FROM THE FIELD

Worry and Hope: What College Students Know, Think, Feel, and Do About Climate Change

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"Colleges and universities can only thrive if society and the biosphere are healthy. Any institution that is so shortsighted as to pursue its ends without taking into account the interests of the larger community or ecosystem in which it is enmeshed will not achieve sustainable success. In the end, it will find itself forced, one way or another, to deal with the fact that its future is linked to that of the larger web of social and ecological relations" (Bardaglio & Putman, 2009, p. 174).

"You are not mature enough to tell it like it is. Even that burden you leave to us children" (Thunberg, 2018).

Introduction

A comprehensive sustainability assessment at over 1,000 two- and four-year colleges in the United States, conducted in 2001 and again in 2008, gave participating colleges a C average on sustainability curriculum, noting in 2008 that "Today's student is just as unlikely as in 2001 to graduate with exposure to basic ecological principles, much less with an understanding of how the human-designed economy can work in harmony with natural systems" (McIntosh, Gaalswyk, Keniry, & Eagan, 2008, p. 5). These two national "campus report card" studies illustrated that, if students are not majoring in environmental studies or biology, it is possible, indeed likely, that they will graduate with no formal instruction in climate change, its impacts, or mitigation and adaptation. While a third assessment planned for 2018 was not completed, in another, smaller study completed in 2010, Wachholz, Artz, and Chene (2014) surveyed 375 students at one New England university, reporting that "the students in our sample gave their university a failing grade on how well it was teaching them about climate change" (p. 136).

Given such dismal reports of climate education in college, it is unfortunate that there has been no further comprehensive study of climate change curriculum, literacy, and attitudes among college students in the United States. To be sure, much research around the topic exists. Leiserowitz, Smith, and Marlon (2011) studied knowledge and attitudes among American teenagers as part of the Yale Project on Climate Change Communication, and Ojala (2012) studied college-aged students in Sweden. Several assessments of competencies in sustainability degree programs have been done (Levesque & Blackstone, 2020; O'Byrne, Dripps, & Nicholas, 2015). Yet, a blind spot persists in our understanding of what is being taught about climate change across general education and thus what typical college students actually know, think, feel, and do about climate change.

Universities are effective producers of climate knowledge through research enterprise, but the higher education sector provides no assurance that college graduates have been formally exposed to basic information about the science, scope, and scale of global warming and climate change, nor to a realistic understanding of the anticipated localized impacts that will impact their futures. What is the function of college in preparing for such an uncertain future, and how will the higher education sector meet the rising concerns of the next generation?

Current college students born after 1995, known as Generation Z, have been exposed to climate change knowledge since middle school. (As a point of reference, they were 11 when Al Gore's An Inconvenient Truth was released.) The Next Generation Science Standards, which integrate climate change into earth science curricula, have been adopted by or inform science standards

in 40 states, representing 69% of high schools in the United States (National Science Teachers Association, 2019). Yet, in a 2016 survey of 1,143 Generation Z college students at 15 institutions, only 23% reported concern about climate change. Seemiller and Grace (2016) speculated that "the idea of saving the planet is embedded into the day to day consciousness of Generation Z students" and that "these issues may pose little to care about in that they appear to be progressing through the legislative process and gaining more cultural acceptance" (p. 296, see also Feldman, 2010)[1]. And yet, according to recent polls by Gallup and *The Washington Post*, levels of concern are rising among all demographics. In 2019, 51% of Americans were "highly worried" about climate change, an increase from only 37% in 2015 (Makower, 2019). A September 2019 *Washington Post* poll of 628 American teens reports that youth are becoming both more frightened and more active (Kaplan & Guskin, 2019).

Levels of knowledge among college-going adolescents appear to vary widely, while levels of concern appear to be increasing rapidly. What is clear is that both knowledge and concern about climate change are poorly understood, inadequately assessed, and inconsistently addressed in the college-going population. One result in the United States is the well-known "six Americas" which describe how one's socioeconomic status, family, community, and peers have a direct influence on an individual's understanding of climate science and perceived self-efficacy with regard to climate change impacts (Leiserowitz, Maibach, Roser-Renouf, Feinberg, & Rosenthal, 2015). There are six categories of concern in the U.S. population: 29% are "alarmed" and 30% are "concerned", while others are "cautious" (17%), disengaged (5%), doubtful (9%), or dismissive (9%). The "alarmed" segment has doubled since 2013 (Leiserowitz et al., 2015).

