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"Natural" Disasters, Cultural Framings, and Resilience in Indonesia: Transdisciplinary Engagements in an Immersion Program

ARTICLE

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ABSTRACT

In this paper, we will discuss a two-week experiential learning trip to Indonesia, ranging from the design phase to a module course and in-country implementation with two institutional partners in country. The trip involved four faculty and eight students from disciplines ranging from Geology, Anthropology, Environmental Studies to Chemistry and Music. Comparison was at the heart of the project. Our team explored the cultural and functional responses to the 2004 tsunami in Banda Aceh and volcanic eruptions of Mount Merapi in Central Java. Contrasting views of cause and recovery proved especially enlightening. Acehnese responses were tightly woven with immediate pre-tsunami political upheaval along with Islamic framings of the disaster. In comparison, we found responses to volcanic eruptions on Java were quite different because the community affected was more multicultural. We will pepper our account of this pedagogical experience with personal outcomes, cultural interactions, and the trip's engagement with moving beyond interdisciplinarity to collaborative, transdisciplinary engagement.

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INTRODUCTION

Situated on the Pacific Ring of Fire, Indonesia is home to seismic, volcanic, and tsunamic events that adversely affect human populations and result in international news headlines. Coverage following the tsunamis in Palu, Sulawesi, on September 28, 2018, and Sunda Strait on December 23, 2018, detail the lack of an effective early-warning system. As Fergus Jensen and Fanny Potkin report, "a country-wide tsunami warning system of buoys connected to seabed sensors has been out of order since 2012 due to vandalism, neglect and a lack of public funds," and only fifty-six out of one thousand needed sirens are in place (2018). Earlier that same year, in January, our team of four faculty and eight students from Oberlin College learned at the Tsunami Disaster Mitigation Research Center in Banda Aceh that it was not enough to have the early-warning system in place: sirens were ineffective without proper socialization of, and education amongst, the general populace on appropriate responses when they sounded. Despite the informed efforts of individual academics and officials to work toward disaster preparedness in Indonesia, the ongoing lack of preparedness—both at government and private-sector levels—points to the need for more integrated knowledge. Our Oberlin team learned the importance of integrated approaches on the ground in Indonesia: it is not enough to understand the scientific causes of tsunamis, and effective disaster-preparedness and mitigation plans also require structuring and dissemination in culturally sensitive ways. And the importance of that approach has, unfortunately, been reinforced as participants have tracked news of subsequent disasters and ongoing threats to environmental sustainability and cultural resilience.

Illustrated by our two-week study tour in January 2018 titled "Natural" Disasters, Cultural Framings, and Sustainability in Indonesia, this article traces the intentional design of the trip to move beyond interdisciplinarity and multidisciplinarity to a collaborative engagement best described as transdisciplinarity. *Facing Hazards and Disasters: Understanding Human Dimensions*, a report by the National Research Council, argues that there is an "[e]merging consensus … that research can generally be characterized by the degree of interaction among disciplines. In order of increasing interaction, the spectrum ranges from 'multidisciplinary' to 'interdisciplinary' to 'trans-disciplinary' research" (2006, 181). While there is disagreement on the definitions of these terms (National Research Council 2006; Klein 1990; Klein et. al 2001; Pellmar and Eisenberg 2000), we have taken as our definitional departure point that "transdisciplinarity" is a holistic approach requiring integrated knowledge from distinct disciplines, whereas "interdisciplinarity" requires the transfer of knowledge from one discipline to another but ultimately remains within the framework of the originating discipline, and "multidisciplinarity" involves the juxtaposition of disciplines. Our experiences in Indonesia reaffirmed it is not enough to address infrastructural deficits without also anticipating cultural responses to the event itself and implementing disaster mitigation strategies. As Greg Bankoff *et al*. assert in the introduction to the seminal volume *Cultures and Disasters: Understanding Cultural Framings in Disaster Risk Reduction*, "the significance of 'culture' must be understood and incorporated into any attempt to deal with natural hazards, rather than being viewed as largely irrelevant" (2015, 2).

