students are accountable to partners on the one hand and to the professor and TAs in charge of their grades on the other: they must help the former and meet the curricular expectations of the latter. In Remaking, the interviews reveal an emerging collective sense of responsibility, with the students and partners becoming one body, in one vessel, navigating ambiguity to (1) provide benefit to the community and (2) meet course expectations collaboratively. As one student boasted, “*our partners were so willing to tackle the problems with us. They want to design with us. They want to propose ideas.*”

Over time, partners started to loop in more of their staff and community members, sharing their day-to-day tasks and challenges. “*They helped us get to know the problems and everything that they had. We got three different perspectives...we got to see all those things and with [the partner’s name] we got to see how the places administered and everything.*” These conversations were not confined to offices; they reverberated in streets, coffee shops, apartments, festivals, on campus, at the farmers’ market on the island, and in one case over a Thanksgiving dinner that students were invited to.

One of the most promising projects emerged from a team that was committed to meeting every week and talking for hours at various locations throughout the island. When they were asked about the success of their collaboration, they would say “*we’re not really sure, but it’s working. We couldn’t explain [to the organization board] the gestalt of this really amazing process.*” Frequent interactions helped everyone make it through “*the transitional path*”, care about each other, and find joy in the collaboration.

6.3 Building Relationships Over Artefacts

Partners mentioned in interviews gaining several indirect practical benefits, such as students exposing data gaps, realizing the limits of their financial/infrastructural means, discovering new things about their users through surveys and prototype deployment, testing new ideas, and completing dormant tasks. But students and partners seemed to value the relationships they developed more than any concrete outcomes or deliverables that did or did not result. Partners were unanimously grateful and enthusiastic about future collaborations; even if the project did not achieve any material goal, they valued the

collaboration, fresh ideas, web and social media guidance, and learning things about our institute (for example, that we are not nerds “*who spent their day in the dark starting at a computer screen*”), and ultimately their own organizations.

On the student side, they seemed to get the value of “*partnership with people. I got that idea ... to understand their needs before rolling up my sleeves to do something for them. Pretty quickly I think I got on the right track towards just talking with them, having a great time, building our relationship. Talking about work also talking about something from everyone's life so we can maintain a relationship like friends.*”

Some students felt that these relational outcomes were not useful for their portfolios or CVs, especially when compared to building sophisticated technologies like in other courses and research activities. But students acknowledged in interviews and course evaluations that they valued learning about product design, initiating collaborations, talking to the community to find solutions, and acquiring new skills to fit partner needs.

Finally, most interviewees appreciated that the course was explicitly not about high-tech; “*this kind of a class is a break for me from everything else that I do. For every other course I do there are assignments when I'm sitting in front of monitor you know staying awake for 3-4am... I was totally ok with not doing machine learning for this course... I wanted to have a good experience and I wanted to partner with someone, work in a team*”, as one student explained.

6.4 Partners' Co-Ownership of Remaking

Our partners took co-ownership of the course from the time they first met students. They also helped us frame the class pedagogically by making the students and us understand the value of engagement and demonstrating real acts of care to students.

Partners approached their involvement with Remaking as providing value and service to our institution; “*we are more than willing to do things for the students*”, as one partner summed up her participation. Furthermore, partners named many skills students would have to acquire to succeed in life such as interacting with needy customers, managing real projects, expanding professional networks, taking initiative, and finding people with similar interests. As one partner elaborated, “*this whole island is a network. And that's why [your institution] has to become part of the network... the students have to find their own network ... [because] you have to get a job, you have to deal with people.*” Another partner called it “*a sharing experience. They can learn from us, we can learn from them.*” The learning and growth symmetry, propelled by frequently ambiguous interactions, cultivated respect, care, and commitment, and

not only fulfilled the civic mission of service learning, but thwarted physical borders, demographic boundaries, and power dynamics, allowing both sides to interweave their worlds into “interdependent existences” that fostered affective and material engagement” [55].

