The Geology and Sociology of Consumption: Team-Teaching Sustainability in an Interdisciplinary First-Year Seminar

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ABSTRACT

The complex consequences of current consumption practices, such as climate change and ecosystem degradation, necessitate increased interdisciplinary exploration. In order to raise student awareness of these consumption-related issues, we designed a first-year team-taught seminar on sustainability. This innovative interdisciplinary course links geology and sociology in examining real-world problems through a variety of reflective, experiential, and collaborative activities. Our assessment of this course was based on a qualitative review of 18 students' reflective blog posts as a direct measure of student learning. While we continue to work on deepening the interconnections between geology and sociology and promoting student agency, students were successful in understanding the multifaceted complex nature of sustainability and recognizing the personal and social implications of consumption. Given these positive outcomes, we encourage the development of similar interdisciplinary collaborations. © *2017 National Association of Geoscience Teachers*. [DOI: 10.5408/16-172.1]

Key words: sustainability, interdisciplinary, team teaching, first-year seminar

INTRODUCTION

The impact of climate change, the disruption of ecosystems, and the depletion of natural resources has created the need for conversations and collaborations across different disciplines. While the geosciences provide an important foundation for understanding Earth-based problems, the relationship among environmental degradation, resource scarcity, and economic, political, and social instabilities and inequalities necessitates an interdisciplinary approach to sustainability (see, for example, Liu et al., 2010; Burns, 2013; Michelson, 2013; Welch-Devine et al., 2014; Coops et al., 2015; Levintova and Mueller, 2015). Scholars have called for changes in current teaching practice to emphasize interdisciplinary perspectives and focus on critical problem solving, experiential learning, collaboration, and personal empowerment (Davis, 1995; Peters and Stearns, 2003; Burns, 2013; Redman, 2013).

We, a geology professor and a sociology professor, have, over the past 8 y, utilized a range of collaborative formats to develop interdisciplinary perspectives on consumption and sustainability among first-year students. These collaborations were developed within a liberal arts culture of faculty collaboration and interdisciplinarity. Our experiences have led us to believe that interdisciplinary-focused first-year seminars (FYSs) are a particularly effective way to engage students in the dynamic processes of learning necessary to achieve a broader context and understanding of the complexities of sustainability issues. This article focuses on an innovative, team-taught FYS, "Cell Phones, Coffee, and Clothing: Critiquing Consumption," designed to provide an intentional interdisciplinary introduction to the concept of sustainability through the theme of consumption. In this 2015–16 course, students focused on real-world problems through a variety of experiential and collaborative activities, honed their critical-thinking and reflection skills, and worked together to examine consumption-related sustainability issues.

We designed this interdisciplinary FYS to raise students' environmental and social awareness. By linking geology with sociology, we sought to increase students' understanding of the cyclical dynamics by which social demands affect natural resource acquisition; natural resource acquisition affects the environment and society; and social responses influence demand and support (or hinder) sustainability efforts. We wanted students to recognize the complexities surrounding sustainability: that these issues are not black and white, there are no simple solutions, and collaboration among constituencies is crucial. We encouraged students to develop a personalized connection with the consequences of consumer activities in order to increase their investment in sustainability and their sense of empowerment. Our assessment of these course goals was based on a qualitative review of the students' reflective blog posts.

CONTEXT

Interdisciplinary Approaches to Sustainability

Several recent studies demonstrate that students approach sustainability primarily from an environmental science perspective (Liu et al., 2010; Dyment and Hill, 2015; Levintova and Mueller, 2015). As Dyment and Hill's assessment (2015) of student learning confirms, "understandings were largely limited to environmental notions of sustainability, with notable lack of reference to other dimensions of sustainability, such as economic, social, or political, which are considered key interrelated aspects of sustainability" (28). This limited focus is problematic given the interdisciplinary and multifaceted nature of sustainability issues. When sustainability education draws chiefly from an environmental sciences perspective, students are less likely to understand or to incorporate research on the social dynamics that affect sustainability (Levintova and Mueller, 2015). Offering a comprehensive examination and integration of different perspectives can address the extent to which

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students privilege the environmental over other components (Liu et al., 2010; Dyment and Hill, 2015; Levintova and Mueller, 2015).

The unique combination of sociology with geology addresses this narrowness of focus, providing students with overlapping perspectives from two seemingly unrelated disciplines. Integrating a sociological perspective with a geoscience perspective requires students to examine the meanings, practices, and social implications of consumption alongside the physical processes and environmental implications. Combining these perspectives also highlights the disjunctures, as well as the intersections and commonalities, among various ways of knowing (Nowacek, 2009; Rives-East and Lima, 2013) by exploring different content areas and having students examine what kinds of questions get asked and what counts as evidence in different disciplines. This is important to understanding sustainability, because while geology and sociology share some aspects of the scientific method of inquiry, these disciplines have different methodological approaches and different foci, which, when integrated, encourage a more multidimensional investigation. For example, by including more qualitative sociological examinations of sustainability, students gain an enriched understanding of social resistance to sustainability ideologies and actions. Qualitative explorations not only supplement quantitative geoscientific evidence of the need for sustainability practices and policies but also reveal the interpersonal and structural components that support (or hinder) sustainability efforts.

