Becoming Interdisciplinary: Fostering Critical Engagement with Disaster Data

ROBERT SODEN, University of Toronto, Canada
DAVID LALLEMANT, Nanyang Technological University, Singapore
PERRINE HAMEL, Nanyang Technological University, Singapore
KAREN BARNS, Arup, USA

ICTs such as mapping platforms, algorithms, and databases are a central component of how society responds to the threats posed by disasters. However, these systems have come under increasing criticism in recent years for prioritizing technical disciplines over insights from the humanities and social science and failing to adequately incorporate the perspectives of at-risk or affected communities. This paper describes a unique month-long workshop that convened interdisciplinary experts to collaborate on projects related to flood data. In addition to findings about the practical accomplishment of interdisciplinary collaboration, we offer three interrelated contributions. First, we position interdisciplinarity as a critical practice and offer a detailed example of how we staged this process. We then discuss the benefits to interdisciplinarity of expanding the range of temporal logics normally deployed in design workshops. Finally, we reflect on approaches to evaluating the event's contributions toward sustained critique and reform of expert practice.

CCS Concepts: **Human-centered computing**~Collaborative and social computing theory, concepts and paradigms

KEYWORDS

Crisis Informatics, Interdisciplinarity, Participatory Design, Workshops, Critical Technical Practice

ACM Reference format:

Robert Soden, David Lallemant, Perrine Hamel, Karen Barns. 2021. Becoming Interdisciplinary: Fostering Critical Engagement with Disaster Data. In *Proceedings of the ACM on Human-Computer Interaction,* Vol. 5, CSCW1, Article 168 (April 2021), 27 pages, https://doi.org/10.1145/3449242

1 INTRODUCTION

Disasters affect millions of people every year, leading to loss of livelihood, forced migration, injury and death. As a result of climate change, unsafe building practices, and economic and social vulnerabilities, the impacts of disaster are increasing. At present, flooding is the most common, and rapidly increasing form of disaster [31]. To understand flood risk and impacts, experts from a number of scientific and engineering disciplines produce information products such as risk models, hazard maps, or post-disaster damage assessments. As a result of their expertise, professionals in this field are entrusted with safety-critical tasks such as planning flood defenses, designing construction regulations, and leading emergency response.

However, the field has come under increasing criticism in recent years for valuing engineering, natural science, and other "technical" fields over humanities and social science [62][98], failing to adequately incorporate the perspectives of at-risk or affected communities [58][106], and reinforcing unequal power relations between people or countries [20][86]. As with a number of other fields that engage with pressing social problems, such as healthcare and criminal justice, urgent questions are now being raised about the technologies that shape our understanding of these issues and inform how we respond to them [8][12][16].

This research, in the tradition of computer-supported cooperative work (CSCW), engages with concerns over the social consequences of computing technologies through attention to the work practices, knowledge, and beliefs of the experts who create and maintain them. Human societies have struggled to prepare for and cope with the effects of flooding for millennia. In contrast, computational approaches to assessing disaster risks and impacts have developed comparatively recently. These new approaches provide powerful new understanding but also contribute to increased specialization in the field and privilege some perspectives over others [92]. Indeed, one of the challenges that experts face when producing flood information, in addition to attempting to ensure fairness and inclusivity, is the many different kinds of knowledge are needed to understand the wide range of impacts that floods have on our communities. As a means of supporting sustained interdisciplinary collaboration capable of developing thoughtful critiques of the tools and data we use to understanding flooding, we organized an extended workshop, called the "Urban Flooding Field Lab", in Chiang Mai Thailand.

The Urban Flooding Field Lab took place over four weeks in June 2019. During this time over 150 artists, scientists, engineers, designers, software developers, cartographers, non-profit staff, university researchers, government officials, and citizens gathered in Chiang Mai, Thailand to work together on projects related to urban flooding. Inspired by feminist science studies, critical making practices, and participatory design, this "unconference", or open-space event, was designed to explore and expand the range of approaches involved in the knowledge politics surrounding urban flooding. The event's schedule and organization were emergent and driven by attendees, with only three simple rules for participation. 1) Make something; 2) Document it; 3) Contribute to the community. Attendees from more than 20 different countries participated. Many spent the full month, while others came for just a few days or a week. Together over this period, they produced a body of work that included gallery-quality art, machine learning algorithms, aerial imagery, policy notes, maps created in collaboration with residents of the city, high tech ways of communicating flood risk, and experimental writing forms.

The Field Lab itself was an experiment. The organizers, a small team of designers, technologists, and disaster researchers, aimed to facilitate the development of responsible and socially engaged collaboration between flood experts from diverse fields and backgrounds. If, as critics have alleged, disaster management as a field is overly focused on technical solutions and not engaged enough with local communities [20][21], how could the Field Lab help develop the relationships, tools, or approaches that could help mitigate these problems? Building upon prior experience with participatory design workshops, hackathons, and similar activities, we attempted to create an event that blurred the boundaries between participant and organizer, gave attendees ownership over the schedule, the opportunity to collaborate with experts from outside their discipline, and enough time to develop meaningful collaborations around complex challenges related to flood information. In doing so, we sought to learn what an extended

interdisciplinary workshop in which participants controlled the schedule could teach designers and researchers about the facilitation of interdisciplinary collaboration.

For the organizers of the Field Lab, the promise of interdisciplinarity was sustained and meaningful dialogue across epistemic boundaries through which vital critique about the data we use to make sense of disaster could be raised, and alternatives could be explored. Drawing primarily on interview and survey data from participants in the Field Lab, this paper makes several theoretical and methodological contributions [107] to crisis informatics and CSCW more broadly. First, we demonstrate that interdisciplinary collaboration, when staged carefully, holds significant potential to support critical evaluation and improvement of the computing technologies we use to understand disasters and other complex social challenges. Second, we argue that temporality, as much as any other element of a workshop or other design event, structures participants' experience of the activities and that this experiment demonstrates the opportunity to think much more expansively about the range of design choices available to us in this regard. Finally, in response to concerns raised about the longevity of impacts of design workshops, we consider approaches for assessing the lasting effects of these events toward sustained social change. In addition to the detailed description of a unique event, this paper contributes to ongoing CSCW concerns related to the role of design workshops in research and the social consequences of how experts create, analyze, and use data.

2 RELATED WORK

2.1 Questioning Disaster Data

Flooding is a growing challenge that affects cities and communities all over the world. Despite the common practice of referring to flood events as "natural disasters", researchers have long argued that, in fact, "there is no such thing as a natural disaster"[9]. Instead, the increased risk of flooding is seen as the result of complex interactions between environmental phenomena, like storms or coastal tides, and socially-produced vulnerability to such phenomena, such as poor land use practices, inappropriate construction techniques, or inadequate emergency preparedness[9]. This is, to some extent, a hopeful framing of the problem. Instead of disasters being thought of as "acts of god", or otherwise outside of society's ability to control, this view of flooding reasserts societal agency, and responsibility, for these events [92]. It also positions flooding as being part of much longer processes of human history, culture [78], and politics that lead to vulnerability, or shape recovery in the aftermath. This is in contrast to the sensational focus on discrete moments of crisis that characterizes popular and media narratives of disaster [64].