Our brand-new campus is “*an architect's delight*” where novel and revolutionary ideas are nurtured to drive global techno-economic innovation. But it can also feel alienating; “*too programmed and sanitized*” as one partner put it. The short duration of the professional graduate programs (1-2 years) and large international student population further exacerbate the issue. It is no wonder that student interviews (and partner speculations) reflected a sense of collective isolation and loneliness. For example, despite regularly asking students to share project updates and challenges with the entire class or in smaller groups, one student reported that “*it felt like we were this group foundering alone*”. It was therefore heartening to hear the students feeling “*warmly embraced*” by their neighbors.

Students were invited to Thanksgiving dinners, festivals, and pizza, were given gifts and hugs, and asked caring questions such as “are you eating enough?”, “do you miss your family?”, and “aren't you working too darn hard?”. “*It's something that doesn't happen at [our campus]!*” a student exclaimed. She had found a warm refuge at the senior center where she connected with many seniors despite their age and culture gap. Others interacted with local immigrants who were also building their “*own American dream.*” These affective dynamics and acts of care “*changed a lot of my life on [the island] ... I was so happy throughout the semester... now I owe [the island]*” another student fondly reported.

In return, partners spoke fondly of the excitement of interacting with the students and our institution, the students' persistence in working around obstacles, the energy that made residents “*come alive*”, and engagement beyond the service project. For example, a partner recalled how one student “*would just stop in and say hello. I love that. I thought it was really wonderful that he would just stop in and say hello.*”

7 DISCUSSION

The service dynamics in Remaking the City and its inherent ambiguity helped co-create social relations, rapport, and shared contexts within our community. This entailed challenging predominant pedagogical strategies aligned with future-driven productionist paradigms and the “erosion of casual encounters” [39]. By revealing the “invisible cement” [39] of relationship building, we showed what it means to appreciate the “biology” of the community

through care time and learn to share space (figuratively and materially) rather than being mere consumers. Furthermore, since care “unfolds in action” [72] and is “vague” [53] and “messy” [48], we articulated examples of its specificities that legitimize its varied forms and sentiments of enactment. This is especially important for tech students who are typically exposed to streamlined and alienated notions of productivity, success, and innovation.

7.1 Ambiguity as a Way for Finding Meaning

Students and partners had unique needs, resources, skills, and expectations. Therefore, the course valued emergent qualities, processual frameworks, and persistence implicitly (through open-ended requirements) and explicitly (through feedback, discussion, readings, and grades). Students who regularly talked to us about their fear of not meeting expectations were assured that they were fine as long as they were making effort and letting the process take its course. But students and partners still experienced the “forms of discomfort, confrontation, tension and precariousness” that Akama et al. report on their uncertainty-promoting design project [4].

In our case, the pragmatic and symbolic role of ambiguity was to (1) democratize the collaboration process so that partners and students had full control over what was meaningful to implement, (2) grant both sides the choice to purposefully forgo parts of the formal design processes given the tight semester timeline, and (3) free students from their intrinsic tendency to optimize for grades and CV credentials. In return, we legitimized less utilitarian, less measurable, and more affective dynamics such as care, shared ethos, civic engagement, situatedness, and dismantling interaction barriers. That helped students learn firsthand that knowing takes commitment and immersion, good ideas require time, partners are not predictable, and the sheer messiness of the interaction of technology with real life.

To navigate ambiguity, students had to leave behind the artefact-centric, investor/manager (for which the professor serves as a proxy) mindset, involve their partners in the quest to negotiate desired outcomes given the time and resource constraints, build relationships, and handle the emergent together, making that in itself a “central and welcome quality of how both ... experience processes, relationality and environments”, and that experience “...relies upon trust – in the process and in one another – and a sense of optimism and confidence that something will come through” [4]. The result was not only interventions and proposals, but symbiotic caring practices, each being “affective state”, “ethical obligation”, and “practical labor” [55].

Avoiding prescriptive orientations presented a challenge, particularly when it came to the fine line between negotiating emergent relations and just “slacking off”. We introduced collective accountability through student progress reports on the blog, semi-weekly project updates in class, and meeting with groups that were confused or not making progress. We repeatedly stressed in class that the service project should provide immediate and tangible value for organizations - we just did not specify exactly what should be produced, hence the diversity of outcomes in 4.3.1. Our goal in introducing ambiguity was to redirect accountability from the class and university to relations with and within the community itself. Constructs in 4.3 (weekly blogs, class updates, presentations, final reports, check-ins with organizations, and final presentations with an audience of community members) were incorporated to support an active process of reflection while ensuring that students were learning and partners benefiting, as evident in section 6.3. We also modeled care through our own involvement in the community. Ultimately, by giving students the time to care and embark on a journey to get the “biology” of the community despite the “looming time limits”, we aimed to transcend the transactional and achieve the relational.