Team teaching provides a particularly strong framework for integrating different disciplinary perspectives. Working together, we investigate the interconnections among disparate, specialized fields; expose students to diverse teaching pedagogies and practices; and promote collaborative problem-solving skills necessary to address sustainability issues. We model a collaborative learning process as we each take on the role of specialist and the role of generalist (Davis, 1995). Participating in an academic conversation, we illustrate the process of learning through asking questions, building upon each other's ideas, bringing in different perspectives, having different reactions, and discussing our different points of view, all in a respectful and collaborative manner. Nowacek (2009) argues that one of the most beneficial aspects of team teaching is the "direct, explicit discussion of the similarities and differences among multiple disciplinary ways of knowing" (496). Thus, interdisciplinarity, fostered through team teaching, provides a broad foundation through which students examine and address the complexities of sustainability.

First-Year Focus

The facility with which students cross disciplinary boundaries is a significant factor in the success of sustainability education (Burns, 2013). Some studies suggest that to truly understand interdisciplinary connections, students must already be experts in a given discipline (Mahoney and Brown, 2013); however, others argue that first-year students are uniquely situated to be more receptive to crossing disciplinary boundaries (Krometis et al., 2011). Messieneo (2012) argues, "The first year is a key time to introduce students to critical issues, encourage value exploration, examine identity, develop civic responsibility, and deal with diversity" (67). However, both interdisciplinary learning opportunities and sustainability curriculum are often focused on the more mature and knowledgeable upper-level student (Mahoney and Brown, 2013; Coops et al., 2015). Furthermore, upper-level sustainability courses generally require several prerequisites, effectively blocking entry-level students or students without this disciplinary background (Coops et al., 2015).

Early introduction to interdisciplinary thinking may also provide students with the foundational skills to more fully integrate disciplines and to develop more substantive, meaningful syntheses in more advanced courses (Krometis et al., 2011). If interdisciplinary collaboration only takes place in upper-level or major-related classes, the integration may be more superficial, with students focusing on areas in which they already have expertise (Rives-East and Lima, 2013). In contrast, first-year students, even those with a preexisting interest in a particular discipline, are in the process of learning the disciplinary and interdisciplinary conventions. Because of this, they may have less of a predisposition to privilege certain disciplinary perspectives over others and may be open to integrating different approaches (Krometis et al., 2011). While their examination of sustainability issues may be introductory, their integration of multiple perspectives may be more holistic.

POPULATION AND SETTING

All first-year students at our college are required to enroll in a FYS, limited to 18 students, which is intended to introduce students to disciplinary content, as well as to college-level expectations and academic resources. While typically discipline-based topics courses, our FYS is interdisciplinary by design. Our FYS is intended to be an interdisciplinary introduction to issues of consumption and sustainability rather than an introduction to sociology, geology, or environmental studies or an overview of these fields. Class sessions are cotaught by a geology and a sociology professor. While each of us brings particular disciplinary expertise to the study of consumption and sustainability, we collaborated on all aspects of the course design and implementation to more fully integrate geological and sociological perspectives.

Eighteen students enrolled in this FYS after reading through a list of possible FYS course descriptions. The description of this course is as follows:

> *"Life, as we know it, is dependent on the everyday consumption of goods and services; however, our consumptive practices can also have negative social and environmental consequences. This first-year seminar combines sociological and geological perspectives to provide a unique viewpoint on the causes and effects of our consumer society. Sociology allows us to examine the changing meanings, practices, and social implications of consumption, while geology provides scientific insight into the physical processes and environmental implications of consumption."* (Cornell College, 2015)

Despite the focus of this course, none of the enrolled students identified themselves as planning to major in geology, sociology, or environmental studies. Given the likelihood that this is a different composition of students than those enrolling in advanced courses in environmental studies or sustainability, interdisciplinary FYS courses are a

successful way of engaging a broader range of students in the study of sustainability.

As a Midwestern liberal arts college, our student body in 2015–16 included approximately 1,050 students from 45 states and 19 countries. Of these students, 93% lived on campus; 31% were Pell Grant recipients. Of the class of 2019, 45% were women, 19% were students of color, 25% were first generation, and overall, they had incoming academic grade point average and SAT/ACT scores in the middle 50%. The 18 students in our FYS were traditional-aged, nontransfer students and included 11 women and 3 domestic students of color. One was an international student, while the rest came from a range of states, such as Iowa, California, Texas, and New Jersey.