Technical experts that assess the potential impacts of floods on cities and communities, design mitigation schemes, or lead response and recovery efforts in the aftermath of disasters increasingly depend on information technologies in order to conduct their work. For instance, digital sensors are used to collect environmental data to then build statistical models of the frequency and magnitude relationship of hydrometeorological events. These become input into flood inundation models, complex computer software that also rely on such data as digital elevation models, satellite or drone photography, and land-use maps [90]. "Flood risk" can then be computed with probabilistic analysis software by combining inundation simulations with data on exposure and vulnerability, and then visualized on GIS platforms or incorporated into insurance products, flood risk mitigation strategies, or emergency response planning.

Though these tools contribute important understanding about disaster, they also face criticism for how their design and implementation shapes knowledge about disaster risk, in whose interest, and with what effect [92]. Crisis informatics is a multidisciplinary field within HCI focused on the role of emerging ICTs in crisis response and management [71][79], has recently begun to explore these questions. A study of disaster damage data following Hurricane Sandy, for example, has argued that official disaster statistics represent government priorities in emergency response, often missing out on important ways in which communities and vulnerable people are impacted [52]. These "silences" in turn impact who receives aid in the wake of a disaster, and whose priorities are centered in the design of recovery efforts [91]. Outside of crisis informatics, other studies have pointed out a gulf in understanding between scientific and public conceptions of disaster risk information, leading to the improper design of, or difficulties in implementing, disaster safety programs [105][108]. More radical critiques have argued for a code of ethics for disaster researchers [21] and the decolonization of disaster studies [20],

One of the many challenges to just and effective flood management is that the complexity of social and environmental phenomena that influence flooding requires a diverse set of knowledge and experiences to understand. For example, the floodplain maps that shape much of public policy around urban planning and preparedness are created through collaboration between experts with backgrounds in hydrology, engineering, and cartography [90]. In addition, unpacking the complex, locally specific, relations between human settlements and the environment may require the involvement of anthropologists and geographers [68]. Disaster sociologists have provided crucial insight into the ways that vulnerability to flooding is unequally distributed across race, class, and gender [98]. Other work has highlighted the role of art in communicating disaster science to diverse audiences [42], challenging dominant framings [72], or aiding psycho-social recovery in the aftermath of crises [76]. Participatory methods have been used to involve affected populations in flood mitigation or recovery processes [105]. The research described in this paper investigated one approach for bringing these disciplines together, reducing the hierarchies between them, and supporting deep engagement and sustained collaboration across the diverse community of practice engaged with questions of urban flooding.

2.2 Designing Interdisciplinary Encounters

In creating and facilitating the Field Lab, our goals were to facilitate new connections, create opportunities for mutual learning, bring new viewpoints and forms of knowledge into the community, and support long-term collaboration. In doing so, we sought to design an event that increased the capacity, or to use Haraway's term, the "response-ability" [25] of its participants, to grapple with the difficult challenges at the intersection of science, information technologies, and society's relationship with disasters. In the fields of climate and disaster risk management, interdisciplinary research and practice is frequently positioned as a solution to the many "wicked problems" that arise from the many uncertainties that characterize complex social-environmental systems [30][66][83]. Here, interdisciplinary practice offers to bring greater understanding of the social aspects of these issues to domains that are largely shaped by technical perspectives. Interdisciplinary approaches are also seen as necessary due to the many different kinds of research relevant to issues of climate change and disaster noted above. Yet in many cases, it has remained a buzzword, and accomplishing the meaningful, sustained interdisciplinary collaborations necessary to achieve this promise has proved difficult [4][45]. In

addition, the success of interdisciplinary collaboration is often hard to evaluate [4], and the practical, day-to-day work of enacting it has often been given less attention than the potential benefits or outcomes of specific projects [101][102].

One challenge to effective research into interdisciplinary work is the wide range of activities that are given the label. Interdisciplinary work has been, as in the case of environmental issues, problem driven. At other times, as with the women's movement and efforts at racial justice, interdisciplinarity aimed at fomenting societal change [45]. In addition, scholars have distinguished between instrumental, or problem-solving, aims of interdisciplinary work and more critical efforts aimed at rethinking the ways in which problems are framed [45]. A third possibility is what Barry and Born term as the "inventive" potential of interdisciplinary collaboration, where the creation of new questions and relationships across disciplines are seen to open up radically new terrains of discovery and action [4]. Finally, the "inter" in interdisciplinary is most often used to indicate significant engagement between disciplines, whereas multi-disciplinary approaches are characterized by a juxtaposition of multiple perspectives emphasizing breadth and diversity [45]. In practice however, these distinctions are often blurred.

CSCW, itself an interdisciplinary field, has yielded important knowledge of how interdisciplinary cooperation is accomplished and structured. Star and Griesmer's development of the concept of boundary objects [93], for example helps to explain one mechanism by which coordinated scientific work can be achieved across the ontological and epistemological boundaries of the social worlds of different research traditions and explored in numerous studies of interdisciplinarity [22][73][89]. Other research has highlighted the importance of repeated or sustained collaboration between participants [13], the opportunity for informal interaction [27][65], and the development of trust and intersubjectivity to successful interdisciplinary work [102]. Recently, CSCW researchers have also put forth interdisciplinarity as an approach toward informed and ethical application of data science [3][46]. We built upon these findings when designing and facilitating the Field Lab.

2.3 Workshops and Events in CSCW and Participatory Design

Workshops and similar events are central elements in the toolbox of CSCW and participatory design research. Despite this, many of the practical elements of their design and facilitation have gone under-studied in CSCW [53][82]. In this research, we drew inspiration from work in feminist and participatory design [19][29][82] to create a participant-led workshop for flooding experts. In a recent paper, Rosner et al. frames workshops "as interventionist projects that shift relations, resources, materials" [82]. Importantly, this places workshops not only as sites of enquiry but as an opportunity to participate tactically in the ongoing reconfiguration of social life, knowledge, and expertise. Fox et al. write about workshops as infrastructural inversions, or as material-semiotic breaching experiments, that can unsettle dominant modes of understanding social and political issues [19]. Peer and DiSalvo show that workshops can act as boundary objects, thus making important contributions to collaboration across disciplines and other social worlds [73]. Other research has raised the importance of workshops in providing opportunities for personal growth [2] or to broaden professional networks [36]. Hope et al. also take a wide vision of the kinds of impacts that these events can accomplish, including influencing public policy and building community [29].

Designers and facilitators of workshops, conferences, or hackathons, are, through the choices they make in preparation for and during such events, setting the scene for participants [33].

Participation is always constrained; by necessity there are logistical, material, structural factors that limit and shape events such as these and the nature of participation that they support [28]. It is through recognition of, and artful engagement with, such constraints that participatory designers construct their practice [53][54]. In this study, we made numerous design decisions in the planning and facilitation of the event. In particular, we chose to experiment with the extended duration of the workshop and the radically open agenda because we felt they were likely to support the overall goals of the event, but also as a means to understand more about how these particular constraints influenced the participants' experience and the kinds of outcomes the Field Lab was designed to achieve.