In other words, it's not just what one knows, but what one thinks one knows, what one's friends know, and what one wants to know. Misperceptions can be reinforced, even by well-intended teachers, due to cognitive factors such as confirmation bias; the brain seems to prefer information that supports what it already believes (Cook & Lewandowsky, 2011). Perhaps the frontal cortex, which regulates future thinking and is not mature until approximately age 26, plays a role, according to current understandings of the brain's hemispherical design and evolution (Blakemore & Choudhury, 2006; Haines, 2017). Certainly, the cognitive dissonance between what we hear about global warming and climate change and what most U.S. residents experience in their daily lives is confusing and emotionally destabilizing.

The U.S. Global Change Research Program (2009) defines a climate literate person as someone who:

> Understands the essential principles of Earth's climate systems; knows how to assess scientifically credible information about climate; communicates about climate and climate change in meaningful ways; and can make informed and responsible decisions with regard to actions that may affect climate change (p. 3) .

It seems a reasonable goal to expect college graduates to be climate literate, and to expect such literacy to be a baseline for the problem-solving that it seems future generations will face. Milfont (2012) found a positive association between increased knowledge and increased concern. Yet concern does not always translate to action. There is a "know-do" gap that seems to keep an individual, group, or nation from moving attained knowledge into required action.

According to knowledge translation theory, there are four causes of this gap: Don't know, don't understand, don't care, don't agree (Bennett & Jessani, 2014). Knowledge translation is about understanding how a target audience (in this case, college students) processes information. Climate change information is usually taught with a deceptive linearity known as the "science push" model of knowledge transfer (Bielak, Campbell, Pope, Schaefer, & Shaxon, 2008). This often takes the form of riveting, yet ultimately numbing bad news "Powerpoint" presentations. This is analogous to the much-maligned "banking model" of education, in which the teacher-as-expert simply transfers or inserts knowledge to the student (Freire, 1970). Learning just does not work this way, and learning about climate change appears even more highly subject to distortion, bias, and resistance (Marshall, 2014). Poorly executed climate change messaging on the part of teachers, known among faculty as "glooming and dooming," can

[1] Authors' note: The Generation Z Goes to College study was published prior to the Trump administration's rejection of the Paris Climate Accord, and before Greta Thunberg's climate education strike in Europe. It is included as an example of the swiftly changing landscape of concern among college-age students in the United States.

produce despair, being overwhelmed, numbness, hopelessness, fatigue, and cynicism (Rowe, 2002; Maniates, 2013; Meineke, Nelson, Kokic, Stone, & Selvaraju, 2006; Ray, 2018). Other factors, such as gender, further confound the user experience of climate knowledge, with females appearing to be more interested in learning about climate change, while also more likely to underestimate their understanding—the "gender confidence gap." Male students, on the other hand, tend to overestimate what they know, and overestimating one's knowledge may limit interest in learning more about climate change (Selm, Peterson, Hess, Beck, & McHale, 2019).

Climate literacy in college is more complex than in high school and must be approached through various disciplinary lenses. Milfont (2012) suggests there are three kinds of climate knowledge: system knowledge, action knowledge, and effectiveness knowledge. Climate knowledge is also both explicit and tacit. Explicit knowledge is generally understood as "words and numbers shared in the form of data," while

> [T]acit knowledge is highly personal and hard to formalize, thus making it difficult to communicate or share with others [3]. Subjective insights, intuitions, and hunches fall into this category of knowledge. Furthermore, tacit knowledge is deeply rooted in each individual's actions and experiences, as well as in the ideals, values, and emotions they embrace (Desouza, 2003).

The interplay between explicit knowledge and tacit knowledge occurs in a physical embodiment, what Polanyi (1966) beautifully described as an "indwelling." This is critical to effective climate change education. It is one thing to be told information and another to really take it in. Climate information can be acquired on an explicit level but must also be integrated into the physical-mental self (Straw, 2016). Creating conditions for the indwelling of climate knowledge that is tacit, emotionally resonant, accepted, and felt seems to be at the crux of college-level climate literacy, because such knowledge is emotionally charged and intimately connected to one's worldview and paradigms of time, space, and nature.