THE IMPORTANCE OF A TRANSDISCIPLINARY APPROACH

Bankoff *et al*. argue disaster risk reduction approaches have historically failed to take into account cultural and social dynamics. They highlight the "need to focus more on people's interpretations, negotiations, experiences and creative adaptations to hazards" for analysis of, and intervention in, disasters. As they continue, "if risk is seen as embedded in culture, then the study of how risk and disasters are produced, interpreted and acted upon should be carried into a much broader multi- and transdisciplinary field" (2015, 1). When disaster risk reduction initiatives are "based on a practical, 'rational' or 'scientific' approach, and a belief that [framing] concerns about significant natural hazards are universal," they are likely to be unsuccessful, because their vision and priorities are not shared (7). As the authors emphasize, there is a need to engage local understandings and perceptions, and to offer up solutions that are appropriately designed, inclusive, and mindful of community-based needs and local power dynamics (7–8). They conclude the chapter by recognizing that the disaster sector needs to move "beyond our conventional frames of reference … [to incorporate] the perspectives and insights from other disciplines such as social psychology, public health, anthropology, geography, sociology, history, architecture and behavioural economics" (14). While the authors do not directly articulate it, they are effectively calling for a transdisciplinary approach to disaster management that encompasses knowledge stemming from yet transcending many individual disciplinary approaches. For example, Wignyo Adiyoso and Hidehiko Kanegae document the ways that disaster preparedness programs in the Yogyakarta region have been ineffective "due to a lack of considering communities' social, cultural, religious and local contexts," but also note a marked preparedness when these programs have incorporated intentional Islamic religious teachings (2017, 561). Likewise, David Kloos and Annemarie Samuels write that:

> the scale of the tsunami coupled with the historically deeply ingrained presence of religion

> in Acehnese everyday life has magnified religious discourses on misfortune, not only in the immediate aftermath of disaster, but continuing over the past 15 years. The case of Aceh thereby offers exceptional insights into religious idioms of disaster. These insights may help to better understand socially shared experiences of vulnerability in post-disaster settings in Indonesia and beyond. (2019, 6)

They found, moreover, that the "concept of fate almost never means inaction. Quite to the contrary, it often comes with equally religiously inspired notions of collective responsibility, perseverance and self-betterment. Individuals and institutions engaged in programs of disaster response would be wise, we feel, to take such notions seriously and consider the potential asset they entail" (2019, 7; cf. Kloos 2018).

OUTLINE OF THE IMMERSION PROGRAM

Our 2018 trip, part of Oberlin's Winter Term program (a credit-bearing degree requirement that encourages experiential and intensive learning supplementing the more traditional curricula), entailed visits to three different areas: Banda Aceh in the Sumatran province of Aceh, ground zero of the 2004 Indian Ocean tsunami; Bukit Lawang in North Sumatra, formerly an orangutan rehabilitation center and a region devastated by deforestation connected with palm oil plantations; and the area around Yogyakarta in central Java that is home to Mount Merapi, the most active volcano in Indonesia and the cause of many disasters, but also the site of other disasters, including the 2006 Bantul earthquake. Comparison was at the heart of the project, especially between Banda Aceh and Yogyakarta, the areas where we spent the most time. We were interested in exploring the cultural and functional responses to both different kinds of disasters and disasters in different regions. Thanks to ongoing institutional affiliations maintained through Shansi Oberlin, a non-profit interested in cultural exchange between Asia and the US, we partnered with universities at our two main sites, Syiah Kuala University in Banda Aceh and Gajah Mada University (UGM), Indonesia's oldest university, in Yogyakarta. These partnerships mobilized both academics and their non-governmental community partners, deepening our understanding of disasters and the need for multifaceted, transdisciplinary approaches for establishing effective mitigation and to develop resilience to natural disasters.

The trip was transdisciplinary in design from the outset. We didn't just want students to engage in a comparative study of disasters but believed that scientists need to know cultural effects, impacts, and understandings of disasters while humanists and social scientists need to comprehend the root, geological causes of disasters in order to effectively address disaster preparedness strategies and resilience. The program design began with a definition of "disaster" that specifies that hazards only turn into disasters when they encounter a vulnerable human population, hence the idea that there is nothing "natural" about the catastrophic events that unfold following a seismic, volcanic, or tsunamic event.