3. RESEARCH SITE & METHODS

3.1 Setting and Organization

Chiang Mai is a medium-sized city in northern Thailand. It was recently designated one of Thailand's "Smart Cities" and has a robust internet and energy infrastructure and an active local arts and music scene. The city has a rich cultural history due to its location at the center of historical trade routes and the presence of a number of indigenous communities and ethnic groups. In addition to these factors, Chiang Mai was chosen as a host city for the Field Lab for several reasons. First, it regularly experiences small flood events during rainy season and has a history of more extreme floods. For example, during the 2011 floods that affected much of Thailand, the Ping River overflowed and inundated much of the city. Second, many Asian cities are projected to suffer increased flood risk as a result of climate change and rapid urban growth and there is significant work in many parts of the region underway to prepare. Third, several members of the organizing team had previously lived in Chiang Mai and as a result had relevant connections to local institutions and organizations who could be engaged in the the event.

The authors and event organizers are part of a small worker-owned cooperative run by technical experts in disaster risk management and response. Collectively, we have professional and academic backgrounds in design, technology, engineering, and natural science and have collaborated on several projects over the past few years that seek to critically evaluate the role that technical experts can play in helping to address the threats posed by disasters and climate change [87]. The Field Lab was part of our ongoing efforts to bring participatory and critical design approaches into wider use in these domains. Organizing assistance was also provided by the World Bank's Global Facility for Disaster Reduction and Recovery (GFDRR) and staff and students from the Earth Observatory of Singapore. Funding for the event came from the World Bank, the Understanding Risk Community, Facebook, and the Earth Observatory of Singapore. Other collaborators included Nanyang Technological University in Singapore (NTU), the Humanitarian OpenStreetMap Team (HOT), Arup, and the Natural Capital Project of Stanford University. Local organizers and partners included the Chiang Mai University School of Public Policy and Department of Computer Science, the Foundation for Older People's Development (FOPDEV), and the Weave Artisan Society.

3.2 Research Methods & Author Positionality

The authors utilized a number of different research instruments to solicit feedback and insights directly from the participants. First, we analyzed the application materials for each of the participants to assess their backgrounds and motivations for attending the event. In addition, participants that attended for the full month were asked to complete a survey at the

end of the first week, describing their personal goals for the month and the projects they wanted to contribute to during their time at the Field Lab. All participants were also asked to complete an exit survey at the end of their participation, describing their experiences, what they learned through their participation, plans for future collaboration with other attendees, and feedback on the design of the event. All surveys were hosted using Google Forms and shared via email and the event Slack group. In total, we received 143 responses from participants to the surveys. More detail on the surveys is contained in the Supplementary Materials.

In addition, the lead author conducted 16 semi-structured interviews with participants of the event in July and August of 2019 in order to go into greater detail on their experience of the event. Interviews generally lasted between 45 minutes and one hour and covered topics such as challenges they faced, the extent to which the activities changed their perspective on flooding, their favorite parts of the event, and aspects that they would change about future Field Labs. Interviewees were chosen to reflect the diversity of event participants' backgrounds, duration of attendance, and project participation. Thus interview participants were from 13 different countries of residence and evenly split between those who attended for 1-2 weeks versus 3-4 weeks. 6 interviewees identified as flood risk modelers with backgrounds in engineering. The remainder were from diverse fields including cartography, public policy, urban planning, economics, and art.

Data collected from participants was supplemented with ethnographic field notes taken by the lead author. It was analyzed according to our research interests related to the structure of the event and issues and challenges related to interdisciplinarity. Following an exploratory round of data analysis through open coding, the lead author re-organized the initial codes, re-analyzed the data, and drafted four thematic memos. Following the initial draft, they were then discussed amongst the authors and collaboratively revised. The revised memos formed the basis of Section 5, which conveys our primary findings in regards to how the structure of the Field Lab supported the practical accomplishment of interdisciplinary collaboration amongst its participants. The organizers and authors both helped design and facilitate the Field Lab, but also took part in and learned a great deal from the event. Through our experiences we developed new friendships and collaborations that we hope will continue into the future. We have thus been interested participants, rather than neutral observers of the activities we report on in this paper.

4 EVENT DESIGN

4.1 Event Structure

To support the participatory goals of the event, the Field Lab followed an unconference, or open space [70], format. In traditional workshops or conferences, the agenda is determined in advance by the organizers. While registration is often open or at a fee, the speakers are invited, or chosen through evaluation of submitted papers, proposals, or abstracts, and there is some expectation that presentations will be completed, or at least well-formulated, work. In open space events, the participants create the event as they go along, reserving spaces as they are available to discuss or collaborate on whatever topics they wish. Attendees are encouraged to create their own sessions and organize them however they choose. The organizing team had attended day or weekend-long unconference events related to discussion of political action and technology topics in the past. The Field Lab differed in that it lasted for four weeks and attendees were encouraged to collaboratively create things including datasets, software, design

proposals, pieces of art, and other artifacts. One participant described the event as feeling more like an "ultra-hackathon" than a workshop, referring to its extended making and doing character.

To give the event structure and help attendees who couldn't join for the full month determine which portions of the event to join, organizers announced nine working groups in advance and assigned 2-3 groups to each week of the month. The themes were chosen by the organizers in consultation with event partners, to reflect emergent areas of interest, and to represent a broad swath of expert disciplines in flood management practice. They included mapping, partnering with vulnerable communities, machine learning and artificial intelligence, nature-based solutions, risk communication, art & science collaboration, smart sensors and IoT, and user-centered design. Participants were free to join in any of the working groups or propose their own projects and themes. While a full accounting of all of the many activities and events that occurred during the Field Lab is beyond scope of this paper, we provide an overview in Table 1 of some of the main projects of each of the working groups.

Table 1. Working Group Activities

Theme	Activities
Art & Science	This working group convened twelve artists, designers, and scientists to develop art that explored the many ways in which life in Chiang Mai is shaped by its relationship to water. Participants worked individually or in small groups for a week on projects that ranged from interactive installations or experiential pieces to highly technical data-art exhibits. The works were shown, along with other outputs of the event in an "Art & Science Fair" at a local art gallery for a month after the Field Lab.
Artificial Intelligence	This group sought to develop applications such as models for rapidly estimating flood extents or damages using satellite imagery, models for prediction of future land-use and settlement patterns in Chiang Mai. They also provided several introductory information sessions and trainings for practitioners with less background in either machine learning or flood science. One session that brought together a range of attendees focused on questions of ethics and bias in flood data.
Social Vulnerability	The Social Vulnerability working group focused on the political, cultural, and economic factors that shape flood impact and recovery. This group partnered with a local foundation to develop a participatory flood preparedness plan for elderly people in a flood-prone neighborhood. Other projects involved working with local indigenous groups, experiments with ethnographic techniques in flood-prone neighborhoods, and the production of a documentary film describing residents' experiences during past flood events.
Nature-based solutions	This working group explored how solutions to flooding that incorporate natural processes are designed, implemented, and what they mean to different population groups. Participants collaborated on a hydrologic model for Chiang Mai's Ping River, which was used to estimate the effect of watershed restoration interventions. They also developed a series of fact sheets that explain the effect of nature-based solutions and adaptation measures in the context of Chiang Mai.