Knowledge Translation and Climate Change

Knowledge translation theory provides a useful lens for understanding the role of higher education faculty in learning and teaching with and from multiple stakeholders: community partners and informal educators, workforce, outreach and extension agents, and K–12 educators, other faculty including scientific researchers, and, of course, their students. College faculty are trained as experts in academic disciplines, but most have no formal training in climate change science or communication. Choi (2005) describes knowledge translation using the analogy of a regional power grid:

> …[I]n which generating plants from different localities contribute electricity at half a million volts. The high voltage is necessary to increase efficiency—that is, to minimize energy loss for conveyance along power lines over long distance. But then at the other end the electricity must be stepped down to the household voltage before it can be used. Similarly, complex high power technical information must first be integrated and then stepped down for communication to different audiences in the most appropriate way (p. 93).

It may be inadvisable to drop the "full voltage" of climate change into an outlet that is not calibrated for it; a shock may result. As an example, Jem Bendell's controversial "Deep Adaptation" paper (July 2018) concluded that humanity faces a near-term social collapse due to climate change. The paper has sparked the Positive Deep Adaptation movement, with over 100,000 readers downloading the paper. Climate anxiety has become a topic covered in mainstream media. Mother Jones covered the psychological state of climate scientists. "They know this deep truth: They are on the front lines of contending with the fear, anger, and perhaps even panic the rest of us will have to deal with" (Corn, July 2019). How are higher education faculty, those who are not trained as climate scientists, supposed to integrate and communicate such complex information, with such high stakes?

Ward, Smith, House, and Hamer (2012) describe knowledge translation as a fluid framework of "streams" through which information flows. They label these as: problem, context, knowledge, intervention, and use. Each can occur in any order, or simultaneously, although "there may be a tendency for each component to occur with more or less intensity at different points in the process" (pp., 301–302). In the area of sustainability science

specifically, Hering (2016) calls for more effective knowledge brokering, noting that "knowledge brokering is an iterative and bidirectional process of translation, tailoring of information for specific contexts, feedback, and integrations" (p. 364).

A brokering field for climate change education would include students and their values and prior learning as equal to faculty and their values and expertise. Knowledge brokering is, ideally, a two-way process between equal partners, undertaken with an understanding of the user's context (Pablos-Mendez & Shademani, 2006). Knowledge mediation and intermediation are alternate terms, though intermediation may more accurately describe the responsibility of moving knowledge both with and without translation (Schlierf & Meyer, 2013). It is interesting to note that best practices in teaching and learning—in an emancipatory teaching framework and especially in Indigenous learning methodologies—exhibit this type of equalizing of teacher and learner roles (Meyer, 2003).

In addition to understanding user context (i.e., student perspectives) and equalizing teachers and students, collaboration across knowledge fields is desirable. Kislov, Wilson, and Boaden (2017) warn that "creating isolated knowledge brokering roles is not enough to produce sustainable impact on the 'know-do gap'" (p. 111). A brokering role, in this case, might be held by a sustainability officer, or the lone environmental studies professor on a small campus who finds herself responsible for the climate education of the student population. Collective brokering is implemented by interdisciplinary, multi-professional teams. The role of the isolated knowledge broker is fraught with risk and responsibility:

> To translate is to connect, to displace, to move, to shift from one place, one modality, one form, to another while retaining something. Only something. Not everything. While therefore losing something. Betraying whatever is not carried over (Meyer, 2011, p. 99, quoting J. Law, 2002) .

One faculty member in one academic discipline (biology, say, or English, or art) will both consciously and unconsciously filter and shape climate knowledge through the act of translation: both what is taught (explicit), and what is modeled or felt (tacit). Different academic lenses apply different filters, and the teacher's personal values are also always present. All climate knowledge is brokered knowledge. It is "knowledge that has been de- and reassembled" (Meyer, 2011, p. 123).

This paper presents findings and a useful protocol for conducting focus groups with college students. Results shared will follow the questions asked: What are students experiencing and learning in college classrooms about climate change and related sustainability issues? What do they know? How do they know what they know? How do they feel about what they know, and how do they use this knowledge?