The trip, which was coupled with a half-semester course as preparation, originated in a confluence of forces. The ethnomusicological research of Jennifer Fraser (2013) in Indonesia led to a project investigating musical responses to a devastating 2009 earthquake among the Minangkabau people in the province of West Sumatra. This research established her interdisciplinary interest in disasters requiring both humanistic and scientific approaches to disasters and the seeds for a move toward transdisciplinarity. Interested in taking students on an experiential-learning trip to Indonesia, in January 2014, she led a three-week Winter Term trip entitled Music, Disasters, and Islam in Indonesia with a colleague from music theory and ten students, most of whom were majoring in music or interested in music in some way. The connections between music and disasters were not well integrated, tangential and interdisciplinary at best. When Oberlin received a Luce Initiative on Asian Studies and the Environment (LIASE) exploratory grant for 2014–5, the seed for the 2018 trip was planted, and the planning ensued in earnest when we received the implementation grant in 2016 (titled Sustainability and Resilience in the Face of Environmental Stress and Extreme Events). The design of the module and trip, moreover, was informed by Fraser's attendance as an Oberlin representative at the LIASE conference in St. Paul, Minnesota, in fall 2017, where she was inspired by the dialogue with and experiences of colleagues at other liberal arts colleges. It was also instrumental that there were two Oberlin Shansi visiting scholars, Faradilla Fadlia and Dinaroe (who uses just the one name), from Syiah Kuala University on Oberlin's campus in spring 2017 and Nazamuddin, then Syiah Kuala's vice rector for planning, collaboration, and public relations, made a campus visit in fall 2017, preceding our departure. Fadlia, a psychologist who teaches in the Faculty of Social and Political Sciences at Syiah Kuala, had experiences working in the NGO sector with the Red Cross on psychological and social responses to the 2004 tsunami, while Dinaroe teaches in Syiah Kuala's Faculty of Business and Economics. The presence of these two on campus allowed for collaborative planning for the Banda Aceh portion of the trip; both had long-established connections to academics and NGOs working on post-tsunami disaster recovery and mitigation in the city. Moreover,

Dinaroe, who moved into the office of international affairs upon his return from Oberlin, was the point person coordinating our visit to Banda Aceh. Finally, another person who assisted us on the ground in Indonesia was Asrul Sidiq, a faculty member in urban planning who was appointed as the Oberlin Shansi visiting scholar for spring 2018. He accompanied the Oberlin group for much of our time in Aceh, thus establishing connections prior to his departure to the US at the end of January. The strong professional and personal connections pre-departure were instrumental to the success of the programming and—more significantly—building social and academic connections in Aceh.

In its design, the membership of the faculty team needed to be diverse in order to build a transdisciplinary take on disasters: each faculty member would bring their disciplinary expertise to bear on the questions of disasters and together we would demonstrate the need for integrated understandings. As trip leader, Fraser wanted to ensure there was at least one person from geology and one person from environmental studies so that we would have representatives from hard sciences and social sciences to move toward the transdisciplinary approach to which the trip aspired. Individual faculty were invited in the hopes they would use the experience for future teaching, helping infuse the curriculum and broaden the parts of Asia taught on campus beyond East Asia. Karla Hubbard, a geologist, was interested because she teaches the large introductory course that includes materials on volcanoes, earthquakes, and tsunamis. Karl Offen, a cultural geographer in the environmental studies program, teaches courses considering humanistic dimensions of environmental stability and has had a long-standing interest in Indonesian material. Erika Hoffman-Dilloway, a linguistic anthropologist interested in graphic and visual anthropology, was our fourth member, and she was similarly interested in Indonesia.

Once the faculty team was solidified, we proceeded to recruit student participants through an interview process. We intentionally created a diverse group, both in terms of majors and also economic and racial backgrounds, and ensured that it was financially accessible to all interested students. The students came from across campus, including majors in geology, chemistry, viola, computer science, anthropology, psychology, environmental studies, and cinema studies. In applying, the students had to articulate how they saw the trip contributing to their liberal arts training and possible career trajectories. Our hope was that the students would not only learn deeply from an experiential, immersive experience but that they would also receive a nuanced, rich understanding that reinforced the importance of broad, integrated approaches to some topics.