Table Continued

Table 1 Continued. Working Group Activities

Theme	Activities
Mapping	The mapping group experimented with a range of techniques and approaches to creating maps and other kinds of spatial data for Chiang Mai. Activities included flying drones, attaching a 360-degree camera to the top of a taxi to collet "street-view" style ground-level imagery, and trainings on field and remote mapping using the OpenStreetMap platform. The team also collaborated with some members of other working groups to conduct a full house-by-house survey of vulnerable buildings in a flood-prone neighborhood of Chiang Mai.
Sensors & IoT	This workshop began with presentations from faculty about flash-flood early warning systems, approaches to co-design that incorporate at-risk communities, public trust in flood forecasting, and discussion of maintenance challenges of sensing technology following their installation. Participants then developed a new prototype for a water-level sensor that included optical sensors, experimented with machine learning approaches to better predict the relationship between water-level increases upstream and flooding downstream, and tested the prototype in a flood-prone community.
Risk Communication	Over the course of the Field Lab, participants also worked to develop outputs related to communicating complex flood risk information to a range of audiences. This group worked on flood risk communication through gathering and sharing oral histories and experiments with different approaches to information visualizations. Faculty and staff a local university also led several projects focused on the design of serious games related to local environmental issues.
User-Centered Design	The user-centered design group focused primarily on teaching Field Lab attendees some of the basics of design research and user-centered design practice. Using a regional flood risk mapping website as a case study, the group conducted heuristic evaluations, competitor analysis, interviews, user testing, and think-aloud activities. Through these, the group developed recommendations for improving the usability of the site that were then shared with site's owners, who are planning to implement some of these recommendations in 2021.
Emergent Projects	In addition to projects undertaken by working groups that were created and assembled prior to the start of the Field Lab, numerous emergent projects were developed during the event itself. For example, a reading and discussion group around the theme of decolonizing disaster science met several times a week for the full month and has continued to collaborate after the end of the event. Another group developed a persona library of local stakeholders for participatory planning of nature-based solutions to flooding. Other projects included the development of a policy-brief on disaster management in Thailand, a group that met several times a week for sessions on watercolor painting, and a "documentation team" that produced a website, an illustrated zine, and other materials about the event itself.

The weekly schedule of the event was designed to support collaboration and awareness of needs and activities across project groups while retaining the flexibility and participant-driven character of open space events. On each Monday morning, following a welcome and orientation

session, representatives from each working group active during that week would give short overviews of higher-level goals for the week, describe potential or planned projects, and let other participants know how to get involved. On each Friday afternoon, at the end of the week, working groups would discuss their activities and major accomplishments of the week, and all participants were invited to give feedback on the event structure and suggestions for improvements during the following week. In between, the only other scheduled activities were 9:00am announcements every morning where any participant could request assistance with their projects or organizers could alert participants about logistics for the day.

4.2 Event Space and Group Communication Tools

The Field Lab was held at a small event center near downtown Chiang Mai (Figure 2). The space, built out of decommissioned shipping containers using sustainable construction techniques, typically hosts study abroad groups visiting Thailand or puts on small events for local organizations. The Field Lab organizers rented out one large seminar room, which comfortably held around 50 people, the largest number of attendees at any given time, and three smaller rooms. Each room was climate controlled, had wireless internet, a whiteboard, and a television screen that could be used for presentations. The venue also had multiple outdoor seating areas, a library where participants could work quietly, and a cafe next door.

The physical space, particularly in the large seminar room, was a key tool for helping participants plan and organize their activities. One wall of the room held "the board" (Figure 1), which was a schedule of the week, divided by day. Each day was divided grid-wise with each of the major rooms and working areas along one axis, and time slots along the other. Participants used sticky-notes to post session topics on the board, using placement of the note to indicate a location and time, divided in 90-minute sessions. In response to a participant suggestion, one corner of the room was used to exhibit polaroid photos of each attendee, with their names and areas of work or research. This became known as the event's "analog facebook" and helped attendees connect with each other more rapidly as new arrivals were joining every week. A resource library in another part of the room was used for participants to share books related to flood management, art, design, Thai history, and other relevant topics as well as sticky-notes, markers, scissors, tape, and other materials. An "open mic" [29] section of one wall allowed participants to post sticky notes containing calls for project assistance, field trip ideas, or post other requests and suggestions.

Participants and organizers also relied on a range of digital tools to communicate, plan social events, coordinate working groups, share documents and other resources, and document the event. Organizers set up an instance of the team coordination tool Slack several months prior to the event and added registered participants to discussion groups based on working group. Google drive was used to share other materials including photos and videos taken by participants and slide decks of the (relatively few) formal presentations that were given during the month. GeoNode, an open-source platform for managing and sharing geospatial information, was installed so participants could share the maps and spatial data they collected and used as part of their projects. Over the course of the event, participants self-organized a shared Mendeley group to gather relevant academic literature and built a website to communicate the work of the Field Lab to the global community of experts who could not attend the event.

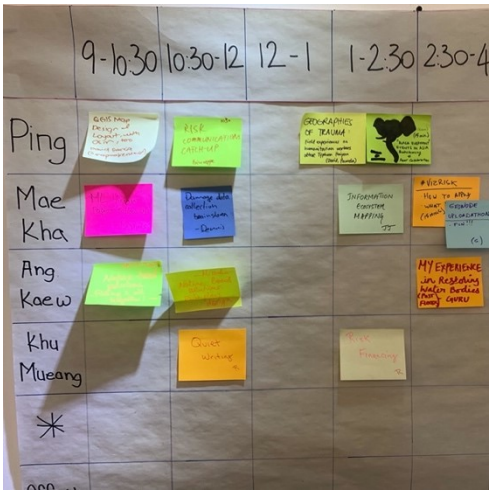

Figure 1: The board, a schedule where participants posted meetings for each day (each row represents one meeting room, named after Chiang Mai waterbodies, columns are time-slots).

Figure 2: External view of the Field Lab venue

4.3 Participants

The organizers selected participants through an application process, limiting visiting attendees (those traveling from outside Chiang Mai) to between 30 and 50 per week in order to accommodate the space constraints of the venue and a manageable group for the small organizing team. The Field Lab was advertised on email lists comprised of students and professionals working in disaster risk, design, and international development and shared on social media. To apply, individuals completed an online form, answering questions about their educational and professional background, prior experience working on flood issues in the region, interest in interdisciplinary collaboration, and personal goals for attending the event. Members of the organizing team read each application and scored them according to the strength of their responses, relevance of their background, and perceived benefits of participation toward their personal or career goals. Of the accepted participants, about half were either faculty or graduate students conducting research in relevant fields. Others worked as practitioners in the area of disasters, environment, or technology in government, non-profits, or the private sector.

Attendees came from at least 20 different countries. An important goal of the event's design was accessibility to participants of varying economic resources. This was achieved, to some extent, by selecting a location with relatively low cost of food and lodging and an international airport accessible to the rest of southeast Asia, making participation free of charge, providing travel scholarships, and creating a flexible time frame for attendance. Most visiting participants were self-funded, or received funding from their employers or universities to attend. Scholarships were provided to 19 undergraduate and graduate students and recent graduates primarily from South Asia, Southeast Asia, and Oceania to spend the entire month at the Field Lab.

Table 2. Scenes from the Urban Flooding Field Lab

Photo captions (starting top-left, proceeding clockwise): 1. Designing an interactive 3D flood risk visualization tool; 2. Lunch-time lecture on flood issues; 3. Building a flood sensor; 4. The output of a new flood inundation model for Chiang Mai; 5. Participatory mapping exercise; 6. Serious games workshop; 7. Interactive "flood table" for flood mitigation learning; 8. Capturing aerial imagery using drones.