Methods

A case study of the University of Hawai'i system, originally titled "Green Workforce and Education," was approved by the University's Institutional Review Board to explore these questions. A semistructured focus group interview protocol was repeated 18 times at eight out of 10 campuses, with 150 undergraduate student participants. The smallest group size was four and the largest, 15. First-, second-, and third-year undergraduates from a wide variety of majors were represented, including: agriculture, astrophysics, automotive, business, emergency management, facilities management, fashion, liberal arts, political science, Hawaiian studies, nursing, sustainability science management, and others. Convenience sampling methods included class visits and campus meetings. To avoid sample bias, we extended invitations, via email, to talk generically about "what you are learning in college and how it influences your future." We also conducted focus groups in general undergraduate classes, such as first-year composition containing a variety of majors.

While the relatively small number of participants does limit generalizability, the repetition of the focus group protocol 18 times at eight different campuses began to yield consistent, saturated responses that seem representative of the general experience of undergraduates across the state of Hawai'i. The focus group methodology, in comparison to a survey, emphasizes a constructivist approach to the conversation and interactions of the group. Deep listening provided a clearer understanding of the intensity of student emotion, and how these emotions could be impacting the overall learning, retention, engagement, and mental health of the student body. Two interviewers were present at all sessions, to limit researcher bias and triangulate interpretations.

Over 35 hours of audio recordings were transcribed by the researchers and coded using MAXQDA. Both theoretical and emergent codes were used, following Miles and Huberman's (1994) suggestion that analysis of qualitative data should occur in three stages: data reduction, data display, and conclusion drawing. The transcripts were reduced to 996 discrete "utterances" (meaningful statements, opinions, or descriptions) which were coded into four predetermined (etic) categories: Knowledge Topics, Sources of Knowledge, Use of Knowledge, and Emotions. Emergent (emic) codes (not analyzed in this paper) included Communication and Civics, Indigenous Perspectives, and Time.

Following coding, eight "member check" presentations on different campuses were held, both with the original participants and with student, faculty, and administration groups that were represented by the findings. Preliminary findings and representative quotations were shared, and we asked, "What resonates?" and "What's missing?" These conversations were productive for the campus communities and helped to develop the findings and implications for this study.

Results

Results of the study are shared in the order of the focus group protocol (see Appendix), which followed a semi-structured pattern of questioning. All of the groups covered many topics related to climate change and related sustainability issues (Figure 1).

Differences emerged between a) what topics students said they knew the most about, b) what topics students indicated they wanted to talk about, and c) the topics they actually talked about (as shown by the actual number of utterances analyzed in the transcripts of their focus group discussions).

Figure 1. Topics Mentioned Most Frequently

Asked where they have learned about climate change and sustainability issues, students mentioned several types of information sources. The frequency with which they referred to their lived experience was striking, as was the last-place mention of college faculty. The category of "lived experience" includes personalized accounts of experiencing climate change: beaches, surf spots, fish and coral reef, roads and flooding, food availability, and weather patterns. Some illustrative quotations of lived experience:

> Scientists are saying, "Oh, we can't calculate the numbers" but you know, we can see it when you dive…. (B)efore when we used to fish, had plenty fish, but now you're not seeing too many (male, second-year student).

> I'm from Washington state, and my birthday is in November. It snowed on my birthday all the time when I was a kid, and now it never snows that time of year (female, second-year student).

Though college courses were the least frequently mentioned as sources of information, when prompted, students reported a wide range of college courses where climate change is covered. Fifty-three specific courses were mentioned, fairly equally distributed across discipline areas (Figures 2–6). The most frequently mentioned were: anthropology, biology, English, environmental science, Hawaiian studies, oceanography, political science, and philosophy. Individual faculty members were frequently mentioned by name, indicating that personal relationship was significant to the impact of information.

Climate Science Literacy

The conversations revealed low levels of literacy and self-confidence in understanding the science of climate change. Climate change is caused by the greenhouse effect, often described using a metaphor of a blanket that doesn't allow generated heat to be released. Inaccurate ideas and mental models about the ozone layer, pollution, and other erroneous explanations persist. Here is a typical comment confusing a hole in the ozone layer with the greenhouse effect:

Figure 2. What Students Actually Talk About (Numbers = Utterances)