STRUCTURE OF THE COURSE AND THE TRIP

Our trip and preparatory course were structured around three core concerns: we wanted to understand "natural" disasters from (1) a scientific viewpoint, asking why and how they happen; (2) a cultural and humanistic viewpoint, asking what the cultural framings are, including religious interpretations; and finally (3) disaster preparedness and mitigation, asking what structural and social responses to disasters have been and the infrastructural needs for building personal and communal resilience. Our approach was deeply comparative, relative to both different kinds of disasters and also disasters in different regions of Indonesia. We aimed to explore the cultural engagements with and responses to hazards and disasters to understand how communities interpreted, understood, and rationalized disasters and ultimately how they made peace with living in a hazard zone (Hoffman and Oliver-Smith 2002). These responses were very much colored by the differing worldviews we encountered in Aceh and Java. The Acehnese, the majority population of Aceh province, are particularly devout Muslims. Aceh, for instance, is the only province of Indonesia to implement Sharia law, which exists side-by-side with federal law, not in place of it, and the population of the province was measured as 98% Muslim on the 2010 census. In contrast, while many Javanese people claim Islam as their faith, it is possible for someone to be culturally Javanese but follow Christianity, Buddhism, Hinduism, or a syncretic mix that blends in animistic beliefs. Central Java in general, and especially the cosmopolitan metropolis of Yogyakarta, is a more culturally diverse environment than Aceh. Therefore, we anticipated encountering diverse religious framings of disasters.

Unlike Fraser's 2014 Winter term trip, we were committed to a required pre-departure modular course for all student participants in the second half of fall 2017 as academic and cultural preparation for the trip. It was also useful for starting the process of getting to know each other before traveling halfway around the world together. The module met for seven weeks. We hoped that faculty modeling how they framed the same questions from their home disciplines would inspire students to start moving toward the necessity of transdisciplinary knowledge of and approaches to disasters. The course included introductory material to Indonesia; a session presented by each faculty member on a topic related to their strengths and interests; and visits from Nazamuddin and other Oberlin Shansi representatives with in-country experience. The course drew on research in the sciences, social sciences, and humanities to provide the students with an academic grounding in disaster studies, geology

of disasters, political ecology of hazards, and humanistic interpretations of specific disasters.

In the course, we modeled the need for a transdisciplinary approach for understanding the disasters we were studying in a key assignment: The students were divided into two teams to cover each region using materials from humanistic, social science, and scientific research perspectives. One team focused on Banda Aceh and the 2004 tsunami with its strong Islamic framings. The students from similar majors were intentionally split, and students were encouraged to read articles from outside their home disciplines; so in the Aceh team, we had a geologist reading psychology (e.g., Rahiem, Abdullah, and Kraus 2017), a chemist reading on memories of trauma (e.g., Miller and Bunnell 2011), a computer scientist reading on Islamic interpretations of disasters (e.g., Wieringa 2010), and an environmentalist looking at photographs (e.g., Garcia 2005). The other team focused on Yogyakarta with the 2006 Bantul earthquake, Mount Merapi's 2010 eruption, and mythological and Islamic understandings of these disasters (e.g., Adiyoso & Kanegae 2017; Nazaruddin 2017; Harjanto 2011; Pursubaryanto, n.d.). Each team took ownership of its location, presented it to the other participants, and ensured they had a basic understanding of the disasters and their physical and social consequences from an intellectual standpoint. Teams were also required to make a map using Google Maps with attached images so that they had a rudimentary understanding of the lay of the land and could interpret the consequences of each location's proximal distance to the ocean, the waves that inundated the land, and villages that were buried in pyroclastic flows or lahars. We thought that previous knowledge of how things looked pre-tsunami or in its immediate aftermath would help students appreciate and unpack a sense of place once on the ground in Indonesia come January 2018. For example, the students found an image of the Lampuuk Mosque, the only structure in that area left standing. When we visited the mosque in person, they could appreciate the reconstruction of the area and the significance of the section of the mosque that retains a permanent reminder of the tsunami—left unrepaired, the floor is littered with coral and sand that washed in from over 500 meters away (see ***Figure 1***).

Also, the pre-departure course not only enabled important social bonding among the students who would be sharing rooms but also allowed students to get to know faculty with whom they'd never taken a class. Finally, it provided opportunities for basic training in cultural etiquette regarding dress, protocols, and behavior, including what *not* to do. From Fraser's perspective, there was a marked difference between the 2018 Winter Term trip that had a pre-departure course and the 2014 one that did not that transcended differences in the personalities of the participants: the former was significantly more effective on a social, cultural, and intellectual level. There is no doubt the students on the 2018 trip were better prepared for what they would witness and experience, which, in turn, led to deeper learning.

