

Teaching Climate Change Through Fiction, Data and Lived Experiences

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Our Vision

Almost 70% of Americans say that global warming is an issue of personal importance, yet that same number would not contribute \$10 a month to help cool the planet (Meyer 2019). To address this mindset gap, we created a course to motivate young students to act.

Our course connects the climate science to versions of the future told through stories that create a perspective of the “enormity, urgency and indeterminacy” of climate change. Our coursework weaves together basic science, scientific modeling of future climate projections, and human determinants along with current fictional literature (recognized as the literary genre Climate Fiction, or CliFi). By exploring the lives of relatable protagonists in near futures impacted by climate issues, these stories potentially add context to make the scientific underpinnings of climate change more broadly compelling (Goodbody and Johns-Putra 2019).

While our goal was to connect students emotionally to the world’s climate crisis, we were mindful of the real possibility of creating climate anxiety and depression. So we consciously examined a variety of stories for which we could analyze contributing science to the altered future envisioned within, to reinforce the idea that we need not land in dystopia (see Course Reading List, below).

Over the year we spent developing this course we closely followed the break-neck pace of CliFi publications. Just before the class started, two brand-new short story anthologies were published (November and December 2019) that included stories of hope, adaptation and positive outcomes. Recognizing the timeliness of this writing and the evolving waves of themes represented in each new set of stories, we decided to incorporate these and other anthologies into our course readings.

Our Course: Our future as told in “CliFi” (Climate Fiction) and “CliSci” (Climate Science)

5 credit Winter 2020 UW Bothell First Year and Pre-major Program (FYPP) course

At the core of our class was an adaptation of the InTeGrate Module Cli-Fi: Climate Science in Literary Texts (Hanselman et al., 2017). We built on this framework using other classroom tested materials from InTeGrate and CLEAN, and from our own previous teaching experiences, while also creating new materials specifically for this course.

First half of the course: fundamentals of the science of climate change and climate modeling.

- Science concepts we taught in some depth:
- the climate as a system
- the global carbon cycle and time scales
- climate models and projections
- global and regional impacts of climate change

Students contextualized climate change with data (e.g. drought indices, weather station data) relevant to their own lived experiences.

Second half of the course: an introduction to the newly burgeoning literary mode of Climate Fiction (CliFi).

- Students contextualized the climate change issues of protagonists in futuristic short stories and longer novels with science and data projections.
- We used examples of writers with scientific training (Barbara Kingsolver) as well as science-literary partnerships (e.g. stories in McSweeney’s 2040 created with input from the National Resources Defense Council, NRDC) to demonstrate ways that the two fields could complement each other.
- Students read articles discussing the recent emergence and extraordinarily rapid evolution of the CliFi genre.

Throughout the course: students explored specific ways they can engage in solutions through educational or career pathways tailored to their interests, skills and personal choices.

Culminating Project: In groups of 2-3, students integrated their understandings of climate science, literary themes, and solutions in a final poster/poster session revolving around three (group selected) CliFi pieces.

Assessment of Learning and Attitudes: We measured progression of student learning and attitudes through written assignments, quizzes, and a series of surveys. These data informed our evaluation of the effectiveness of the curriculum for both teaching climate and inspiring participation.

CliFi Reading List

Novels

New York 2140, Kim Stanley Robinson
Permafrost, Alistair Reynolds
Flight Behavior, Barbara Kingsolver
Birthmarked, Caragh M. O’Brien
Parable of the Sower, Octavia Butler
The End We Start From, Megan Hunter
Odds Against Tomorrow, Nathaniel Rich
Ship Breaker, Paolo Bacigalupi
Memory of Water, Emmi Itaranta
The Water Knife by Paolo Bacigalupi
Gold Fame Citrus, Claire Vaye Watkins

Short story anthologies

I’m with the Bears (ed. Mark Martin, 2011)
Everything Change Volume I (2016)
Everything Change Volume II (2018)
McSweeney’s 58 2040 A.D. (2019)
Our Entangled Futures: Stories to Empower Quantum Social Change (2019)

Movies

Snowpiercer, Bong Joon-Ho, 2013
Day After Tomorrow, Roland Emmerich, 2004
Water World, Kevin Reynolds, 1995

Who are our students?