The conference maintained an "open door policy" to residents of Chiang Mai, meaning that anyone could attend any part of the event, without prior notice or registration and numerous individuals from Chiang Mai University, local non-profit organizations, and others attended, gave presentations, and participated in project groups. Overall, just under half of the total participants were from Thailand, the majority of whom were from Chiang Mai. However, the language of the event was primarily English, and although Thai-English translators were present during events where speakers or participants requested assistance, the event had a strong international character.

A central element of the open space event format design is the blurred distinction between organizers and participants. This seeks to ensure attendee ownership and freedom to pursue interests or emergent ideas. The organizers raised the necessary funding, announced and recruited for the event, managed logistics of the space, and handled other basic tasks but once the Field Lab began, the majority of the activities were organized by participants themselves. Organizers used various tactics to facilitate this atmosphere, including the way the schedule was managed but also by announcing that all attendees were "co-organizers" and taking time during the Monday morning orientation sessions to highlight that in open-space events, all participants are potential speakers, facilitators, and experts in their own areas.

5. FACILITATING INTERDISCIPLINARY COLLABORATION

The Field Lab was designed to facilitate collaboration on practical projects amongst flood experts from many different disciplines and backgrounds. In doing so, the organizers were engaged in what Klein has described as boundary work, or engaging with the "claims, activities, and structures that define, maintain, breakdown, and reformulate boundaries between divisions of knowledge"[45]. Through our research into the event, we identified four themes related to the practical accomplishment of interdisciplinary collaboration that we use to structure our presentation of results. First, we observed that many participants were able to learn new skills and approaches from attendees from other fields, learning which served to critique and broaden their prior conceptions of flood information. Second, we found that some of the more interesting interactions across disciplines began as a result of confusion, disagreements, or other frictions that served to draw attention to issues and focused participants' time and energy on them. Third, we identified several of what we term as liminal practices, and mapping in particular, that provided the opportunity for focused, in-depth collaboration between participants of different backgrounds. Finally, our findings support prior research that emphasizes the importance of personal networking and developing social ties to successful collaboration. In what follows, we highlight evidence that attendees in the event developed new perspectives, relationships, and knowledge through their participation, but also point to some of the challenges encountered along the way.

5.1 Collaboration as Critique

Almost all attendees, through survey responses and individual interviews, reported that they learned something new about flooding from another participant. Such outcomes included expanded technical skills in areas like machine learning or GIS mapping, improved understanding of the role of social sciences and the humanities in managing disaster risk, and clarified research or professional goals. One participant joked that the event felt like a "summer camp for flood nerds", with ad hoc and impromptu lectures, classes, and other activities that

provided learning opportunities almost every day. Almost all interviewees expressed that their view on flooding had been expanded through interaction and collaboration with other participants of the Field Lab, an important indicator of interdisciplinary knowledge exchange. For example, an urban planner who attended for the full month told us:

> *There were so many different perspectives brought in to talk about the issue that it really broadened my scope… To have the people who are experts in those fields come together added a level of depth that I don't normally see in a conference setting.*

Such sentiments were common in our interviews, and for many participants, the lessons learned through practical, contextualized collaboration helped critique their own disciplinary assumptions about flooding and broaden their perspective. One interviewee, with a background in engineering, said:

> *Flooding for me was just a couple of inundation depths for a couple times of year, for a few hours and such. But I think that I've understood that it can affect people in a psychological and emotional way as well that we don't take into account in our practice.*

The hands-on orientation of the Field Lab also seemed to support knowledge exchange amongst participants from different areas of expertise. The event took inspiration from hackathon-style events that focus on the production of code or other artifacts in order to materialize particular solutions, ideas, or arguments. However, the "bias to action"[35] was less about the development of products that could be shipped or scaled, as is the case in many hackathons, and instead an exploration of the relationship between learning and practice [49], and an attempt to develop the sorts of epistemic entanglements that can lead to alternate imaginations of how flood data can be collected, managed, or used. Through practical collaboration in interdisciplinary working groups, attendees were able to experiment with new approaches, or delve more deeply into difficult questions than a typical conference where, as one interviewee noted, the majority of the content being presented or discussed has already been completed. In a survey response, another participant wrote, "I enjoyed the intersection of social science and arts, while also seeing real-time actionables (sic) from on-the-ground research and interviews."

The sensors & IoT working group split their time between the conference venue, where they built new types of flood early warning system, and a flood prone community upstream. Through pre-existing relationships with the community developed by Field Lab participants from Chiang Mai University Department of Computer Science, the working group met with local emergency responders, interviewed residents, and visited areas that were damaged in previous floods. These experiences, along with drone imagery collected on the trip, were essential to informing the design and location of the flood sensors, as well as the emergency alert communications. Yet for many participants with technical expertise in flood management or analysis, this was a rare opportunity to learn both from experts in other disciplines but also flood-affected communities themselves. One engineer, who worked primarily in developing flood risk models, reported a newfound interest in learning more about methods for effectively communicating risk to the public. They said:

> *This was a chance for me to meet people who are actually being exposed to these floods… I learned that it is not only the analysis that we do, how accurate it is, but it's, also how easily disseminated this kind of information is to the people that actually need them.*

In addition to working directly on projects together, another way in which participants reported learning from each other is through storytelling, or sharing experiences with past disasters. These "war stories", as Orr referred to the narratives that members of community trade information [69], helped to contextualize broad or abstract forms of knowledge about floods and communicate practical aspects of the work of flood risk management that aren't easily reduced to manuals or other forms of technical delimitation. As one example of this, several interviewees cited a lunchtime presentation given by several participants about how their own experiences as disaster survivors changed their practice as important for better understanding the challenges faced by the people that their work was meant to assist [60]. Another project focused on gathering oral histories of flooding and environmental change from Chiang Mai residents, and the group working on user-centered design used interviews to learn how flood modelers had used data for past projects. In each of these examples, participants relied on storytelling as a means of sharing rich, contextual understanding of the settings in which flood information is developed and used.

5.2 Differences, Disconnects, and Frictions

The interdisciplinary and international character of the Field Lab was, for many interviewees, the highlight of the event. Many participants mentioned that opportunities to collaborate with experts from other fields was rare in their professional lives, despite general recognition of the importance of this kind of work. Participants from numerous countries, cultures, and linguistic backgrounds intermingled and collaborated during their time in Chiang Mai. The ways that they negotiated these differences shaped their experience and the kind of community that emerged. Though this was in some cases challenging, attendees found opportunity to interact with people from all over the world both rare and valuable. As one participant told us during an interview:

> *It was really diverse. One time we were riding in the back of a van (on the way to a site visit) and I think there were 10 of us. We looked around, and we were all from a different country. I don't think I've ever been in a space like that.*

A wide variety of participants' backgrounds, identities, and disciplinary homes are essential to the positive outcomes of collaboration-focused events like the Field Lab. However, research in areas as diverse as social justice [18], accessibility [7], and post-colonial computing [33][34] has argued that differences across cultures and other aspects of individuals' backgrounds are not innocent [33]. Rather they can act as vectors of power, privileging some perspectives over others and, if treated as neutral or unproblematic, can serve to reinforce past inequalities [18]. While we were unable to fully flatten cultural and disciplinary hierarchies, we took care and steps to limit either re-inscribing or essentializing them [19][56][97]. Side events like field trips, lectures and trainings, and social activities did seem to help bring people together across working groups, supported relationship development, and added depth to how the event was able to engage with flood issues. Although organizers attempted to mitigate these effects in a number of ways, including by implementing a code of conduct for the Field Lab that emphasized awareness of differences and respect, they no doubt emerged in various ways over the course of the month.