The trip was designed so that five full days would be spent at each of the main sites, supplemented with a trip to Bukit Lawang. Fraser worked closely with our institutional partners to set up programming. In Banda Aceh our itinerary included:

- A forum entitled "Islam and Disaster Resilience" with Professor Yusni Sabi of UIN Ar-Raniry Banda Aceh (Islamic University of Banda Aceh) and Pusat Penelitian dan Pengkajian Kebudayaan Islam (Center of Research and Study of Islamic Culture).
- An excursion entitled "The Legacy of the Indian Ocean Tsunami," which entailed visiting memorial and commemorative sites, including grounded ships, boats, the Tsunami Museum, and the Lampuuk Mosque that survived while everything around it was obliterated.
- Geological field excursions, which looked at changed coastal morphology, evidence of paleo-tsunamis, and subsidence.
- A forum entitled "Recovery from a Megadisaster" with Dr. Ella Meilianda, program manager at the Tsunami Disaster Mitigation Research Center (TDMRC), and Dr. Yunita Idris, coordinator of engineering at the Technology Research Cluster.
- A forum at the Department of Disaster Science with Dr. Nazli Ismail, geophysicist and head of the master's program of disaster science.

During our travels in Banda Aceh and areas adjacent to the city, we were escorted by administrative staff and academic specialists. Their presence and help in explaining geological features and cultural practices deepened learning and strengthened personal connections. For example, Dr. Yunita Idris, an engineer interested in traditional architecture, was able to explain historical building practices that made Acehnese houses more resilient to earthquakes and how her efforts to structure contemporary versions have been modeled on indigenous knowledge. She modeled the kind of transdisciplinary approach we were interested in for our team.

In Yogyakarta, our experience involved connecting more directly with non-profit organizations and government agencies. Highlights of this programming included:

- A meeting with park officials at the Kalu Kuning National Park on the slopes of Mount Merapi, discussing ways in which the park and its resources (particularly groundwater flow) are affected by volcanic eruptions and human populations that live and/or work in the area.

Figure 1 Part of the mosque left unrepaired and littered with coral following the tsunami. January 4, 2018. Photo by Karla Parsons Hubbard.

- A visit to the Badan Penanggulangan Bencana Daerah DIY (Disaster and Risk Management Agency, District of Yogyakarta) with Budi Supati, the head of the agency, to see how the agency coordinates responses to threats and the eventualities of disasters.
- A visit to UGM's Center for Religious and Cross-Cultural Studies with Dr. Zainal Abidin Bagir and Dr. Achmad Munjid to talk about religious responses to and framings of disasters (see Kemkens 2013).
- A day-long visit with the NGO Batik Giriloyo in Bantul, where we met with leaders and participants in a *batik* (technique of dying cloth using wax and color) cooperative. We also met with Banu Subagyo, member of the Forum Pengurangan Risiko Bencana (Forum for Disaster Risk Reduction), and Sukasmanto, a research specialist at the Institute for Research and Empowerment, partners in a community-engagement initiative following the 2006 earthquake for economic empowerment of local *batik* artisans.
- A visit to the Balai Penyelidikan dan Pengembangan Teknologi Kebencanaan Geologi (Institute for Research and Development of Geological Disasters), where we learned about geochemical typing and monitoring of volcanoes across Indonesia.

In each locale, the opportunity to learn about disasters from multiple angles and experts was beneficial to both the depth and breadth of our experiential learning. In Banda Aceh we were immersed immediately into the Acehnese perspective on the tsunami—and in particular the state of the city prior to and after the tsunami with respect to political and social unrest. Although we had learned much in the pre-departure seminar, hearing the presentation by Professor Yusni, who worked on the 2005 peace accord that ended a conflict between Acehnese separatists and Indonesian government forces, was the perfect introduction to Indonesia once we arrived in-country. He framed the tsunami as a "gift curse," as both a punishment for the fighting and a gift for renewal. Fears ran deep in the aftermath of the tsunami—fears that any aid for victims would be seized by rebel factions. Seeing this danger, the Indonesian government quickly brought representatives of both factions together in Helsinki, and within hours they had formed a peace agreement. Communication of the agreement was the next hurdle in post-disaster recovery, and that was accomplished through the mosques. The role of Islam and the physical presence of the mosques was critical to recovery from the disaster and ending fighting, as revealed in Kloos's (2018) account of Muslims' religious agency in dealing with change brought forth by natural disasters or social pressures. But mosques also served as oases, both physically and spiritually. The concrete structures of the mosques were often the only structure surviving in a neighborhood, serving as both a symbol of and tangible reality for refuge (see ***Figure 2***).