This class is taught as a winter quarter option in the three-quarter long Discovery Core (DC) curriculum required for all students entering as First Years at UW Bothell. It is open to other students on a space available basis. Goals of winter DC courses focus on building analytical, creative and collaborative skills, in addition to introducing tools and resources for excelling in academic and personal life as undergraduate students.

Background:

- Students were between 17-22 years old.
- 87% were First Years with undeclared majors.
- All attended high school in Washington state.
- 81% attended public high school.
- >93% took chemistry and/or biology & <20% took environmental science in high school

News interests:

- 26% follow news through newspapers or cable or local television news at least once a week.
- 36% follow news from various sources sent to cell phone at least once a week.
- 34% do not follow the news regularly.

Connection with Climate:

- 58% report hearing about climate change/global warming at least once a week on social media.
- 13% or less report hearing about climate change/global warming at least once a week from peers, teachers, parents, advisors or librarians.

Examining Student Attitude Response

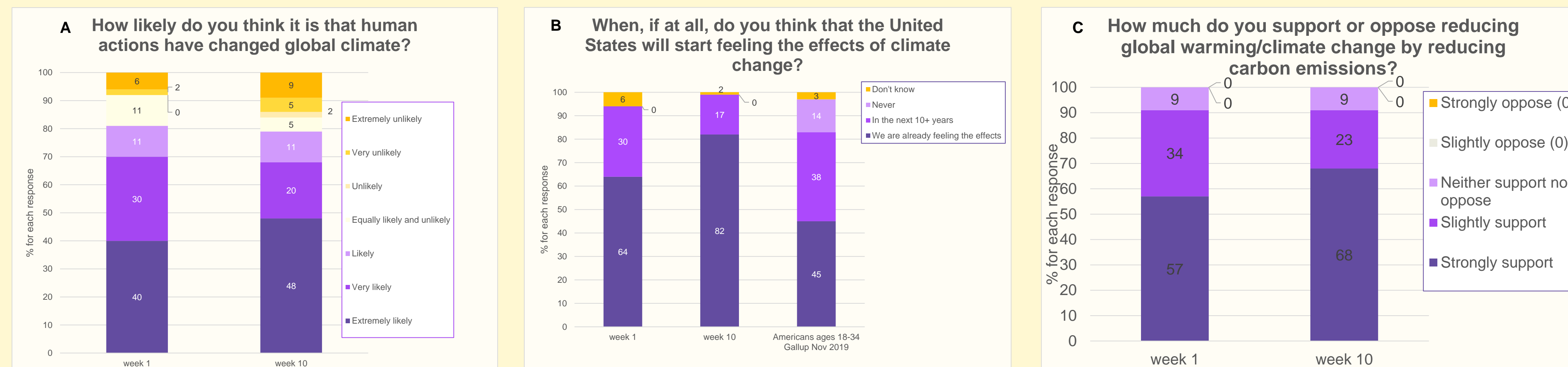


Figure 1. Student response to online survey questions completed at the beginning (week 1) and end (week 10) of the course. We designed questions so answers would be comparable to those from national surveys administered by others (Gallop 2019; Leiserowitz et al. 2019).