In times where people of different areas of expertise did come together and work on joint projects, the ontologies and technical jargon of different fields often posed a challenge. In some

cases, however, these moments of disconnect and friction [47][99], created opportunities for shared learning. In one example, a working session of the group that sought to address questions of ethics and bias in machine learning systems used in flood risk modeling got caught up in competing understandings of the term bias. In statistics, bias is an error and the result of inappropriate measurements or model design, whereas bias in the field of critical data studies, which some participants were drawing on, is frequently conceived as a broader concept and reflects how power is imbued in data collection and usage, reinforcing existing hierarchies and structures. The resulting confusion created initial communication difficulties between the participants, but in this case ended up serving as an opportunity for the group to slow down [96][105] and allow for deeper knowledge-sharing and reflection once the cause of the difficulty was identified, and new forms of accountability across fields established *in situ*. This finding thus complements other work in HCI, STS, and related fields that suggestions that frictions, when artfully introduced or managed, may direct valuable attention or energies to important issues that would otherwise go unnoticed or ignored [5][47].

5.3 Mapping as a Liminal Practice

Through our study of the event, we identified several *liminal practices*, and mapping in particular, that emerged over the course of the month to support hands-on collaboration across different projects and disciplinary backgrounds without necessarily privileging any one perspective. Flood risk is an inherently spatial phenomenon, so the important role of spatial data in many of the working groups isn't surprising. What was striking however was the diversity of ways in which groups incorporated mapping into their activities. For example, a team working with drones collected high-resolution aerial imagery of part of the catchment area for one of the primary watersheds in Chiang Mai. Another group of participants hung a large map of Chiang Mai in one corner of the main meeting room next to a sign encouraging participants to map their own travels through the city and reflect on how they conditioned the group's perspective on flooding issues. A project working with machine learning enrolled dozens of Field Lab participants in the tagging of flooded areas from satellite imagery to create a training dataset for use in rapid estimation of flood impacts. A working group that formed during the month on decolonizing disaster science critiqued Cartesian forms of mapping and experimented with alternative approaches to spatial representation.

A more in-depth example of a project that used mapping to bring together practices from a number of different fields was focused on participatory flood risk management of one flood-prone part of the city. The group was working in collaboration with a local non-profit organization that provided services to elderly residents. Combining skills from engineers, mapping experts, anthropologists, and artists, the group engaged in activities that included collaborative mapping of vulnerable structures, collecting oral histories of flooding in the area, and capturing "streetview" style imagery of the neighborhood using a 360-degree camera affixed to the roof of a *songthaew*, one of the ubiquitous red trucks that serve as both taxis and public buses in Chiang Mai. The group also collaboratively developed novel, to our knowledge, approaches for describing flood risk by asking residents about the height of previous floods, using their bodies and homes as units of measurement, e.g., the flood water came up to my knees, or the top of my window. In examples such as this, mapping tools allowed the group to bring together different understandings of flooding in ways that productively challenged dominant conceptions of the issue.

Over the course of the month, we also observed art and historical research serve similar functions in some of the working groups. For example, work to collaboratively develop artistic representations of society's relationship to flooding allowed individuals with backgrounds in different forms of art but also artificial intelligence and engineering experiment with new approaches to visualizing flood data. Another group that collected and visualized historical narratives of disaster and environmental change in Chiang Mai served to focus the effort and attention of individuals from various disciplines. In each of these examples, liminal practices helped participants in the Field Lab from varied backgrounds collaborate without necessarily privileging any one view, creating space and opportunity for experimentation.

In these examples, liminal practices, in their various forms, worked to focus the attention and energies of participants of varied backgrounds around the practical challenges involved in creating, analyzing, or visualizing spatial information about flooding. In doing so, they provided as an opportunity for interdisciplinary collaboration and the development of shared understanding. Yet the practice remained liminal. Despite the many forms of expertise in which practices such as mapping play a role, no one discipline ever fully subsumed them. As a result, they provided remarkable and sustained generativity throughout the event, as different individuals and projects experimented with them in different ways. We speculate that such practices may assist interdisciplinarity in finding its purchase as a critical approach, bumping up against existing conceptualizations of current practices and creating the necessary space to explore alternatives [4][45].

5.4 Cultivating a Community

The opportunity to meet new people and expand their professional network was, according to our surveys, the primary motivation for people attended the Field Lab. The importance of networking to attendees is common for many workshops, hackathons, and other events [35][36]. Several characteristics of the event design, in addition to the extended duration, seemed to support the development of new connections. The relationships that participants developed were both important outcomes in themselves, but they also supported the day-to-day accomplishment of Field Lab activities. For example, several interview respondents noted that collaborating on projects through the various working groups built deeper connections between participants than traditional workshops or conferences would allow, and made interdisciplinary work less challenging. In this vein, one interviewee spoke about the importance of the opportunity to work together on practical projects toward establishing a sustained connection:

> *You really built a working relationship. You know how people work and you know what they can add to something. You know, at a normal conference you just show them your finished work, or can only see the slides that they show from their work, which are practiced and perfectly polished.*

In addition, social events and field trips like karaoke and movie nights, boat trips down the main river in Chiang Mai, and tours of the old city that took place over the course of the month provided opportunities for participants to interact in more informal ways and develop personal relationships. This unstructured time was cited in many interviewees as both a highlight of their participation but also as being key to building personal relationships with other attendees. Summing up their feelings about the Field Lab, one participant reflected:

> *I think it's those moments, being able to bond with people – it means that you make connections that you take forward and use within other situations... I honestly do believe that you need those spaces where it's enjoyable and you bond with people.*

It is too early to know whether the nascent network that formed at the Field Lab will grow into a robust community of practice, capable of sustaining itself over time. The long-term viability of participatory design interventions and communities of practice has proved challenging in other contexts [85], and we return to this question in Section 6.3. However, based on our research we can say that over the course of the month the 150 people who participated, in one form or another, engaged in activities such as sharing daily and weekly communication routines including morning check-in, end of week report-back, and the collective creation of the conference agenda using "the board." They shared information, planned activities, or requested assistance using Slack and the open mic. In doing so, they began to develop a repertoire of rituals, practices, and habits that strengthen community bonds and identity. These resources, long identified as vital by community of practice researchers [49][103][104], supported shared learning and collaboration needed for meaningful interdisciplinary engagement over the course of the event, and laid the groundwork for longer term connections between participants.