The rest of our stay in Banda Aceh was specifically framed to highlight the intersection of geology, religion, and social-political realities. Although individual stops were focused on one topic (e.g., the Lampuuk Mosque, the tsunami-altered coastline, disaster response and mitigation), none among us could learn about each place in isolation. We could see this in the questions asked by students at each site. They were engaging multiple viewpoints all along the way. For instance, the following post-trip reflection highlights the cultural response that came into focus for this student at this site:

> Perhaps the most striking moment when visiting Lampuuk Mosque was being able to walk inside and see the front room which had been left in the state in which it was found after the tsunami, carpeted with coral and debris. This sight not only helped to drive home the context of the location in which we were standing—it also highlighted one aspect of the trip central to our focus on disasters and culture. Namely, it showed a manifestation of the role Islam plays in the ways in which people from Banda Aceh conceptualize the 2004 tsunami. … In response [to the ongoing political conflict], many believe, God sent the tsunami to punish Aceh and its people for their lack of respect for human life; if they had simply behaved better and not engaged in this conflict, God would not have sent the tsunami. Given this understanding of the disaster, responses to the tsunami and efforts to prevent such catastrophic loss of life in the future center for many people not around creating alarm systems, improving infrastructure, or instituting evacuation training in schools. Instead, they center around better serving God and preventing future conflicts that would cause similar divine retribution.

This reflection from a student majoring in chemistry and music suggests they were understanding the need for multidimensional understandings for effective disaster recovery.

Visits to "disaster tourism" sites were particularly poignant. The Tsunami Museum, a barge moved several kilometers inland to a residential neighborhood, a boat perched atop homes, and the interiors of homes full of belongings melted in the wake of clouds of volcanic gas are all sites that invite voyeurism, a feeling that left us uneasy (***Figure 3***). In contrast, we found local guides at each site were comfortable talking about their personal losses and the aftermath. In their reflections, nearly every student wrapped some of their discussion around the topic of resilience and openness about loss learned

Figure 2 Diorama of the Lampuuk Mosque at the Tsunami Museum in the immediate aftermath of the tsunami. January 8, 2018. Photo by Jennifer Fraser.

Figure 3 Music tapes and CDs from a house in the path of a lahar near Mt. Merapi. January 15, 2018. Photo by Karla Parsons Hubbard.

from these guides. Further, in museums, there was far more willingness to display pictures of the dead than one might find in the US. In discussion with students after these visits, the students were learning that death is approached differently in the Muslim faith. These differences helped the group understand the seemingly remarkable resilience of the Acehnese and encouraged students to reflect on human responses to trauma, as illustrated by one student's comments:

> One of the most impactful moments for me was during our visit to the boat atop the roof in TPI Lampulo. The woman working there explained to us that she had lived her entire life in that village. She lost her family during the tsunami, yet she returned along with so many others… . Someone asked "how does that make you feel?" … [S] he responded that the tsunami was a blessing in disguise that ended the ongoing conflict and strengthened the community's faith… . [E]ven though her answer complemented the ones we had already heard, it wasn't until then that I realized this isn't just some default answer. I don't think there was any lack of sadness or anger initially, but anyone who has experienced trauma will tell you that time offers up new perspective.

This quote shows how a geology major was connecting to the human dimensions of the disaster. This trip was instrumental in leading this student to apply for a two-year fellowship to live and teach in Aceh, straying far from their roots in geology.

The perspectives we encountered in Aceh were clearly guided by deep faith, which allows individuals to move forward from disasters. In contrast, the students felt the response and resilience to the frequent eruptions of Mt. Merapi were slightly more familiar to their pre-trip viewpoints. The fact that the inhabitants of Yogyakarta and surrounding areas have more varied belief systems changed the way people responded to disasters. A chemistry major summarized their view of the differences:

> The response to the [disaster] was never just about the [disaster] itself, it was also about preserving local culture (Kampung Batik Giriloyo) … or creating a lab to analyze samples from across the country (Balai Penyelidikan dan Pengembangan Teknologi Kebencanaan Geologi). While some of the responses we saw were creative business ventures that helped people to survive the economic struggles post-earthquake, when we talked to people at the centers, our discussions were not as focused on the earthquake/volcano the way our discussions in Aceh had focused on the tsunami. The main focus of the centers was about creating a more secure economic future either through arts, tourism or mining.