7.2 The Cost and Value of Making Care Time

ICT literature narrates the unfolding of care within a specific orchestration such as data collection or working in a hackerspace [67,72]. In the case of Remaking, care time was not marginal to the tasks on hand; it was the chief vessel for navigating ambiguity that it compressed the innovation expected by predominant pedagogical scopes in tech. From a capitalist perspective, care here was not “value-creating work” [56] because it contradicted material production and efficiency: the time students spent interacting with the community in various capacities was time not spent on coding, conducting rigorous user studies, or perfecting elevator pitches to attract VCs. Indeed, none of the service projects were novel or innovative from a technical perspective. Students and partners discovered through the course of their collaboration that good ideas take a long time to procure, as does building relationships.

To justify the importance of making time for care, Puig de la Bellacasa argues that such time is irreducible to productionist agendas, so we should not be “focusing on demonstrating the productive character of activities of care” and must instead show the importance of the “vital practices and experiences that are discounted, or crushed, by the productionist ethos” [56]. Steve Jackson’s work on care and repair [33] shows that “no output, no growth in the future, and no innovation or emergence of newness

are possible without a commitment to the everyday maintenance and repair that supports the work of care and continuity of life” [56]. Care is vital for creating “livable”, “lively”, and relevant worlds.

When we see soil as “living” and care-worthy, we are humbled by its ability to take care of its internal processes more holistically than alternative techno-scientific methods. Analogously, as students experienced “the fragility of the worlds we inhabit”, and saw innovation and development counteracted by fragmentation, and resource asymmetry, they experienced the “the ongoing activities by which stability is maintained” [33], and how they as technologists and designers might participate in that careful balance. Furthermore, whether they started out as students, partners, or instructors, everyone’s identities inflated into listeners, messengers, teachers, learners, and advocates. That fed into a collaboration that was “a collective achievement” [53], ethically-engrossed, and driven by “persistent tinkering in a world full of complex ambivalence and shifting tensions” [46].

Working with paper cards, “legacy” web platforms, and existing software tools, contradicted innovation as “the start of the technology chain, in moments of quasi-mythical origination” [33]. It tackled the “inescapable troubles of interdependent existences” [55]. As one partner put it, *“the win-win is knowing each other. The win is walking up that staircase together with you. This isn’t about Cornell doing something for you or the island being genuine and welcoming people, this is about all of us together because we’re all in this together whether anyone likes it or doesn’t like it, this is the way it is. And we need to go forward with that.”*

When the transactional transcended to relational, we co-constructed infrastructures, which is a “fundamentally relational concept” critical to participatory design [65]. Whereas technical skills are taught pervasively in course after course, societal membership is not; *“if not for the course, I would never have the chance to know those people, to have time to make conversation with local residents and have this relationship that we get to meet weekly and share our insights”* a student explained. Once we accepted this interdependence, then in our “worlds made of heterogeneous interdependent forms”, we found that “to care about something, or for somebody, is inevitably to create relation” [55]. When we run into each other now at the bus stop, subway station, supermarket, doctor’s office, we all have a reason to engage in a conversation, to exercise care, and be accountable towards each other.

7.3 Technology was the Starting Point

We cannot forget that technology was a starting point for these conversations. As one partner put it: *“manpower is not*

necessarily something that we are looking for. It’s much more, we run a business and every business these days has to have a strong tech department. What often happens with non-profits is they don’t have that because they don’t have the finances to support it.”