COURSE CURRICULUM

The overarching theme of consumption is strategically utilized throughout the course to engage students in the study of sustainability. Prior research indicates that a thematic approach to teaching sustainability facilitates an active learning environment, creates a locus for multidisciplinary interconnections, and grounds abstract concepts with real-world examples (Burns, 2013). We chose the specific focus on consumption in order to clarify the interrelationships within sustainability, linking geology and sociology through explorations of the physical processes of resource usage, the social factors affecting consumer behavior, and the environmental and social consequences. Consumption is also both interesting and relevant to students, helping them recognize the applicability of these complex ideas to their own lives.

Our FYS investigates a range of geological topics, including climate, water, energy, and mining, and integrates these foci with an analysis of the social, economic, and political context of consumption (see supplemental material available in the online journal and at http://dx.doi.org/10.5408/16-172s1). For example, we examine climate science, as well as climate change denial, environmental activism, and alternative consumption practices. We explore the science of surface water and groundwater and, through analysis of usage patterns, connect water science to the social, economic, political, and environmental implications of drought. We also investigate energy in the context of usage, discussing in more detail the role of coal in creating electricity, the environmental impacts of burning coal, and the potential social ramifications of varying energy sources. We talk about natural resources in the context of renewability, which requires a closer look at the geological origin of natural resources; the processes of resource acquisition, refinement, and processing; and the environmental, social, economic, and political consequences of these processes. Within this same context, we show how social dynamics influence consumption, thereby affecting the demand for natural resource acquisition. Later in the course, we introduce the idea of the Anthropocene, which allows us to explore the geological impact of consumption. Since we team teach every session of this course, we are able to continuously emphasize the interconnections of the natural and the social. This integration provides students with a foundation from which to explore the complexities of sustainability. In order to further expand our interdisciplinary framework, we invite other professors to the class. For example, an economics professor lectures on the tragedy of the commons, further linking social decision making to sustainability, and a physics professor discusses the sustainability implications of various energy sources.

To begin the course, we discuss a reading selection from McPhee's *Encounters with the Archdruid*. In Part 1, McPhee (1971) describes a hike into the Glacier Peak Wilderness with Parks, a mining geologist, and Brower, the executive director of the Sierra Club, who are examining and debating the viability and impact of an open-pit copper mine. This material is both engaging and frustrating for the students, because they find points of agreement with each perspective and discover that this issue is more multifaceted than they had realized. As Susan, a student, noted in her reflective reading blog, "It can be hard to understand where others are coming from, and of course we will never all achieve the same opinion on all topics, but I believe compromises have to be made if we want our world to continue to thrive." This reading provides a good introduction to the course, because it addresses the tensions between economic development and environmental sustainability; illustrates how the perspective of each participant is rooted in different assumptions regarding human need, wilderness, and sustainability; and models respectful debate across substantive areas of disagreement. Readings are incorporated throughout the course to build on these concepts and reinforce the complexities of sustainability.

We then use the film *Connecting People: The Human Cost of Mobile Phones* to introduce the concept of the life cycle of consumer objects. Every consumer object can be parsed into a life cycle, starting with the natural resources needed to make the object, the manufacture and transport of the object, the purchase and use of the object, and the discarding of the object. Geology provides a basis for understanding the formation and acquisition of natural resources, as well as the production of energy. Sociology provides insight on demographic patterns and the marketing and design of the objects. Finally, the entire life cycle of the product has social and environmental impacts, integrating both geology and sociology.

This interdisciplinary life-cycle concept provides the structure for our major assignments. Students choose an item from four broader categories (agriculture and food, housing, technology, and transportation) to develop an overall understanding of the life cycle of a particular consumer object. For example, groups in the 2015–16 course selected coffee, corn, apartment buildings, video gaming, laptops, and cars. Throughout the course, students write three individual papers on various aspects of this object, including a demographic analysis of contemporary consumption patterns, a geological analysis of a relevant natural resource (including the geological formation and setting, mining and processing, resource usage, and environmental impacts), and an analysis of qualitative interviews about consumption experiences. Students then combine their individual research for a cumulative group poster presentation analyzing individual-level consumption patterns; the material and structural context of consumption; the social, economic, and environmental outcomes; and strategies for addressing sustainability concerns.

We also use reflective and experiential assignments to encourage students to connect their academic knowledge with a real-world context. This promotes the personalization

of larger, sometimes abstract, environmental and social issues. Students write regular reading reflections in which they pose discussion questions and begin to answer those questions, drawing on the course material and, when relevant, their own consumption patterns. These reflections are posted in a class blog, which can be read by other students, and these reflections are integrated into the class discussion. We use hands-on lab projects to illustrate geological concepts and social dynamics in action. For example, through the muffin mining experiment (Joseph, 2014), students gain an understanding not only of the rationale for and outcomes of different mining methods but also of the ethical, social, and environmental consequences of those mining practices. We take field trips to a local power plant, the county landfill, and a community-supported agriculture (CSA) farm to illustrate the direct impact of consumer activities on a local level. By linking consumer behavior to larger social patterns and environmental outcomes, we encourage students to examine their own consumption patterns and related intentional and unintentional consequences.