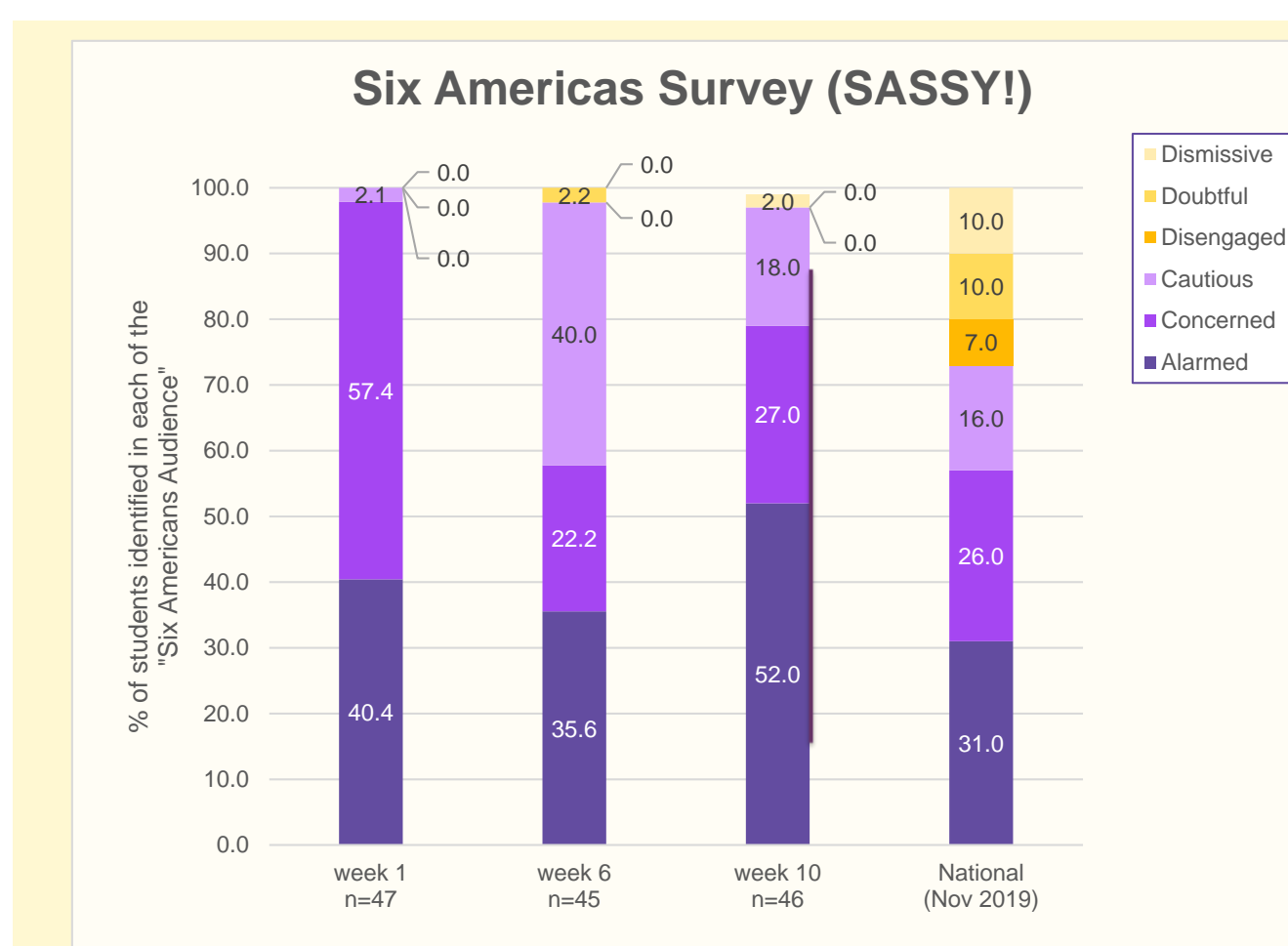


Figure 2. Students completed the four questions Six Americas Super Short Survey (SASSY) (available at <https://climatecommunication.yale.edu/visualizations-data/sassy/>) at the beginning (week 1), middle (week 6) and end (week 10) of the course. We used the online group scoring tool (Christ et al. 2018) to classify overall student perception of global warming in accordance with this classification.