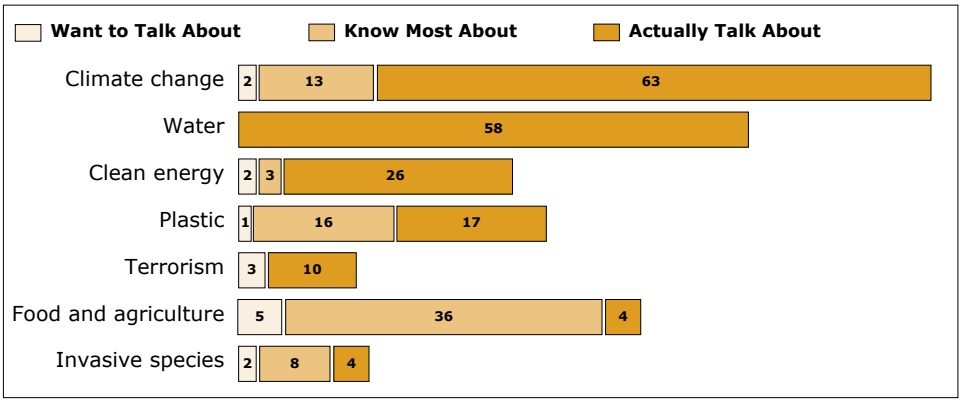


Figure 3. Knowledge Sources (Numbers = Utterances)

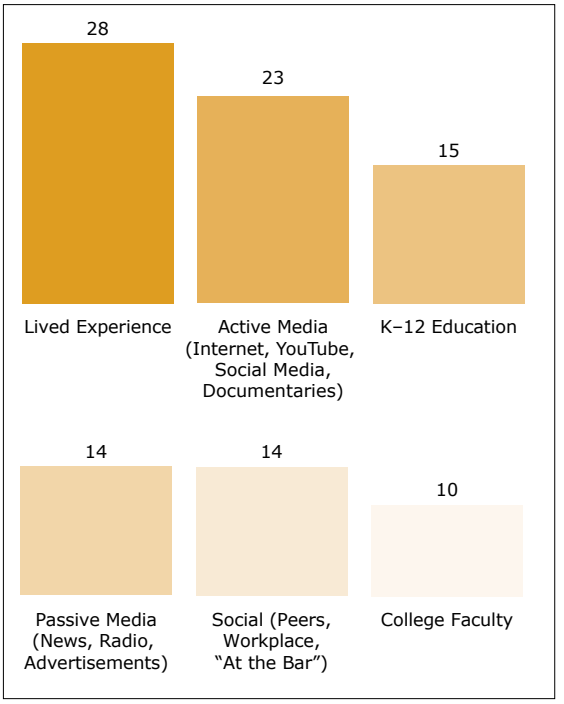


Figure 4. Knowledge Sources by Discipline

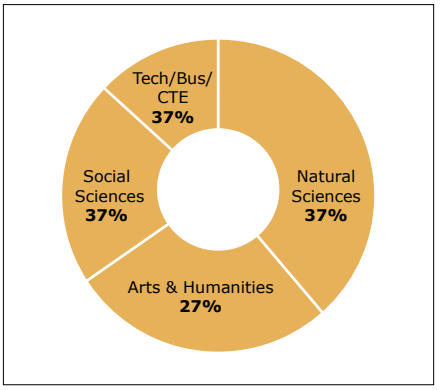


Figure 5. Actions Taken

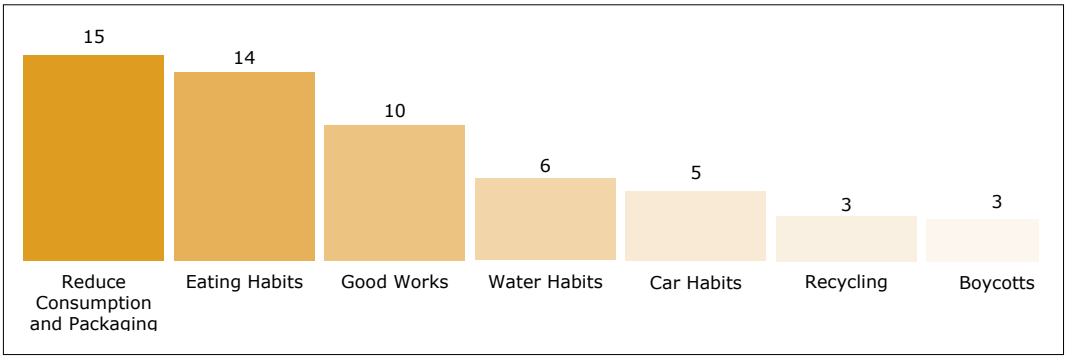
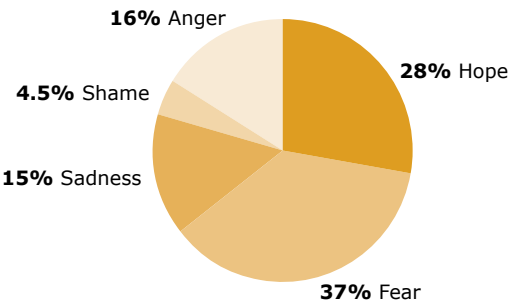