Farmers have a relationship with soil; students have no such pre-existing relationship with the community. What they have is a desire to serve the community with what they know best: technology. Furthermore, students, partners, and community members being “differently positioned in their capabilities and readiness with regard to information literacy and ... technology use” [35] was a form of “social lubrication” [39] that helped interactions flourish and discarded in its manifestation “the positivist [HCI] tradition of producing an unambiguous result” [62]. Remaking emulated Light and Akama’s design model where designing “is no longer led or owned by designers, but becomes a co-articulation of concerns and issues in a world highly mediated by technology” [39].

Furthermore, if making time for care as a goal seems disengaged from the futuristic techno drive, what if we see it as a form of “ancient wisdom” for instilling ethics of care in tech programs or as an alternative ontology within the innovation paradigm? It (1) has the tension, tiresomeness, and messiness of wiring circuit boards, cleaning training sets, and debugging code, (2) is as non-linear as the innovation trajectory itself, (3) it galvanizes our imagination and problem-solving neurons, and (4) it is real: care after all is “a necessary everyday doing” [56]. While most technology curricula “suspend and compress” the present, Remaking distended the present, “thickening it with a myriad of demanding attachments” [56]. Fear, urgency, and output had to be distanced in order to focus on caring, and it was repetition and commitment that helped navigate the restless anxiety of the ambiguous.

We hope that this bricolage of technology-time-care is reflected in the students’ future work and careers, and that the complex relationships of people to each other are considered within participatory design practice as “embodied, located, and emergent” [3]. After all, it is increasingly accepted that design activities do not “specifically involve the making of digital products or services as a means of structuring relations, but instead, they attempt to co-design awareness and understanding, and scaffold connections among people, some of which may manifest in enhanced design, deployment, customization or use of ICT” [39].

8 LIMITATIONS

Despite the positive interviews and course evaluations, the course was not without its pitfalls. Not all of the service projects led to a successful outcome. Students had to work hard to overcome or work around mistrust (e.g. partner declining to divulge credentials for students to access their social media accounts), skeptical board members (to approve proposed service projects), and communication hiccups (e.g. forgotten meetings). They also had to demonstrate commitment and set boundaries (e.g. partners expecting our institution to pay for licenses). In return, some partners felt the students, while “*brilliant*” and “*work too darn hard*”, did not have the skills the partner really needed to advance their organizational mission.

It also not clear how to qualify or measure the care emerging. Our findings are based on observation and interview data: through crossing to uncomfortable and unfamiliar worlds, discovering ways to relate to the community through hobbies, food, and events, maintaining patience and persistence when facing resource limitations, and prioritizing the organizations’ needs over their own were some of the ways students demonstrated care. Clearly more work is needed to explore different pedagogical approaches to cultivating care and studying the results empirically.

Furthermore, not all of the students appreciated the pedagogical goals and values of the class (perhaps that is why some of them declined to be interviewed). Some students felt that they were being used to improve the image of our institution on the island. This is a justifiable sentiment if students did not appreciate the soft skills they acquired, what they learned as citizens and human beings, or how these skills would (or would not) translate into direct economic benefit for themselves and their future projects – especially on a campus founded on notions of innovation-driven entrepreneurial activity. We observed this tension first hand as students completed the course and moved on to their other endeavors. As far as we know, none of the students continued their projects beyond the class. It is an open question how long their relationships will last, although we do know of a few instances where students and partners are still in touch.

In some ways, the legacy of Remaking the City lies in (1) relationships that have already outlived the projects and artefacts as friendship and mentorship, and (2) the good will created on both sides of the university-community divide. The issue of sustainability though leads us to ask: what is next? Robertson and Wagner draw our attention to the ethics of envisioning the future in participatory design, recommending that “increased attention be paid to the ways that design is completed as a way to contribute to resolving ethical issues/conflicts that arise in use” [60]. But

we also share Akama’s emphasis on the design of relations, which is “intangible, on-going and never completed, spreading through encounter and exchange” [39], which, as shown in this paper, takes significant time and effort on both sides.