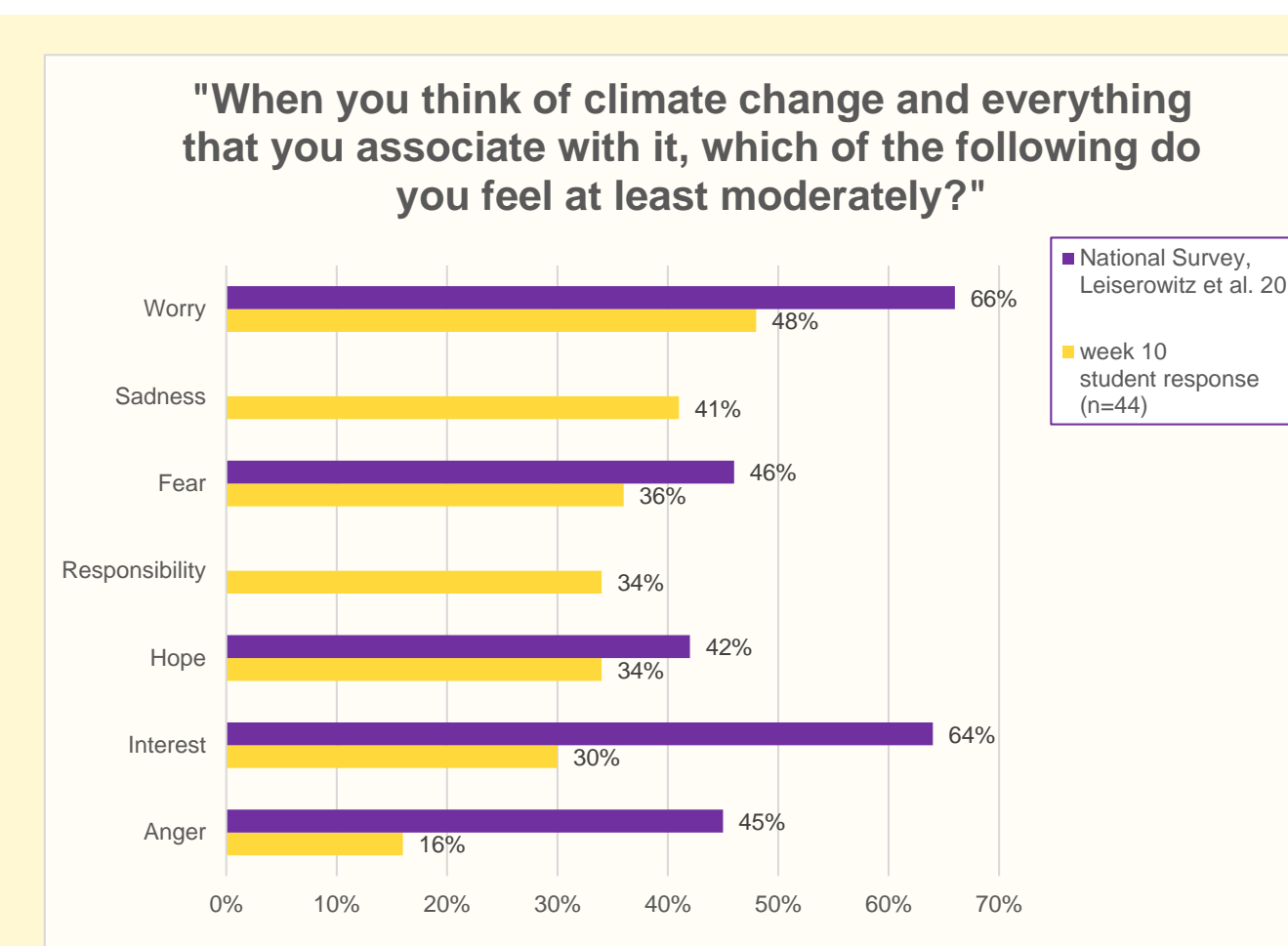


Figure 3. At the end of the course (week 10) we asked students to identify adjectives describing their feelings about climate change. Comparison with adjectives identified nationally in the 2019 Climate Change in the American Mind surveys (Leiserowitz et al., 2019) indicates that our students expressed less emotional connection to climate change than did Americans as a whole. At the end of our course students most strongly reported feeling “worry,” and least strongly reported feeling “anger.” In future we will use a comparable survey question at the start of the course to more carefully monitor shifts in these emotions.