EVALUATION

Our FYS was designed to promote an interdisciplinary perspective on sustainability. We wanted students to recognize the complexities of addressing environmental and social problems and to link sociological and geological perspectives in studying and solving these issues. We also encouraged students to see the relevance of sustainability to their own lives by recognizing the impact of their consumer behavior, taking responsibility, and imagining possibilities for alternative solutions.

We utilized a program evaluation approach, focusing on one FYS course in order to provide a comprehensive description and an assessment of the impact and effectiveness of this interdisciplinary program (Yin, 2011; Starman, 2013). Specifically, after receiving institutional review board (IRB) approval, we conducted a content analysis of students' reflective blog posts, a direct measure of student learning, in order to evaluate our learning outcomes. This qualitative analysis provided an in-depth, contextual understanding of student engagement and comprehension. We selected three general themes (complexity, interdisciplinarity, and personalization) based on our desired student outcomes. We reread all of the students' posts and reviewed the course schedule to determine days in which the course readings and activities would reasonably lead students to illustrate their understanding of these specific learning outcomes related to sustainability. We then selected specific reflection topics (the McPhee reading, climate change, water and watershed, mining and resource management, environmental impacts of consumption, the landfill field trip and an environmental footprint exercise, and alternative consumption) for further analysis. We compiled these posts by reflection topic and excluded student names from the posts. Each author independently read through all reflections, coding student responses to record both the specific outcome-related content and the extent to which a reflection illustrated (or failed to illustrate) the relevant desired outcomes. Collaboratively, we compared and reconciled our coding, noted positive and negative examples, observed themes and patterns in the data, and selected representative quotes to illustrate these findings. We also considered these findings in the context of other sources of information, including course evaluations, classroom observation, evaluations of student work, and our own reflections on the course. The dual coding process, negative case analysis, and presentation of specific student reflections support the credibility, dependability, and confirmability of this assessment (Williams, 2011). In reporting our findings, we use direct quotes from 14 students and replace their names with pseudonyms.

Complexity

Students' first reflection, which covered the McPhee reading, illustrated students' preliminary awareness of different perspectives. For example, students recognized how Brower and Park defined and prioritized human needs and wilderness differently and how this led to different ideas about and solutions for environmental conservation. However, students were conflicted, simultaneously seeking to figure out which "side" was right, and whose ideas they agreed with, while acknowledging points of agreement with the different perspectives presented. The initial desire to reduce complexity and take sides is evident in the discussion questions posted by students. Despite this either-or framing, several students then answered their question by indicating a need for finding a middle ground or some level of compromise:

> *Q: "Should mankind feel entitled to dig up or take what they find in the wilderness, like when Brower and Park found mine-able cooper in the Glacier Peak, or should they leave that area of wilderness untouched and not mined?"*
>
> *R: "Park believes in using the land for the worlds advantage, and believes that copper is an important thing to take from this wilderness preserve…. Bower differs strongly with Park on this matter because he believes about leaving the wildness and especially Glacier Park untouched by human hands for the advancement of 'selfish' reasoning. I agree with both Brower and Park on this matter."* (Jennifer)
>
> *Q: "Which side do you believe to be in the right?"*
>
> *R: "Although Brower may have emotion on his side, I view Park as being more practical in his beliefs…. In the end, I believe a happy medium between the two extremes of preservation and industrialization is the most practical solution."* (Namita)

In early class discussions, students were frustrated by the lack of an unambiguous "correct" response, but as they progressed through the course, they began to recognize the complexities of social and environmental issues. Although Maria argued in a later reflection on water usage that "California needs to put some type of restriction on this in order to preserve some of this water because it's unfair that the farmers are being greedy," most students realized that these issues were much too convoluted to allow for a simple solution or specific villain—for example, in discussing mining practices:

> *"It's easy to blame mining companies for irresponsible mining practices, but in reality it's much harder to clean up and maintain mining sites…. If there weren't such a high demand for these minerals, mining companies wouldn't have to mine so much and so destructively. Companies should of course mine responsibly…. We as consumers should try to be more informed on the products we are buying and companies we are supporting."* (Karla)

Earlier reflections also tended to be more descriptive, recounting the arguments raised in the reading, while later reflections showed more of the students' analytic voice. Their responses shifted from seeking simple answers to examining the ways that different entities (i.e., individuals, corporations, and government) contribute to the problems and suggesting how those same entities could contribute to possible solutions. Students' reflections on possible corporate–government collaborations, the environmental and social benefits of buying local, and types of individual-level changes all illustrate this increased complexity:

> *"I feel the government and companies should work together to minimize environmental destruction, and share the cost. Maybe an extra tax could be put on items which contain metals or other resources that are costly or dangerous to mine to help pay for the costs of maintaining the environment and its health…. Being from California, it's really frustrating to read about how much water goes towards farming. Personally, I try to save water by not eating meat because of how much water it takes to raise cattle. It's frustrating when people say things like, 'you just need to take shorter showers,' because in comparison to cattle production, long showers account for almost none of the water consumption in California. If Americans could change their diet just a little bit, we would save gallons more water than showers could ever take up."* (Karla)

> *"When presented with an option, people should buy from local stores in their community. This in turn provides economic prosperity within the community, adding more value to it and will lower everyone's carbon footprint. I believe this concept would seriously help every community grow and in turn would really help those who desire to contribute to the green movement."* (Maria)

Interdisciplinary Connections

Starting with their first reflections, students recognized the most basic relationship between social demands for natural resources and environmental consequences of resource acquisition:

> *"So long as people still demand the same type of lifestyle and luxuries that we have today as well [as] demand a continued rate of technological advancement then we have no choice but to disturb the wilderness."* (Hayden)

In later reflections on mining and water, students continued to address society's dependence on natural resources and thus the need to extract those resources. In addition, a few students mentioned not only the social impetus to consume but also potential negative social effects of resource acquisition, ranging from affecting workers' and citizens' health to creating political conflicts:

> *"The dangers [of not responsibly and efficiently extracting natural resources] range all the way from a contaminating a clean water source to igniting a civil war."* (Daniel)

> *"Drilling and blasting to extract the ore…can release radioactive elements and metallic dust and can be seen as very toxic to the earth and especially the workers mining it."* (Jennifer)

> *"When there is not enough water to go around everyone will begin to fight over who, or what, deserves it."* (Tina)

As the course progressed, students increased their understanding of and ability to explain geological processes. As such, they were better able to analyze the complexities of the connection between the sociological and the geological. For example, in examining the California drought, Tina explains how the geological processes of surface and groundwater reveal the unsustainability of the current situation:

> *"The basic cause of the drought is because there is less surface water available, meaning there was not enough rain or snowfall to accommodate all the basic needs of the people and farms in the area…however farmers…tap into the groundwater. This is something that will work for now but could make matters worse in the future because the water is being used at twice the rate of natural recharge."* (Tina)

Their increased understanding enabled them to realize how social responses, ranging from individual to governmental, can perpetuate or mediate the impact of geological processes:

> *"California is in the worst drought in history and farmers continue to deplete groundwater supplies to the point that the ground is actually sinking in some areas. It seems simple—if our precious water supply is running dangerously low, the government to step in to protect what little left we have. Unfortunately, it's difficult to monitor groundwater supplies, since it's all underground, and because the water is shared across a large area, it's hard to tell exactly who is pumping out the water. I think many farmers and families that have wells on their land feel entitled to the water they pump out, which complicates implementing regulations, especially because there's never been strict regulations on groundwater."* (Karla)

Students also recognized the need for continued education on the connection between geological processes and sustainability in order for social understanding and action. This was particularly apparent in their discussion of the reasons for climate change denial, including the difficulty laypeople may have in understanding climate science and the complexity of changing people's opinions:

> *"Working with oil and fossil fuels drive the industry in Woodward County and basically run the economy there….*

They see it as a way of life and part of their culture instead of something negative. Skepticism of the media is also a strong influence in their refusal to believe in global warming; …Then the last major reason was because of their belief in God…. It's because of these reasons or mere rationalizations, depending on how you view it, that I feel that I could present some of the data that I obtained off the EPA website and they could refute me with at least a fairly feasible explanation." (Hayden)

"The science community needs to do a better job at communicating to people what exactly is happening and why it is important…. I consider myself a decently intelligent human being. If it was hard for me to completely understand the gravity of the situation that the world's climate is in, then that means that there are plenty of others in the world like me who may not get it. This is dangerous for everyone. If scientists cannot find out how to illustrate the danger of the situation to all of us laymen, then human's may not be able to live on this world comfortably for much longer." (Daniel)

Personalization

On a typical day, one-third to one-half of students reflected on the personal impact of the readings. Early in the course, students commented on their increased knowledge and the importance of personal understanding and individual responsibility:

"In all honesty I didn't know all of the effects of climate change before reading all of the articles for this class, and it changed my point of view, therefore, for some it doesn't take much. We know what we are doing to help the cause of the change, and we know what we need to do to help stabilize it, and that is a reduction of fossil fuel emissions. Once people understand what needs to be done, they can start helping, if they don't know what to do, there is no starting point." (Tina)

"Many families, including my own, have an automated sprinkler system. Because the sprinklers run on its own, many people do not feel that they are responsible for the consumption of their water…. In order to lower California's susceptibility to drought, the people who use water (everyone) needs to feel responsible for conserving the water…. The most important thing to do, in my mind, is to educate the people on why consuming water efficiently is important. If everyone is a part of the problem, then everyone can be a part of the solution." (Daniel)