9 CONCLUSION

In this paper, we discuss how we introduced care and care time within a futurity-driven graduate technology program through service learning pedagogy. We showed how the course became an “initiation ritual” between a brand-new campus and its skeptical community. Through the deliberate incorporation of ambiguity in the course, what started as an endeavor to engage students in responsible citizenship and help local civic organizations improve their technology infrastructure, culminated with building relationships, transforming roles, and all of the involved parties expressing acts of care towards each other. The course created a structured entry point, a purpose, a timeslot on busy calendars, and a context for “strangers” with shyness and other social limitations to enact care with new people who may become their friends, neighbors, and future design targets. Finally, starting with Puig de la Bellaca’s invitation to consider care in more-than-human relations, we showed how this can be operationalized in a more-than-university context. We invite the community to consider what would be the care vessel and time constructs for other contexts because “to care about something, or for somebody, is inevitably to create relation” [55].

ACKNOWLEDGMENTS

The authors would like to thank Jane Swanson for her endless support, enthusiasm, and help in planning, running, and finding partners for the course. We thank our research assistant Arunima Grover for her indispensable help with data processing and analysis, professors Solon Barocas and Malte Ziewitz for their valuable suggestions, as well as all the course partners, students, and guest speakers. This work is based in part upon projects supported by the National Science Foundation under Grant Number IIS-1319849. We also acknowledge the support of a Sloan Foundation fellowship, a Kaplan Fellowship, and Engaged Cornell.

REFERENCES

- [1] Joseph Brian Adams and Erica Runkles. 2004. “May We Have Class Outside?”: Implementing Service Learning in a CS1 Curriculum. *Journal of Computing Sciences in Colleges* 19, 5: 25–34.
- [2] Vincanne Adams, Michelle Murphy, and Adele E Clarke. 2009. Anticipation: Technoscience, Life, Affect, Temporality. *Subjectivity* 28, 1: 246–265.