Figure 6. Student Feelings About Sustainability and Climate Issues



> From what I remember, I'm probably wrong, but...it concerns a tear in the ozone layer, therefore causing the sun's rays to become more potent to the earth. And it just happens to be toward the polar sides…causing the glaciers to melt and then for the rest of the earth those rays are trapped within the earth (first-year student, male).

In addition to pervasive misperceptions about the ozone layer and climate change, some bizarre perceptions of climate science emerged. We include these to indicate the broad range of beliefs and understandings that may exist among college students.

> The currents, right, every so many million years the earth changes, it goes back, the planets could be pulling the water. When water gets warmer it expands. Plus the rubbish in the ocean is taking over, displacing the water [leading to sea level rise](second-year student, female).

> North Koreans are putting out the bomb and that might be affecting the ice cap. All these nuclear tests underground could be affecting the axis of the earth (third-year student, male).

These utterances (among others) could be indicative of a literacy gap comparable to the discovery in the 1980s that incorrect mental models about the Earth's Axis stemmed from certain textbook drawings leading Harvard graduates to hold erroneous understandings about what causes the seasons (Harvard-Smithsonian, 1987).

Lastly, a skeptical perspective toward climate change was expressed at some campuses, but not at others. It is possible that such perspectives are only expressed under certain social conditions as afforded by the focus groups. Here are some typical comments indicating skepticism or "climate denial":

> There's not enough research on climate change. You figure, we have only been alive for a few decades. I want to know what is a generalized change over centuries. Maybe this is just regular. I don't know; we don't know. I haven't seen a long enough term research to say "this is climate change". Maybe a season, if you are looking at the earth, is a hundred years at a time, a thousand years at a time, maybe this is normal. I don't think it's fair to generalize or say it's wrong what we are doing to the earth based on just a century or two (third-year student, male).

> So, in my opinion, we've been coming out of an ice age for millions of years. And when the ice age was occurring, and it killed everything, and then it started to melt, life came back. Now we're here, conscious beings, whatnot. I think that we've, more or less, just accelerated the warmth of the earth. But baby girl's in a cycle. She does what she wants. We could, maybe, have a small kind of effect on it, but ultimately, she was going to warm up anyways (second-year student, female).

Personal Behaviors

Personal behaviors and actions related to food, transportation, clothing, and volunteer work were seen as having some impact and being motivating, even if such actions did not seem to directly address or mitigate climate change. The most frequently mentioned behaviors were related to eating, including both dietary changes (being vegan, eating less meat) and utensils and containers (bringing chopsticks, using reusable containers). Water habits included things like shorter showers, fixing leaks, and water catchment. Some students were unsure whether tap water was safe to drink. Car habits included driving a hybrid or electric car, disposing of oil properly, and cleaning up oil. A number of "good works", such as landscape restoration, picking up litter, and beach cleanups were mentioned.

Table 1. Spectra of Micro-emotions Related to Sustainability and Climate Issues. (Words in bold occurred more than 10 times.)

Fear	Anger	Sadness	Shame	Hope
In denial **Powerless** Speechless Helpless Detached Dumb **Worried** Unsure Mystified Skeptical Nervous Stressed Concerned Alarmed Pressured Shocked **Overwhelmed** Scared	It sucks Irritated Cheated Distrustful **Frustrated** **Angry**	Heavy **Disappointed** Pessimistic **Sad** **Terrible** Depressed Resigned Discouraged Dampered Heartbroken Devastated **Hopeless**	Ashamed Embarrassed Guilty Cringing Gross Visceral reaction	Humble Grateful Empathetic Interested Opinionated Knowledgeable Enlightened Concerned Motivated **Inspired** Reassured Responsible Determined **Hopeful**

Emotions

The interview protocol concluded with a specific question about emotional response. We asked "How do you feel about all of this?" This question alone generated 203 utterances. Our data visualization was inspired by Plutchik's (1962) Wheel of Emotions, which breaks down primary dimensions of emotion into micro-emotions, and then scales them by intensity (see www.6seconds.org). Plutchik identified eight primary emotions: joy, sadness, acceptance, disgust, fear, anger, surprise, and anticipation. In this research, we discerned five: hope, sadness, anger, fear, and shame (we use the term shame as a category of what Plutchik called disgust.)