6. DISCUSSION

6.1 Interdisciplinarity as Collective Critique

The interdisciplinarity of the Field Lab was a means for supporting critical engagement with current limitations in how data about flooding is created, circulated, and used. In our initial advertising and outreach around the event, we intentionally recruited engineers, natural and social scientists, artists, designers, and experts from other fields. In the design of the event, we hoped to avoid concerns raised by Tsing about certain kinds of interdisciplinarity, where arts and humanities are merely enrolled to fill in the gaps of more quantitative, or "technical" approaches [100], a type of interdisciplinarity that Barry and Born refer to as *subordination* [4]. We also didn't seek to fully collapse the boundaries between different perspectives. Instead we sought to develop what we might call a friendly agonism (see also [4][17]) where alternative epistemic traditions are put in creative or productive tension with each other. Through lunchtime talks and workshops led by participants, project-based collaborations, and other activities, we encouraged participants to take other kinds of knowledge as sources of inspiration, as prompts to self-evaluation and transcendence of the bounds of ones' own perspective.

This positioning of interdisciplinarity is thus less of an instrumental means to "solving" pressing problems, as it is often portrayed in the field of disasters and climate change. Instead it aimed a critical gaze at the particular ways in which these problems are posed, and experimented with alternatives. In this way it bears some relation to Agre's critical technical practice [1][84]. For Agre, critical technical practice is a means to destabilize and subvert discursive assumptions embedded in the framings of science and engineering problems. Here we didn't prioritize solving technical problems over developing other modes of addressing flood risk [42], nor do we ascribe to the division between technical framings and humanistic evaluation that Agre's vision of critical technical practice seems to assume [87]. Most importantly, though is that in the setting that the Field Lab sought to cultivate, critique became a collective endeavor. Agre's description is generally that of a lone researcher, forced to tack

back and forth between the "split identity" created by the oppositions between technical and humanistic practices, and he describes the sensations of vertigo he encountered as a result [1]. In contrast, we witnessed during the course of the Field Lab the surprise, excitement, and community that arises when pursuing critique as a collective endeavor.

The potential of workshops to support critical interrogation of data and other computing technologies has been highlighted by a number of recent papers in CSCW and participatory design [19][73]. Staging such encounters is an art and practice about which we, as a community, still have much to learn about [53][54][82]. The openness of the event's agenda, it's extended duration, and other elements of the design of the Field Lab supported the ability of participants to work together toward reframing their conceptions about flood data. Despite this potential, as Phillip and Irani argue in their discussion of post/de-colonial computing, the contribution of our research and practice towards the use of technology towards a more just and sustainable world "cannot rest on a celebration of difference, creativity, and possibility" alone. Indeed, the final move in Agre's (iterative) critical technical practice is the reformation of technical practice based on insights gained through critique. The work of experts to identify the silences, limitations, and exclusions in their practice is an important step, but more effort, on multiple other fronts, is required to reform a field that has for so long acted to sustain them [23].

6.2 Time as a Design Element in Workshops

Careful attention to time, and how it shapes participants' experience of workshops and ability to develop relationships of friendship, trust, and intersubjectivity that support interdisciplinary work, was a recurring theme throughout this research. When designing the temporal architecture of workshops, organizers make choices that "privilege certain types of action and foreclose others" [82] at their events. Workshop schedules, and the flows and rhythms that are co-created when participants and facilitators engage with them, are thus vital structuring features of participation. CSCW research has made the distinction between the discrete, scheduled, measurable logic of "circumscribed time", and "porous time", which more closely matches the polyrhythms of lived experience [57]. Plans, schedules, and other tools often serve to link these two logics [94], acting as critical articulation tools and enabling complex coordination at scale [67]. Despite these theoretical insights, it hasn't been easy to use their conclusions to practically inform workshop design and despite growing attention in participatory design, "we are still far from having an established time-sensitive discourse" [95]. Individual and collective experience of time is challenging to study [94], not least because people often lack rich vocabularies to discuss their experience of time outside the circumscribed units of calculation provided by clocks and calendars [57]. Nonetheless, the experience of the Field Lab suggests the potential benefits of considering a wider range of temporal options in workshop design than is often considered.

The extended length of the Field Lab, and its open schedule, were two of the more conspicuous design choices made by organizers while designing the event. Whereas hackathons and other similar workshops are intentionally time-bound for a few hours or, at most, days, the Field Lab lasted four full weeks, with many attendees present for the full period. For hackathons, the time pressure and intensity is frequently thought to support team creativity and a bias in project design towards outcomes that are achievable in the short term [36]. The goals of the Field Lab were different. In the attempt to establish a shared understanding, develop relationships, rituals and norms that support collaboration, and create liminal practices, the extra time opened up opportunity for reflection, sitting with difficult challenges, and "staying

with the trouble" [26] that can arise through the frictions and double-binds that complex, interdisciplinary challenges present [6][77].

Though many of the benefits of the extended length of the Field Lab were likely experienced to a greater degree by those who stayed for a longer time, even those who only attended for part of the event benefited in some ways. Those who came later in the month, for example, were able to quickly learn from peers who had been there longer how to navigate the unfamiliar format, add new sessions or activities to the board, and so on. They were also able to plug into the network of relationships that developed with local nonprofits or data that had been collected by projects earlier in the month. The month-long timeframe, despite the many logistical challenges entailed, contributed to the ability of attendees to develop relationships, learn from one another, and create interesting projects together. Though hosting a month-long time event will likely be impractical in many situations, we speculate that designing other forms of extended interaction, such as working groups that meet periodically, would yield many of the same benefits.

In addition to the longer time-period, we also sought to vary the pacing and intensity of the event. The open space format also gave attendees considerable agency to design their own experience. Recent work in CSCW on workshop design has argued for the importance of allowing flexibility of temporal framings of activities in order to facilitate different kinds of participation and varying rhythms of work [82]. Such variation has accessibility benefits and supports the ability of participants to manage their own experience of the process. To these ends, the Field Lab provided quiet writing rooms, a variety of concurrent activities that participants could choose from, field trips and site visits, and created other opportunities for Field Lab attendees to carve out moments of repose and reflection within the intense daily work schedule. This variation and flexibility seemed to support participants to different types of thinking or the ability for participants to pursue emergent ideas as they arose. These experiences suggest workshop designers may wish to explore building such flexible and polyrhythmic scheduling into their events, even shorter ones. We believe this to be particularly true in cases where workshops goals include interdisciplinary collaboration, community building, or critical reflection on extant technologies.

6.3 Sustained Impact

Many design workshops struggle to sustain the activities or benefits of the project to participants once the designer has exited the scene [37][85]. This issue has become especially acute in recent years when, as was the case with the Field Lab, the goals of participatory design projects have often expanded beyond the design of discrete systems in particular contexts to infrastructuring publics with the capacity to foment wider social or organizational change [50] [85]. In these cases, questions of sustainability, or the extent to which the results of the activities live on and continue to be impactful after the end of the workshop, are important. As we have found through this research, critical interdisciplinary work benefits greatly from extended interaction, opportunities for pause and reflection, and the opportunity to collectively iterate on promising ideas. Supporting lasting collaborations that contributed toward the critique and reform of the ICTs used in disaster risk management was thus one of the stated goals of the organizers of the Field Lab.