- [3] Shana Agid. 2016. "...it's your project, but it's not necessarily your work...". Infrastructuring, Situatedness, and Designing Relational Practice. In *Proceedings of the 14th Participatory Design Conference* (PDC'16), 81–90.
- [4] Yoko Akama, Sarah Pink, and Annie Fergusson. 2015. Design + Ethnography + Futures: Surrendering in Uncertainty. In *Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems* (CHI EA '15), 531–542.
- [5] Mike Ananny and Kate Crawford. 2018. Seeing without Knowing: Limitations of the Transparency Ideal and its Application to Algorithmic Accountability. *New Media & Society* 20, 3: 973–989.
- [6] Alexander W Astin, Lori J Vogelgesang, Elaine K Ikeda, and Jennifer A Yee. 2000. *How Service Learning Affects Students*. Higher Education Research Institute, University of California, Los Angeles.
- [7] Melissa Atkinson-Graham, Martha Kenney, Kelly Ladd, Cameron Michael Murray, and Emily Astra-Jean Simmonds. 2015. Care in Context: Becoming an STS Researcher. *Social Studies of Science* 45, 5: 738–748.
- [8] Erling Björgvinsson, Pelle Ehn, and Per-Anders Hillgren. 2010. Participatory Design and "Democratizing Innovation." In *Proceedings of the 11th Biennial Participatory Design Conference* (PDC '10), 41–50.
- [9] Susanne Bødker and Morten Kyng. 2018. Participatory Design That Matters—Facing the Big Issues. *ACM Trans. Comput.-Hum. Interact.* 25, 1: 4:1–4:31.
- [10] Marilynne Boyle-Baise. 2002. *Multicultural Service Learning: Educating Teachers in Diverse Communities*. Teachers College Press, New York.
- [11] David J Burns. 2011. Motivations to Volunteer and Benefits from Service Learning: An Exploration of Marketing Students. *Journal for Advancement of Marketing Education* 18, Summer 2011: 10–23.
- [12] Jenna Burrell. 2016. How the Machine "Thinks": Understanding Opacity in Machine Learning Algorithms. *Big Data & Society* 3, 1: 1–12.
- [13] Tim Chatterton and Georgia Newmarch. 2017. The Future is Already Here: It's Just Not Very Evenly Distributed. *Interactions* 24, 2: 42–45.
- [14] Susan Benigni Cipolle. 2010. *Service-Learning and Social Justice: Engaging Students in Social Change*. Rowman & Littlefield Publishers, Lanham, MD.
- [15] Randy W Connolly. 2012. Is There Service in Computing Service Learning? In *Proceedings of the 43rd ACM Technical Symposium on Computer Science Education* (SIGCSE '12), 337–342.
- [16] Cynthia Gordon da Cruz. 2017. Are We Really Helping Communities? A Teaching Case to Challenge Dominant Narratives about Sources of Inequity. *Journal of Community Engagement and Scholarship* 10, 1: 100–108.
- [17] Christopher A Le Dantec and Carl DiSalvo. 2013. Infrastructuring and the Formation of Publics in Participatory Design. *Social Studies of Science* 43, 2: 241–264.
- [18] Carl DiSalvo, Andrew Clement, and Volkmar Pipek. 2012. Communities: Participatory Design for, with and by Communities. In *Routledge International Handbook of Participatory Design*, Jesper Simonsen and Toni Robertson (eds.). Taylor & Francis Group, London, 182–209.
- [19] Pelle Ehn. 2017. Learning in Participatory Design as I Found It (1970–2015). In *Participatory Design for Learning: Perspectives from Practice and Research* (1st edition), Betsy DiSalvo, Jason Yip, Elizabeth Bonsignore and Carl DiSalvo (eds.). Routledge, New York, 7–21.
- [20] Madeleine Elish. 2016. Moral Crumple Zones: Cautionary Tales in Human-Robot Interaction. In *Proceedings of We Robot 2016*.
- [21] Virginia Eubanks. 2018. *Automating Inequality: How High-Tech Tools Profile, Police, and Punish the Poor*. St. Martin's Press, New York, NY.
- [22] Janet Eyler and Dwight Giles. 2002. Beyond Surveys: Using the Problem Solving Interview to Assess the Impact of Service-Learning on Understanding and Critical Thinking. In *Service-Learning: The Essence of the Pedagogy*, Andrew Furco and Shelley H. Billig (eds.). Information Age Publishing, Greenwich, 147–159.
- [23] Constance Flanagan and Peter Levine. 2010. Civic Engagement and the Transition to Adulthood. *The Future of Children* 20, 1: 159–179.