Each of these emotion categories consisted of a spectrum of micro-emotions listed in order of the researchers' interpretation of intensity (low to high). While intensity is subjective, and emotions have complex sociocultural norms, it seems important to try to understand the progression from "helpless" to "overwhelmed," from "disappointed" to "hopeless," or from "grateful" to "determined."

"Overwhelmed," "angry," "hopeless," "ashamed," and "hopeful" are the most intense words occurring with the highest frequency. This emotional context exists even if it is unacknowledged, and whether or not climate change is being taught explicitly. We believe that these emotions can be assumed as a background field resulting from the current zeitgeist.

Discussion

We drew the title of the study, "Worry and Hope," from a student who, when asked, "How does all of this make you feel?" said:

> It's just like, some days you see the news, where it's mostly bad, and it makes you worse. But other days you see someone making a small little change and you think, "now I feel good, I can take over the world, I can do something. I feel like just having a little bit of hope can overpower the doubts" (second-year student, female).

This student thoughtfully described a fragile hope influenced by environment, media, teachers, and peers. A contradiction between what is taught and what is experienced (such as learning about plastics in an oceanography class, and then being unable to recycle plastic on campus) leads to a form of cognitive dissonance: If we can't deal with this single plastic bottle correctly, how will we ever combat climate change? On the other hand, a simple example or action—composting, using a reusable container—can be inspiring and motivating, a reinforcing moment that we call an act of cognitive resonance. By focusing on creating cognitive resonance, rather than eliminating cognitive dissonance (which is impossible), we might discover strategies toward hope and resilience. Whether or not these acts of cognitive resonance have critical impact, and whatever their cost to the college, they are important to fostering

a student's indwelling of climate knowledge, and thus to effective knowledge translation.

Returning to the metaphor of "voltage," there is an amount of information or engagement with climate change information that becomes emotionally paralyzing. Both researchers in this study experienced conditions of emotional distress as a result of this study. The term solastalgia seems to best capture the condition. Solastalgia, a term coined by Albrecht (2019), is "the existential and lived experience of negative environmental change, manifest as an attachment on one's sense of place" (pp. 38–39). While climate literacy is an imperative for college students, there is a degree at which immersion in climate change information can become paralyzing: It is literally too much information, too fast, in too many dimensions. Knowledge translation provides a conceptual framework to understand what the educators must integrate, and what they must bear; this, in comparison to what they should teach, and how they translate this information to the youth generation. The indwelling of climate change information, the tacit, unspoken, difficult part of it, is a different prospect to a 20-year old student facing climactic disruption, social upheaval, or climate collapse than it is for their 40–60-year-old college professor. If all knowledge is brokered knowledge, then what, here, is the responsibility of college faculty, as key translators in a brokering field?

Recommendations

The main implication of this study is that extensive further research is needed to understand how climate knowledge is mediated across the higher education sector. However, some recommendations can be made in three areas: faculty implementation, institutional planning, and future research. Most of these are known interventions and approaches that may be better understood if faculty can approach climate literacy from a lens of knowledge brokering or inter-mediation. The task facing faculty is to design a socio-emotional pedagogy that balances "worry and hope" and connects explicit and tacit knowledge. Institutions of higher education would be wise to connect the concurrent crises of enrollment, retention, engagement, as well as the domains of mental health and human flourishing with climate change education and translation.

More collaborative, student-oriented, and multidisciplinary curriculum and pedagogies for climate change must be rapidly diffused throughout the higher education sector in order to influence behavior (for mitigation efforts and problem-solving) and create societal foundations for long-term adaptation, both practical and psychological. To acknowledge and invite student lived experience and positionality, faculty acting as knowledge brokers should immediately de-center their expertise to invite and empower student leadership and perspectives.