While it is too early to report on whether the Field Lab was successful in supporting lasting collaboration that would sustain beyond the duration of the event, there are reasons for optimism. In the exit survey and follow-up interviews, many participants described plans to

continue working with each other in the future. For example, the machine learning group have developed plans for conducting joint research and have launched a new project around ethics and biases in machine learning for disaster risk data. The decolonizing disaster science working group has continued discussion through a collaborative writing project and submitted a conference abstract on the topic. The group developing the role-playing game for nature-based solutions to flooding has continued to iterate the design and are planning its use in training sessions in upcoming projects. There are also ongoing discussions with partners at Chiang Mai University about continued development of some of the work undertaken during the Field Lab. The Slack workspace used during the event is still used by some of the working groups to share information and coordinate activities. No doubt some of the elements of the event's design discussed above—the extended duration, opportunities to develop personal relationships, and orientation around practical collaboration—contributed to these results.

However, this research concurs with other findings in participatory design that a broader conception of sustainability than a singular focus on the persistence of a particular project may be more helpful in guiding interdisciplinary workshop design choices [48][55][95]. Van der Velden writes that, "constructing interdisciplinarity… may not only be about understanding how the different disciplines and interdisciplines can contribute to the project, but also about developing caring relationships between them [101]." Recent studies have raised the importance of incorporating a feminist ethic of care into collaborative work about data and technology [40][59]. If care is, as theorists have argued, about the ongoing practices needed for maintaining and sustaining the relations that give shape to daily life [15], then part of the art of staging critical interdisciplinary encounters is encouraging such relations amongst participants. Informal networks and social ties have been recognized as critical to the function of the large-scale knowledge infrastructures needed for flood risk modeling [51], and other research has noted the importance of the biographies and life experiences of technical experts in organizational change and knowledge management [43].

The contribution of critical approaches toward the reform of a technical discipline is difficult to accomplish, but, as Agre warned [1], is also difficult to assess. Indeed, questions regarding the outcomes of participatory design activities and how they can be measured are longstanding, unresolved, concerns in the field [10]. The types of workshop outcomes that support deep interdisciplinary engagement and lasting change to expert knowledge practices provide alternate measures of the sustainability of participatory design initiatives, but may stand in tension with events designed around the production of code, technological artifacts, new companies or organizations, or other instrumental outputs. These outcomes may also be harder to recognize and evaluate than whether a particular project is maintained, replicated, brought to scale, or other indicators of sustainability used in participatory design [37]. Instead, as organizers of the Field Lab, we will look for, amongst other things, signs of continued relationships between attendees, new collaborations that emerge over time, evidence that approaches or insights developed over the course of the month are being adopted in the by participants in their future work, and, ultimately, signs that the data used to shape our understanding of flooding and other disasters is being created and deployed more carefully.

7. LIMITATIONS & FUTURE WORK

Though the event was successful in a number of ways, there are significant limitations both in terms of its design and how we studied it. Besides the extended timeframe, which placed serious constraints who could facilitate as well as attend for the full event, the organizers could

have done a number of things differently in the planning and execution of the Field Lab. First, despite the Slack group we did very little to promote remote participation, either during or before the event. The schedule of activities was heavily focused around the use of "the Board" and other analog means of planning and organizing working sessions and meetings. Early on in the event, several participants tried to create an online version, but it was difficult to keep up to date with the constantly evolving plans of the working groups. As a result, it quickly fell out of use. A solution to this issue could expand the potential for remote participation in Field Labs. Supporting participants to connect to one another remotely, through email otherwise, ahead of the Field Lab may have also allowed them extra time for project planning or to prepare for the unconference format of the event, which was unfamiliar to many attendees.

Another area where we would imagine modifying the design of the Field Lab would be to have the activities be more problem-driven. Hackathons and other design workshops are often organized around specific challenges or problem-statements that participants are meant to tackle over the course of the event. We note that the focus on the local context of urban flooding issues as they affect Chiang Mai helped to focus participant energies and activities, but that there was opportunity to push this even further in a number of ways. For example, we could have asked attendees to focus their data collection and analysis on just one neighborhood as one group did, with positive results. Alternatively, groups could have addressed specific policy decisions such as where to site particular flood defenses or target just one aspect of the disaster management cycle such as early warning or long-term flood recovery. We hypothesize that increasing the granularity of the problem framing for participants might result in increased intensity and challenge of interdisciplinary collaboration, yielding interesting results.

Finally we note that in this paper we take a relatively wide perspective on the event in order to understand, in broad ways, how the setup and facilitation of the Field Lab shaped and constrained the forms of interdisciplinary collaboration that occurred. This is partially in result to our main sources of data — surveys and retrospective interviews. Though the first author did take field notes throughout the event, the facilitation demands of the Field Lab were quite high and many of the micro-interactions of the participants, key decisions and conflicts in the working groups as they happened, and other more detailed data on the practical accomplishment of interdisciplinarity were not capture by this research. Further ethnographic or ethnomethodological study of interdisciplinary collaboration between disaster experts would likely generate important insights for our research in this area.

8. CONCLUSION

On the final evening of the Field Lab, we held an "Art & Science Fair" (inspired in part by [29]) on the theme *Living with Water*. The Fair took place at a new gallery in Chiang Mai that had recently been converted from an abandoned 1960's ice factory into an arts and community center. The Fair was the opening night of a month-long exhibit at the gallery that featured the work that we had produced together over the course of the month. On display were pieces that ranged from traditional academic posters that showcased some of the research that had been conducted to an experiential art installation that took blindfolded attendees through the basement of the factory, doused their feet in water, and asked them to contemplate survival and recovery in the first hours after flood events. An exhibit led by the Chiang Mai University School of Public Policy asked visitors to write their hopes for the future of Chiang Mai on small cards and affix them to one of dozens of threads suspended from the 30m ceiling of the gallery. Videos of oral history interviews were projected on walls alongside maps and data tables

describing flood risk models of the city and surrounding region produced by engineers and hydrologists who attended the Field Lab.

For many of the Field Lab participants, the Art & Science Fair was the first opportunity to take in anything like the full breadth of activities and collaborations that had taken place over the course of the month. The exhibition, by intermixing the many artifacts and artworks that had been developed, put them on equal footing. It showed that what we produced, despite our differences in training and backgrounds, fit together and contributed to a new conversation about how our burgeoning community can help address the threats posed by disaster and re-articulate our relationship to the natural world. The Field Lab, as a month-long design workshop where participants created their own event, contributed to the cultivation of these kinds of relationships between attendees, and through them, the disciplines from which they come. For the facilitators, and the community that began to emerge over the course of the event, it was a small, but important, step toward becoming interdisciplinary.

Interdisciplinarity, as we have positioned it, is a sustained collective practice of building relationships toward thoughtful critique and reform of expert knowledge. It requires a community of experts from various areas to come together and develop ways of troubling boundaries or working across them. We have found through this research that by participating in such a collective, individuals can develop facility for these practices and learn to become interdisciplinary. Events play an important role in this, and in doing so aid in the development and sustaining of interdisciplinary communities that can further develop, and act upon, the insights they gain along the way. The tools of participatory design, most often used to reduce asymmetries between experts and end-users, can be used within expert groups themselves in order to better prepare them to partner with communities and grapple with complex socio-technical problems they may encounter in the wild. Through artful planning and facilitation, designers can play an active part in cultivating these processes, contributing to reimagining the role that data and information can play in supporting our collective ability to adapt and thrive during difficult times.

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Received June 2020; revised October 2020; accepted December 2020.