- [24] Masanobu Fukuoka. 1978. *The One-Straw Revolution: An Introduction to Natural Farming*. Rodale Press, Emmaus.
- [25] Andrew Furco. 1996. Is Service-Learning Really Better Than Community Service? In *Service Learning: The Essence of the Pedagogy*, Andrew Furco and Shelley H. Billigs (eds.). Information Age Pub, Greenwich, CT, 23–50.
- [26] Karl-Heinz Gerholz, Verena Liszt, and Katrin B Klingsieck. 2018. Effects of Learning Design Patterns in Service Learning Courses. *Active Learning in Higher Education* 19, 1: 47–59.
- [27] Michele A Govekar and Meenakshi Rishi. 2007. Service Learning: Bringing Real-World Education Into the B-School Classroom. *Journal of Education for Business* 83, 1: 3–10.
- [28] Charles Hannon. 2006. Service Learning in Information Technology Leadership: A Natural Connection. *Peer Review* 8, 4: 16–19.
- [29] Andrew Hatala, Lisa Erickson, Osemis Isbister-Bear, Stryker Calvez, Kelley Naytowhow, Tamara Pearl, Omeasoo Wahpasuw, Rachel Engler-Stringer, and Pamela Downe. 2017. The Interpersonal Skills of Community-Engaged Scholarship: Insights from Collaborators Working at the University of Saskatchewan's Community Engagement Office. *Journal of Community Engagement and Scholarship* 10: 44–58.
- [30] Elisabeth Hayes and Sondra Cuban. 1997. Border Pedagogy: A Critical Framework for Service-Learning. *Michigan Journal of Community Service Learning* 4, 1: 72–80.
- [31] Elaine R Ingham and Matthew D Slaughter. 2014. The Soil Foodweb – Soil and Composts as Living Ecosystems. In *Proceedings of the International Conference Soil and Compost Eco-Biology*, 127–139.
- [32] M M Irfan and P Sammaiah. 2017. Service Learning Course in the Engineering Curriculum: EPICS. *Journal of Engineering Education Transformations*, Special Issue.
- [33] Steven J Jackson. 2014. Rethinking Repair. In *Media Technologies*, Tarleton Gillespie, Pablo J Boczkowski and Kirsten A Foot (eds.). The MIT Press, 221–240.
- [34] Helena Karasti. 2014. Infrastructuring in Participatory Design. In *Proceedings of the 13th Participatory Design Conference: Research Papers - Volume 1* (PDC '14), 141–150.
- [35] Helena Karasti and Karen S Baker. Community Design: Growing One's Own Information Infrastructure. In *Proceedings of the 2008 Tenth Anniversary Conference on Participatory Design* (PDC '08): 217–220.
- [36] Naveena Karusala, Aditya Vishwanath, Arkadeep Kumar, Aman Mangal, and Neha Kumar. 2017. Care as a Resource in Underserved Learning Environments. *Proc. ACM Hum.-Comput. Interact.* 1, CSCW: 104:1–104:22.
- [37] Christopher A Le Dantec and Sarah Fox. 2015. Strangers at the Gate: Gaining Access, Building Rapport, and Co-Constructing Community-Based Research. In *Proceedings of the 18th ACM Conference on Computer Supported Cooperative Work & Social Computing* (CSCW '15), 1348–1358.
- [38] Karen E C Levy. 2015. The Contexts of Control: Information, Power, and Truck-Driving Work. *The Information Society* 31, 2: 160–174.
- [39] Ann Light and Yoko Akama. 2014. Structuring Future Social Relations: The Politics of Care in Participatory Practice. In *Proceedings of the 13th Participatory Design Conference: Research Papers - Volume 1* (PDC '14), 151–160.
- [40] Panagiotis K Linos. 2012. Ten Years of EPICS at Butler University: Experiences from Crafting a Service-Learning Program for Computer Science and Software Engineering. In *Service-Learning in the Computer and Information Sciences*, Brian A. Nejme (ed.). Wiley-IEEE Press, 39–75.
- [41] Aryn Martin, Natasha Myers, and Ana Viseu. 2015. The Politics of Care in Technoscience. *Social Studies of Science* 45, 5: 625–641.
- [42] Jed Metzger. 2012. Teaching Civic Engagement: Evaluating an Integrative Service-Learning Program. *Gateways: International Journal of Community Research and Engagement* 5: 98–114.
- [43] Tania D Mitchell. 2008. Traditional vs. Critical Service-Learning: Engaging the Literature to Differentiate Two Models. *Michigan Journal of Community Service Learning* 14, 2: 50–65.