For example, faculty can activate prior knowledge frequently and ask students to bring in multiple sources of climate knowledge as well as involving or interviewing family, employers, and peers. We were surprised by how much "lived experience" students reported about climate impacts. Faculty can also integrate affective and multi-modal activities such as reflective writing, facilitated dialogue, drawing, and mindfulness practices to engage complex emotions, activate the right brain hemisphere, and facilitate the "indwelling" of climate knowledge. Faculty professional development can be best accomplished through simple peer-to-peer conversation, and by opportunities to engage with climate change experts from within the university.

Administrators can do more to support learning communities, guest teaching, team teaching, combined activities, field work, and any type of cohort-style engagement with faculty and/or students in other courses (see Coleman, Murdoch, Rayback, Seidl, & Wallin, 2018). The reinforcement of messaging from multiple trusted sources (i.e., faculty from different disciplines) is a key component of climate communication. All campus personnel can help to model behavior change. Modeling, in fact, could be the most impactful manner of communicating tacit knowledge.

College campuses can provide many opportunities for acts of cognitive resonance that reduce emotional stress and anxiety. Acts of cognitive resonance are any small daily opportunities such as composting, recycling, water stations, energy, and transportation incentives to reduce greenhouse gases. Campus sustainability initiatives allow students to directly engage in solution-oriented activities to build and strengthen hope. And this supports learning. In addition, campuses can enlist mental health personnel in understanding and responding to emergent conditions of climate anxiety, solastalgia, environmental grief, and pre-traumatic stress induced by climate education.

The higher education sector in the United States is vibrant with sustainability activity,

commitments, and networks. Yet, as Kolenick (2017) and many others have noted, "…the challenge for universities as higher education institutions is in making the shift from a heavily discipline-based curricula and research agenda to a more integrated, multidisciplinary, and community-engaged environment that is problem-based in its approach" (p. 7). Climate change knowledge lends itself to interdisciplinary teaching (McCright, O'Shea, Sweeder, Urquhart, & Zeleke, 2013).

Conclusion: Further Research

There is an urgent need for a comprehensive assessment of climate literacy across higher education institutions in the United States. In addition, there is a need for both research and professional development for better understanding of effective pedagogies and mental models around climate change. How can colleges and universities create a more permeable boundary for knowledge translation with and between community stakeholders and partners, including community practitioners of practical skills (agriculture, shelter, emergency management)? Lastly, a comprehensive, consistent, rigorous, and regular assessment of learning around core competencies of sustainability and climate literacy across all majors and at both two- and four-year institutions is critical to create a competent populace for an uncertain future. Climate change will undoubtedly impact student futures, and thus should be an integral part of their experience in higher education. If it is not, issues of relevancy will continue to further erode the prestige and enrollments of colleges and universities in the United States.

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Appendix: Student Focus Group Protocol

1. Participants are welcomed, and given a release form to read and sign. Participants are informed that the session will be recorded (audio only).

2. Participants are asked to introduce themselves using a pseudonym of their choice, year in school, and self-declared major. Pseudonyms will be used in transcription and coding.

3. The research study is introduced, and the facilitator introduces him/herself.

4. Then a focusing activity is introduced, referring to the website of the Union of Concerned Scientists.

R: The Union of Concerned Scientists currently identifies the following topics as the most important issues (*indicates category added for local relevance). These topics are printed on index cards: Plastics in the Ocean, Invasive Species, Sea Level Rise, Agricultural Pesticides, Clean Energy, Clean Vehicles, Food & Agriculture, Climate Change.

5. R: When you look at this list, what else would you add? What else have you learned about that you think relates to sustainability? (New topics including local issues are added by participants.)

6. R: Now, I'd like you, as a group, to rank the top 5 of these topics (including added topics) that you think you know the most about. (Participants are invited to arrange a set of index cards with the topics printed on them on a table. This could also be done using a polling feature in an online setting.)

7. R: Good. Now, of these 5, which would you like to talk about? Which one interests you most?

8. R: Good. So, what do you know about X ?

9. R: Well, you know quite a bit about X. Can you talk about where you learned this?

10. R: So, What do you think you can do about X?

11. R: You said that these things can be done (repeat back). Which of these things do you actually do?

12. R: In general, how do you feel about X?

13. R: Is this something you think you should be studying in college? Why or why not?

14. R: Is this something you consider when you think about your future work? How might this affect your job choices?

15. R: Is this something you consider when you think about your personal goals and how your life will be?

16. R: Is there any other topic you'd like to talk about? (Repeat questions 8–15 as time allows).

17. R: Thank you for your participation.