"Without taking ownership of the issue and associating with it, a solution will never make itself known. There is no organization waiting in the wings to make a change. Climate change is our problem and will not wait to be solved by someone else." (Jason)

Student reflections on the real-world impact of their lifestyle was particularly strong midway through the course after taking a brief ecological footprint quiz and participating in a field trip to the local landfill. In many cases, these experiences had opposite effects on the students; while the landfill experience was uplifting, for many, the outcomes of the quiz were disheartening:

"Learning how responsible we can be with our waste was uplifting, but learning that even if we were incredibly efficient with managing our waste, our style of living is still not sustainable for everyone." (Daniel)

"If everyone on Earth lived as I do, the footprint calculator states that we would need 4.2 Earths to match the amount of resources used. While I'm certainly not the best example of a green, environmentally conscious lifestyle, I don't believe that I'm much more unique than Earth's population as a whole. This is quite startling, as you begin to realize that because of our gross overconsumption, the planet Earth simply does not have the resources to keep up with our current habits." (Jason)

The knowledge gained by the midpoint of this class led students to think about their own consumption, to discuss possible changes to their lifestyle, or to share their new knowledge with others:

"Throughout my life I have always <u>thought</u> that I had a pretty good grip on what an environmentally conscious mindset was, but after seeing my results from the footprint calculator, visiting the landfill and coal power plants and even by participating in this class has proven my "environmentally conscious" mindset to be not all that conscious. According to the Environmental Footprint Calculator, if everyone lived the way I do, we would need 6.6 Planet Earths to provide enough resources and to support my lifestyle…. This written proof shows me that the everyday choices I make in my life such as consuming food, driving, and producing waste has to be held in a more accountable light if I want to live a more environmentally friendly lifestyle…so I went back to the Footprint Calculator to retake the test, with a different mindset of what I feel is possible of me for change. I lessened the amount I drove, invested in a more eco-friendly car, ate less meat, bought more than half of my produce from organic markets and cut in half the amount of waste I produce. By participating in things like this that can realistically be meet by myself, reduced my numbers from 6.6 to 5.5 of how many Earth's we would need if everyone lived the way I do. It still isn't perfect but it's a good way to start." (Jennifer)

Students continued to explore issues of consumer agency toward the end of the course. In examining their power as consumers, some focused on their individual impact while others insisted that consumers can only have an impact as a collective:

"Operating much like a democracy, we have the power to decide what we agree with, what we choose to stand by…. My choice of consuming organically may influence another's and another's and so on. Quickly, our separate decisions to support local, organic sources has far-reaching implications on what will be provided organically in the future, as well as what is considered the norm for our consumption. My

decision to support a product can go places much farther than I had considered. There is true power in this chain of events." (Jason)

"The amount of power which an individual consumer holds over the producers is next to nonexistent. To an extent, corporations can afford to ignore and lose individual customers…. It is only as a massive body of outraged or outspoken people do consumers wield enough power to influence corporate operations. The idea that consumers control the market and what is produced by 'voting with your dollar' is an oversimplification of the consumer/producer relationship…. The control is a two way street." (Frank)

By the end of the course, several students were pessimistic about whether the individual consumer (or consumers on a collective scale) can cause a system-wide change:

"With the amount of people on the earth today, there is overwhelming evidence that a healthy environment and capitalism cannot coexist. Capitalism breeds copious amounts of consumption. With billions of people in the world living in a capitalist system, billions of people (including myself) over consume. The way that companies make/sell their products does not necessarily align with environment friendly practices. While many companies like Starbucks may find ways to lessen their impact on the environment, like using cups that use 10% post-consumer waste, most of these actions do not have a sizable change on the environment…. The only way that I see a healthy environment and capitalism coexisting is if the population decreases substantially." (Daniel)

Even when students recognized their involvement, not all felt empowered or that change was possible:

"For example, my family [does] not really pay attention to the environment…. And I myself was not really [aware] until now but still can not do anything about it." (Anh)

"I'd sort of prefer to turn away from the issue and let people who actually have knowledge about this issue deal with it. I've always been a fan of ignoring a problem until it simply goes away and I think that's just what I have to do as a person for this issue." (Bridget)

"Though I want to believe that people will do what is right, I am worried for the future. I'm concerned for the generations that follow in terms of whether they will have access to the same resources that we are quickly using up now. Even more so, I'm distressed about what our next steps will be in the immediate sense, and their direct impacts on the environment that we so destructively take advantage of every day." (Vivian)

Two students specifically indicated that despite their awareness of sustainability concerns, they did not wish to make changes to their comfortable lifestyle:

"If the rest of the world followed in my footsteps, we'd all be living with 5.1 Earths of our own. Which wasn't entirely too shocking to me, I'm a fan of my material items and using what I want of resources displayed to me. And I can't tell you that I feel bad about it." (Bridget)