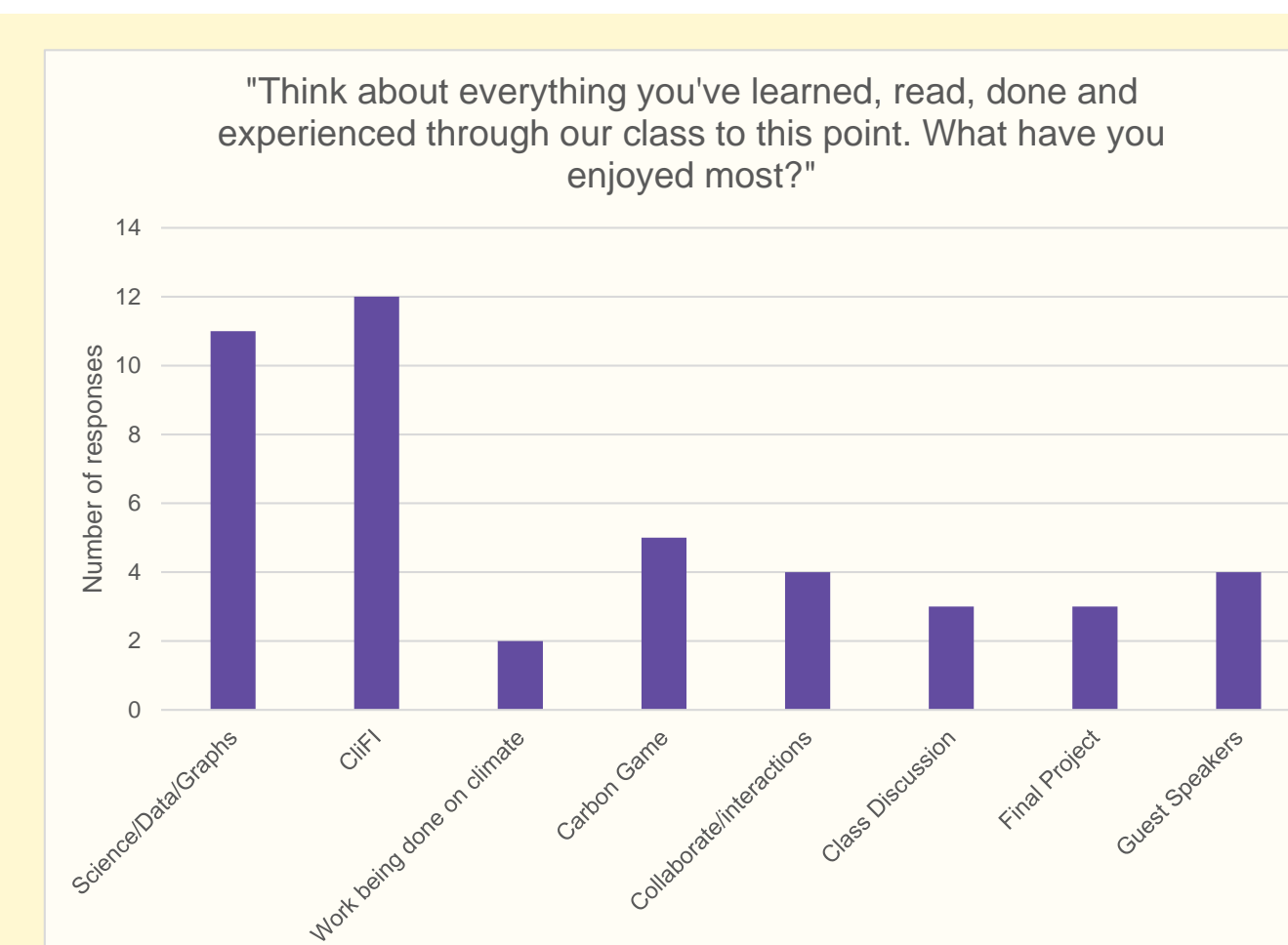