- [44] Tania D Mitchell. 2015. Using a Critical Service-Learning Approach to Facilitate Civic Identity Development. *Theory into Practice* 54, 1: 20–28.
- [45] Barbara E. Moely and Vincent Ilustre. 2014. The Impact of Service-Learning Course Characteristics on University Students' Learning Outcomes. *Michigan Journal of Community Service Learning* 21, 1: 5–16.
- [46] Annemarie Mol, Ingunn Moser, and Jeannette Pols (eds.). 2010. *Care in Practice: On Tinkering in Clinics, Homes and Farms*. Transcript-Verlag, Bielefeld, Germany.
- [47] Bill Mollison. 1992. *Permaculture: A Designers' Manual*. Tagari Publications, Tyalgum, N.S.W., Australia.
- [48] Michelle Murphy. 2015. Unsettling Care: Troubling Transnational Itineraries of Care in Feminist Health Practices. *Social Studies of Science* 45, 5: 717–737.
- [49] Rodica Neamtu. 2012. The Classroom as an Extension of Our Society: Empowering Students through Technology in Service Learning to Bridge the Global Digital Divide. *Procedia - Social and Behavioral Sciences* 106: 2636–2644.
- [50] Brian A Nejmeh. 2012. Preface. In *Service-Learning in Computer and Information Sciences: Practical Applications in Engineering Education*, Brian A. Nejmeh (ed.). Wiley-Blackwell, Hoboken, NJ.
- [51] Safiya Umoja Noble. 2018. *Algorithms of Oppression: How Search Engines Reinforce Racism*. NYU Press, New York.
- [52] William Oakes and J Spencer. 2005. EPICS: Engineering Projects in Community Service. *34th Annual Frontiers in Education, 2004. FIE 2004*, 21, 1: 139–150.
- [53] Anna Pichelstorfer. 2012. Thematic Review of Annemarie Mol's The Logic of Care and Care in Practice. *Culture Unbound* 4, 2012: 533–535.
- [54] Maria Puig de la Bellacasa. 2011. Matters of Care in Technoscience: Assembling Neglected Things. *Social Studies of Science* 41, 1: 85–106.
- [55] Maria Puig de la Bellacasa. 2012. 'Nothing Comes Without Its World': Thinking with Care. *The Sociological Review* 60, 2: 197–216.
- [56] Maria Puig de la Bellacasa. 2015. Making Time for Soil: Technoscientific Futurity and the Pace of Care. *Social Studies of Science* 45, 5: 691–716.
- [57] Maria Puig de la Bellacasa. 2017. *Matters of Care: Speculative Ethics in More than Human Worlds*. University of Minnesota Press, Minneapolis.
- [58] Dan Richard, Cheryl Keen, Julie A Hatcher, and Heather A Pease. 2016. Pathways to Adult Civic Engagement: Benefits of Reflection and Dialogue across Difference in Higher Education Service-Learning Programs. *Michigan Journal of Community Service Learning* 23, 1: 60–74.
- [59] Janet C Richards. 2017. Transformations in Graduate Education Majors' Relational Care in a Service-Learning Writing Course. *Reading Improvement* 54.3: 112.
- [60] Toni Robertson and Ina Wagner. 2012. Ethics: Engagement, Representation and Politics-in-Action. In *Routledge Handbook of Participatory Design*, Jesper Simonsen and Toni Robertson (eds.). Taylor and Francis, Hoboken, 64–87.
- [61] Tony Robinson. 2000. Service Learning as Justice Advocacy: Can Political Scientists Do Politics? *PS: Political Science and Politics* 33, 3: 605–612.
- [62] Jennifer A Rode. 2011. Reflexivity in Digital Anthropology. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (CHI '11), 123–132.
- [63] Christian Sandvig, Kevin Hamilton, Karrie Karahalios, and Cedric Langbort. 2014. Auditing Algorithms: Research Methods for Detecting Discrimination on Internet Platforms. *The 64th Annual Meeting of the International Communication Association. Data and Discrimination: Converting Critical Concerns into Productive Inquiry*: 1–23.
- [64] Andrew D Selbst and Solon Barocas. 2018. The Intuitive Appeal of Explainable Machines. *Fordham Law Review* 87, 3: 1085–1139.
- [65] Susan Leigh Star and Karen Ruhleder. 1996. Steps Toward an Ecology of Infrastructure: Design and Access for Large Information Spaces. *Information Systems Research* 7, 1: 111–134.
- [66] Isabelle Stengers. 2012. Reclaiming Animism. *e-flux* 36, July 2012.
- [67] Austin L Toombs, Shaowen Bardzell, and Jeffrey Bardzell. 2015. The Proper Care and Feeding of Hackerspaces: Care Ethics and Cultures of Making. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems* (CHI '15), 629–638.
- [68] David Vader. 2012. The Collaborator. In *Service-Learning in the Computer and Information Sciences: Practical Applications in Engineering Education*, Brian A. Nejmeh (ed.). Wiley-IEEE Press, 77–116.
- [69] Marie Watkins and Linda Braun. 2005. *Service-Learning from Classroom to Community to Career*. JIST Publishing, Inc, Indianapolis, USA.
- [70] Guy Watson and Jane Baxter. 2008. *Riverford Farm Recipe Book*. Fourth Estate, London.
- [71] Marisol Wong-Villacres, Cristina M Velasquez, and Neha Kumar. 2017. Social Media for Earthquake Response: Unpacking Its Limitations with Care. *Proc. ACM Hum.-Comput. Interact.* 1, CSCW: 112:1–112:22.
- [72] Ellen Zegura, Carl DiSalvo, and Amanda Meng. 2018. Care and the Practice of Data Science for Social Good. In *Proceedings of the 1st ACM SIGCAS Conference on Computing and Sustainable Societies* (COMPASS '18), Article 34 (June 2018), 9 pages.