"It's really hard and kind of selfish about me to say that I don't think my lifestyle [is] going to change…. It's a pretty common, comfortable lifestyle and it's hard to sacrifice the advantage, comfort, benefit out of my life in order to totally save the environment living in this competitive, brutal, chaotic world." (Ahn)

Most student responses illustrated the impact that self-reflection has on awareness, accountability, and action. However, students had mixed opinions as to the effectiveness of personalization in addressing substantive problems. Karla noted the importance of personal experience, indicating that in "places like California where the drought and heat waves are very prevalent [people] have an easier time believing in global warming." She went on to note that "the majority of America, and perhaps the world, know about global warming on an abstract scale, but the only way we are going to see change is if people start to see the effects first-hand." In contrast, Daniel argued that while personalization may affect opinions, "if we wait for everyone in the world to be affected personally in order to enact regulations that curb emissions quickly, the climate may very well be at a point that is too far-gone to save."

DISCUSSION

Evaluating students' reflective blog posts allowed us to examine their learning process directly, noting what was of importance to students in the course material and assessing the depth of their knowledge, the interdisciplinary connections made, and the personal impact. However, there were limitations to this study. For example, a limitation of evaluating preexisting archival data was our inability to direct the inquiry. In future assessments, we plan to use a survey to solicit information not directly addressed in student reflections. A follow-up or longitudinal survey would also allow us to examine changes over time, such as the long-term impact of personalization on student actions or the effect of early introduction to interdisciplinarity on later academic plans and problem solving in upper-level courses. Furthermore, while this particular case study allowed us to provide a rich descriptive examination of this interdisciplinary FYS course and its effectiveness in teaching sustainability to first-year students, it will also be important to study program effectiveness with different populations and different iterations of this course. We recommend future multicase program evaluations to build on this exploratory study.

Our assessment demonstrates that social and environmental components of sustainability were seen as central throughout the course. Students did not prioritize one dimension over the other but instead effectively incorporated scientific, economic, and cultural factors in understanding and addressing sustainability. We also observed students' increasing awareness of the complexity of sustainability. We credit this in part to the selection of reading material, which

often focused on specific real-world case studies, and students' opportunities to regularly reflect on these issues both in writing and through classroom discussion. In addition, lab exercises and field trips provided an experiential illustration of the multifaceted, complex nature of the issues explored.

Students exhibited more awareness of the interconnections of geology and sociology in this FYS compared to students enrolled in earlier course collaborations (Davis and Walsh, unpublished data). The combination of specific case studies, experiential opportunities, and our team-teaching format supported these linkages. Despite this, we received some mixed comments about the depth of interdisciplinary connections in our anonymous course evaluations. While information on the interdisciplinarity of the course was not specifically solicited, a few students included positive comments, including that the course "did a nice job of incorporating two subjects into one class" and that having "two teachers from different disciplines was nice." One student wrote, "I had fun with the interdisciplinary course…. I think that it is very important to see that two disciplines can be used to learn/solve one world problem. The world works this way, so why shouldn't our education?" However, a student also noted, that "the weakness which was not significantly weak was that the joining of sociology and geology were not discussed as much as I would have thought." Relatedly, another student felt that the class switched back and forth between geology and sociology.

Our own observations of the syllabus, classroom dynamics, and student reflections also illustrate the need for additional integration of geology and sociology. In particular, we feel that we were less successful in providing foundational information in a way that highlighted the connections between disciplines. Our introduction of social theories and of earth materials were narrowly focused and were led by the faculty expert. We plan to address this by becoming more active leaders in the classroom on issues outside of our expertise and by highlighting the interdisciplinary connections, even when introducing core disciplinary concepts. This modification will require more scripting and planning of our classroom contributions and could be supported through added course readings and examples that tie the sociological to the geological.

The three primary writing assignments for the course were solidly disciplinary. In order to better illustrate the links between disciplinary and interdisciplinary, we envision a future progression of assignments from informal interdisciplinary explorations, to two formal discipline-specific works, to the final integrated presentation. We plan to revise the initial quantitative writing assignment to become a series of visual mapping presentations illustrating the overlap of demographic patterns, resource concentration, and acquisition and production. This will be followed by the disciplinary-focused geological analysis of natural resources and the sociological analysis of qualitative interviews. For the final presentation, we intend to develop stronger guidelines for linking geology and sociology and illustrating interdisciplinary, collaborative solutions.

Student reflections revealed a consistently high level of personalization of consumption practices and sustainability concerns. Multiple references to course activities, such as lab exercises, interactive in-class activities, and field trips, indicated the importance of a case study approach and experiential components in transforming students' perceptions. However, not all personalization led to empowerment. Some students did not see possibilities for agentic change. One way to address this would be through expanding the case study approach and having students more directly examine and develop solutions. Elaborating on how change occurs, examining paths for addressing sustainability concerns, and emphasizing the role of collaboration in this process would further highlight the applicability of these issues to their lives while providing a foundation for action. Examples for additional activities could include modules from the Interdisciplinary Teaching about Earth for a Sustainable Future (InTeGrate, 2016) website or the development of simulation activities in which students propose individual, community, and governmental responses to contemporary issues, such as the California drought or the Flint, Michigan, water crisis.