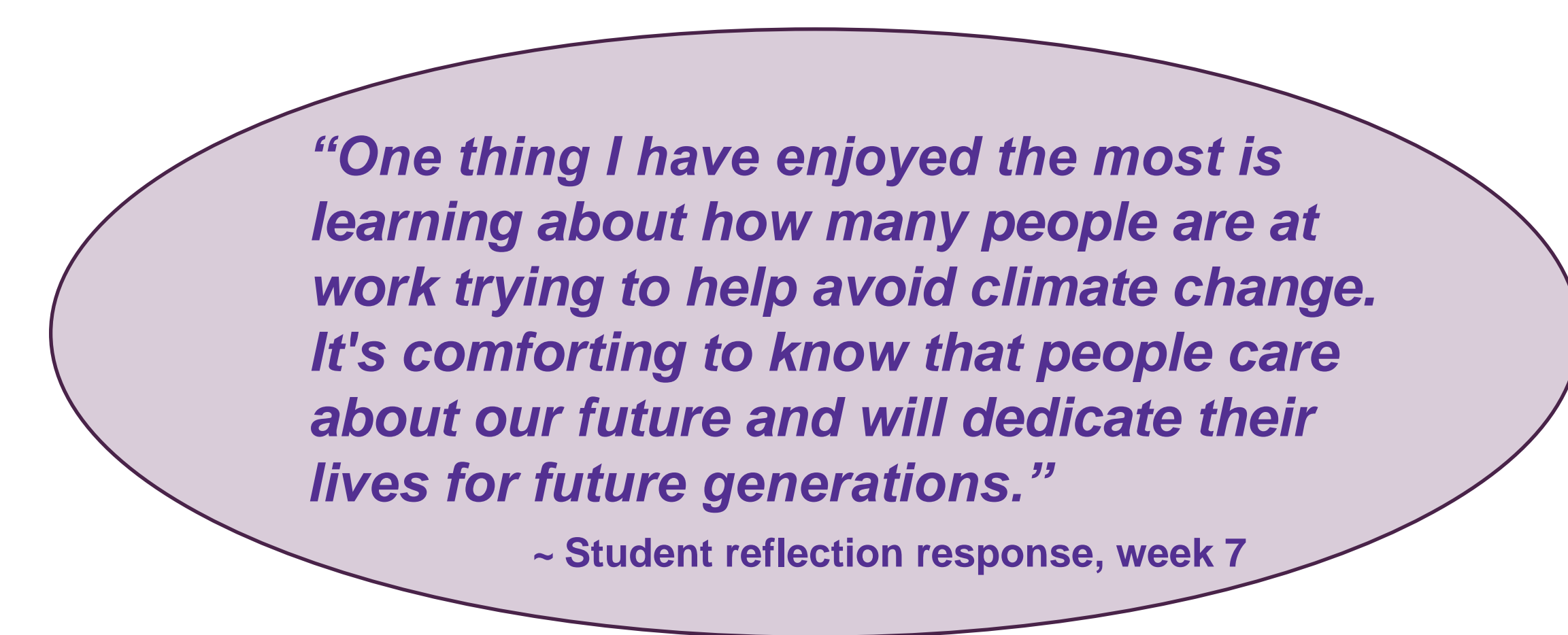