Here the student identifies a recovery theme based on economic recovery rather than resilience based in spiritual or cultural renewal. This student was awarded a major monetary prize in 2019 that is given to one graduating senior who embodies multidisciplinarity. In a campus news story, the student is quoted as saying "I think that colors are the intersection of art and science, and that fascinates me because it contains questions about perception and culture as well as lessons about preservation" (Nagy 2019). Prefacing their quote, they cite the experience of learning from *batik* artisans as fundamental. They will return to Indonesia to apply chemistry knowledge to the art of *batik* dyes. Such a result is the kind of learning we hoped to engender. Another student summarized their experience by saying that no matter how much academic reading they might have done, no classroom setting would have conveyed the real meaning of "cultural framing" the way that this experience did, reinforcing the effectiveness of experiential learning.

INTEGRATIVE PEDAGOGY: INCORPORATING CULTURAL DIMENSIONS INTO THE SCIENCE CURRICULUM

For Hubbard, this project provided new perspectives on introductory geology courses. Geology classes offer important opportunities to teach scientific methodologies through socially relevant topics that are familiar and often personal for students. Importantly, research on improving diversity within the physical sciences increasingly points to bringing societal relevance into the classroom (Harackiewicz et al., 2015). Geology is somewhat uniquely positioned to infuse learning about geological processes with social relevance, especially in the case of violent and difficult-to-predict events such as volcanic eruptions, earthquakes, and tsunamis. In addition, making connections that foreground different cultures within a science class helps to equalize learning by students from varied socioeconomic and cultural backgrounds (Busch-Vishniac and Jarosz 2004).

Teaching about disasters in an introductory geology course is commonplace both as part of a physical geology course and as a stand-alone course for general science credits. Abbot and Zebrowski (1998) published a plea for more university courses focused on the topic. Abbot and Zebrowski have authored a widely used textbook on natural disasters (Abbott, 2016) and a popular book on the science of disasters (Zabrowski, 1997). Although we agree that teaching these topics is important, we note that they characterize natural

disaster courses as interdisciplinary because instructors must teach across several subdisciplines within geology, suggesting a very narrow and unenlightened definition of interdisciplinarity. One statement by Zebrowski strikes Hubbard as particularly revealing: "One challenge in teaching a science course on natural disasters is to keep students from straying so far into the human interest aspects that they begin to overlook the science" (Abbott and Zebrowski 1998, 475). Teaching the science about natural disasters at the introductory level should not be difficult for a geoscientist. But teaching students to consider the impact on human lives beyond their own cultural frame has been more of a stretch, yet it is an imperative for better learning about what makes a geologic event a human disaster. After participating in this transdisciplinary trip, Hubbard believes that Zebrowski is missing an important piece in teaching the science of natural disasters. Students should initially be encouraged to reflect on the aftermath of an earthquake, tsunami, or volcanic eruption from one's own cultural perspective. Most students will not have lived through such an event and so a productive first step might be to reflect on how their own community might respond. Then we must move students beyond our own understanding to think about disasters from local perspectives. Natural disasters occur across the globe and multinational teams are often involved in the responses. Students that have learned about disasters in a transdisciplinary way will be better equipped to discern appropriate response strategies, an important skill for an informed citizen.

As residents of the US, we envision a governmental response as being of the utmost importance and expect the assistance to be appropriate and swift. Of course, we can see on the news that disaster response is flawed even in the first-world economy of the US (e.g., post-hurricane responses to hurricane Katrina in Louisiana, and in Puerto Rico and the U.S. Virgin Islands after Hurricanes Maria and Irma). Hubbard intends to focus on disaster response in more depth in her courses as a result of this trip. Most importantly, she plans to expand upon the differences between our expectations here in the US (that the government will lead in recovery) and in other countries. Students need to reflect on areas of the world that are vulnerable based on their local geology but have very different infrastructural capacities. The case study of Indonesia reinforces that infrastructures do exist elsewhere, but their sources differ. The ability of the Acehnese people to come together, repair, and heal from their natural disasters is centered in their faith and also the physical infrastructure of their community centers, mosques. This experience has led Fraser to step back and rethink her own preconceived ideas; Hubbard hopes that the human response will become central to her students' understanding. It was clear to this geology student from the trip who stated, "[I]f I were to be a geologist who worked on mitigation, there are so many cultural aspects that I would need to be aware of and take into account to do the job right. Learning about Islam gave me more of an idea about how people think and frame disaster and how they show resilience." Another student noted:

> During the course of the trip I realized that there are an incredible number of pressures that shape a community's response to a natural disaster. Seeing the effects of the internal and external pressures on the communities we visited has helped me understand why the implementation of policies and technologies is not always successful, and has made me more realistic about how much effort must go into developing better strategies and how many different disciplines are involved in creating these solutions.