IMPLICATIONS

Developing a successful, truly integrated course requires extensive planning, intentionality, and hard work. Preplanning is crucial. When we first began to collaborate, we received a course planning grant from the college. This provided us with a small stipend for several meetings over the summer, during which we discussed workload, including both individual and shared responsibilities, so that we were each clear about our continued role in developing and teaching the course. Individually, we spent considerable time researching similar courses taught elsewhere and collecting resources for our course. Collaboratively, we worked out our course objectives, the basic course structure, the major course assignments, and the main field trips and experiential learning activities.

Because we had a fairly long history of collaborating prior to team teaching this course, we already had a good working relationship and a sense for each other's particular strengths, preferences, and teaching style. We suggest that, if possible, it may be worthwhile for interested faculty to plan several smaller collaborative projects (for example, linking two separate courses by creating shared course sessions, field trips, experiential activities, or final course projects) before embarking upon a fully team-taught course. Besides helping to determine the interpersonal dynamics between instructors, these smaller collaborative projects can help to test (and allow revision of) early course ideas.

Institutional support is also a crucial prerequisite to team teaching. It is important that the college recognize and support the time commitment that collaborative teaching requires. Fully collaborative team teaching does not reduce an individual faculty member's workload and, especially in the planning stages, may increase the workload. In addition to providing support for course planning, instructors should receive full teaching credit for their team-taught course.

We also have several pedagogical recommendations. To develop a holistic understanding of sustainability, we suggest focusing less on what students need to know about a specific discipline, such as geology or sociology, and more on helping students see the ways in which the interconnections of multiple perspectives contribute to addressing real-world problems. This can be supported through the use of a thematic focus, experiential learning, and faculty collabora-

tion. Each of these components requires careful consideration.

A thematic focus, such as consumption, provides a coherent framework for what might appear to be disparate bodies of knowledge and can help students personalize abstract and complicated issues. Faculty could also consider highlighting a theme such as climate change, natural disasters, overpopulation, energy, or the Anthropocene as the organizing focus of their course. Beyond sociology, a geological perspective could be integrated with a range of social science or humanities perspectives, such as economics or philosophy. The selection of a thematic focus should be rooted in the specific interdisciplinary combinations.

Experiential components, which contribute to personalization, build on the theme and illustrate real-world relevance. Case studies, class activities, and field trips should enable students to see the integration of different disciplinary perspectives. If it is not possible to incorporate field trips into the course, we recommend increasing the experiential lab component. As previously mentioned, the InTeGrate program provides modules and other teaching resources to support "the teaching of geoscience in the context of societal issues both within geoscience courses and across the undergraduate curriculum" (InTeGrate, 2016). TED Talks, documentary videos, and other video resources can supplement experiential activities and/or replace guest speakers. We recommend exploring the National Science Foundation's YouTube channel (NSF, 2016).

A strong theme and experiential focus help in organizing and developing connections across course topics and readings. As noted earlier, in order to reach the full potential of interdisciplinarity, it is important to gain some cross-training and to prescript some course discussion and activities so that they fully incorporate multiple instructors and disciplines. Interdisciplinary learning will not be as effective if faculty do not develop cross-disciplinary knowledge sets and practices, which prepare them to engage more confidently outside of their disciplinary comfort zone.

We find that team-taught interdisciplinary first-year courses can significantly raise student awareness of the complex, multifaceted nature of sustainability. Many of our students entered college with limited information about or interest in sustainability. However, throughout this course, most illustrated an increased interest and investment in problem solving and the ability to make interconnections among these fields of study. As one student wrote in the final course evaluation:

> *"The course reveals harsh realities that many people don't even consider to think of; it makes the students rethink their habits of consumption and how they can help the living conditions on this planet, but it also addresses the other side and that most of the people who work in industries such as the oil and coal don't have intentions on destroying the world, as well as the fact that convincing many people to change their consumption can't be done without informing them of how their consumption affects the environment. This provides a very realistic take on the whole dilemma and what balance there needs to be in order for humans to keep the environment as clean as possible, while keeping the economy stable."* (Anonymous)

This level of engagement and awareness of the possibility for change is further illustrated in Melissa's comments on sustainability efforts observed during our field trips: "Every thing they said was achievable, and I know this because they had already done it. These people had found solutions, and yes, they don't solve all the problems we are facing today but it made me believe in a future where it was possible." Ultimately, this course provided a powerful opportunity for students to witness theories in action, to grapple with divisive and controversial issues, and to engage in the global conversation on living sustainably. We highly encourage others to develop similar interdisciplinary collaborations.

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