Figure 4. Midway through the course students were asked to briefly state what they had enjoyed most in the class so far. They were given no other prompts. At that point we had focused on climate science but had also read two climate fiction stories.

Assessing Climate Science

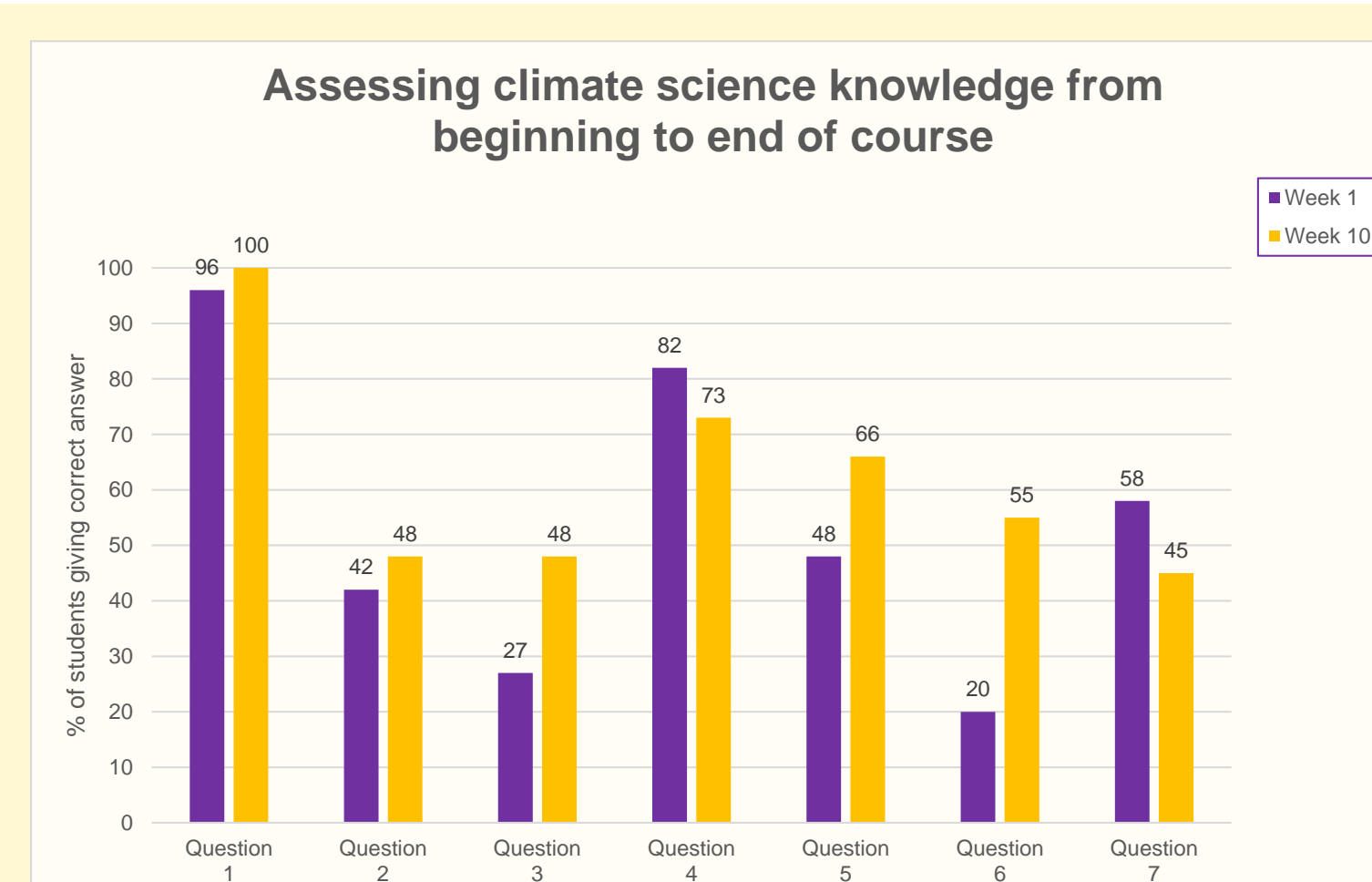


Figure 5. Percentages of students reporting the correct answer for each of seven questions included in a “climate literacy” quiz given at the beginning (week 1) and end (week 10) of the course. We did not specifically review answers with students between the two quiz sessions. Questions were adapted from an online survey prepared by CLEAN (Climate Literacy and Energy Awareness Network) <https://cleanet.org/clean/literacy/climate/quiz.html>. The science content necessary for answering all quiz questions in this figure was covered in the course. A greater number of students reported the correct answer in the Final (week 10) than on the Initial (week 1) for most of these questions, with the exception of Questions 4 and 7. These questions are fundamental to understanding the climate crisis (Q4 = underlying cause of atmospheric CO₂ increase) and urgency (Q7 = time limit for containing 2 degree temperature rise), yet they may be confounded by in-depth study of atmospheric CO₂ making incorrect answers appear.