The student could be writing the definition of transdisciplinarity here.

Given that the visits during our program to both Banda Aceh and Yogyakarta were about one-third devoted to the science of tsunamis, earthquakes, and volcanic eruptions, Hubbard was struck by the near-universal absence of geological insights in the student reflections. Speculation leads her to wonder whether the students thought the science lectures were things they could experience in the same way in a classroom at Oberlin, but it was the social and cultural framing that could only be fully grasped in this kind of immersive experience. Therefore we can conclude that the students were all focused on the fusion of the many disciplines, and that was exactly what we were hoping for. This outcome also highlights the accuracy of the literature that supports the pedagogical value of social framing in the science classroom.

INTEGRATIVE PEDAGOGY: THE STEPS TAKEN BY INSTITUTIONS IN ACEH AND YOGYAKARTA

Syiah Kuala University modeled the importance of this kind of integrated learning, with departments across campus integrating disaster awareness and preparedness into their curriculum. A series of departments and programs, such as the master's program in disaster science, have been established there since the 2004 tsunami, shaping personal career trajectories for many of the individual scholars we met. In addition, whole new governmental agencies focused on disaster science and mitigation have provided career paths, now working towards effective strategies and policies. We found in both Banda Aceh and the areas surrounding Yogyakarta that disaster-preparedness training was a part of the curriculum from kindergarten through high school and a required course at Syiah Kuala for all university students.

President Joko Widodo said of the late 2018 tsunami in the Sunda Strait, "Given the potential for disasters in the country, it's time to have disaster education be part of the national curriculum" (Jensen and Potkin 2018); he could look to pre-existing models within Indonesia that we encountered on our trip. It is increasingly clear that while disasters might be felt locally, they could transpire almost anywhere in this seismically and volcanically active place. Our team from Oberlin witnessed initiatives being developed and implemented in these two locations and learned lessons about the need for approaches that transcend any particular discipline. We welcomed the opportunity to collaborate with partners in Indonesia to provide transformative, experiential learning.

There is a rich literature debating the value of study abroad trips, arguing for care in structure, and questioning the ability to provide transformative experiences from business to public health and environmental studies (e.g. Barkin 2018; Bell and Anscombe 2013; Fox, King, and Reina 2014; Ritz 2011; Rustambekov and Mohan 2017; Strange and Gibson 2017; Tarrant and Lyons 2012; Wright et al. 2018). Our aim is not to review that literature here, but rather add our experiences to the argument that carefully crafted, collaborative, transdisciplinary, and pedagogically thoughtful experiential, *in situ* learning abroad is invaluable for our students. As C. X. J. Hu, A. Abraham, A. K. Mitra, and S. M. Griffiths (2016) found for public health programs, a key component of these structured pedagogical experiences is close collaboration between home institutions and in-country hosts, which in our case included academic, governmental, and non-governmental organizations. Also key was the careful scaffolding of the experience, from framing the issues in the short course prior to departure to witnessing the issues in action. The collective experience of the course and trip was simply not replicable in a classroom in the US. Just as Hu *et al*. found that experiential learning abroad allowed their public health students "to translate abstract public health concepts *into reality* … [increasing] the exposure of public health students to local public health challenges, and [helping] them to enhance their understanding of global public health principles *in action*" (2016, 198; our emphasis), our experience allowed both faculty and students to bear witness to the importance of integrated, transdisciplinary approaches. We take as a small measure of success, at the very least in regards to global awareness and cross-cultural sensitivity, that three out of eight student participants that we are aware of sought to return to Indonesia for longer immersive experiences in the years following the trip.

CONCLUSION

This pedagogical experience has revealed the value of transdisciplinary learning across humanities, social sciences, and sciences for both students and faculty. Integrating the knowledge and experiences gained in a location recovering from "natural" disasters will feed into future classroom projects that provide integrated approaches to understanding complex issues. Our trip reinforced again and again the ineffectiveness of mitigation projects that are culturally blind. In training our students to recognize this disconnect, we ourselves have become more effective teachers.

COMPETING INTERESTS

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