Q1. What is the greenhouse effect?
Q2. What proportion of climate scientists has concluded that humans are the primary driver of today's climate warming?
Q3. What causes the annual up-and-down fluctuation in CO₂ in the atmosphere seen in the graph of CO₂ measured on Mauna Loa?
Q4. What is the primary cause of the overall rising trend in CO₂ in the atmosphere as measured on Mauna Loa?
Q5. What causes ocean acidification?
Q6. What is the leading cause of coral bleaching?
Q7. How fast do we need to stop burning fossil fuels to limit global temperature rise to 2 degrees C (3.6 degrees F)?

Comparing Students’ Attitudes with National Attitudes

Human responsibility for climate change (Fig. 1A):

- Overall a strong majority (81%) of students entered the class with the perception that humans are likely the cause of global climate change. This belief strengthened in this student population over the course of the quarter, with 8% of the students increasing their conviction of human responsibility from “very likely” to “extremely likely.”
- At the same time 20% of the students were unconvinced of this idea both at the start and end of the course. This is a disturbing result, considering students worked through several assignments directly addressing fossil fuel burning as the cause of global warming.

Timing of Climate Change (Fig. 1B)

- 94% of our students started the class believing that the United States is either feeling the effects of climate change already or will in the future (a greater number than the 84% of Americans aged 18-34 in the general US population as surveyed by Gallup in Nov 2019). By the end of the course 98% of our students shared this belief.
- Furthermore, student interpretation that we are “already experiencing (climate) effects” increased from 64% to 82%, far exceeding this belief in the general population in their age range (45%; Gallup Nov 2019).

Support for Reducing Emissions (Fig. 1C)

In alignment with the increased awareness that the US is currently experiencing the impacts of climate change, there was an 11% increase (57 to 68%) in students who would “strongly support” reducing carbon emissions as a pathway to reducing global warming.

Student Emotional Response (Figs. 2-4)

- As measured by the results of the “Six Americas Survey,” the number of our students that fell into the “alarmed” category was greater than the national average of 31% and increased between the beginning and end of our course (from 41% to 52%).
- Despite high levels of alarm, fewer than 50% of our students claimed to feel “at least moderate worry” when asked to identify named emotions to describe their feelings (Fig. 3). This is less than the 65% reported in the American population as a whole and the 70% of Americans age 18 to 34 (Leiserowitz et al 2019, Gallop 2019). Fewer than 20% of our students reported feeling anger at least moderately, as compared with 45% nationally.
- We noted the interesting pattern that towards the middle of the course (week 6) students were less alarmed about climate change (as assessed by SASSY survey). This appeared to reflect reassurance as they learned the depth of active work by scientists and others towards solving the climate crisis. Clues to this explanation can be seen in Figure 6 which illustrates student engagement with the course, and the reflection shared by a student during week 7. The decrease in alarm turned out to be temporary, as by the end of the course the percent of students expressing alarm had increased to levels higher than the beginning of the course (52%; Fig. 2).

Science Knowledge

We used quizzes and assignments to measure and monitor student learning of science concepts studied in class. Additionally, we used a climate literacy survey published by CLEAN to assess general knowledge at the beginning and end of the course. While the topics covered on this survey extended more broadly than our course content, comparisons of before/after course scores indicate that when we taught directly to the science content (as we did for concepts involved in the seven questions shown in Figure 5) student understandings usually (though not always) improved.

Examples:

- **Ocean health.** CLEAN survey Questions 5 and 6: Pre-course scores on these questions reflected prominently held student misconceptions that ocean pollution was the leading cause of coral bleaching. **Specific lessons addressing this issue:** Readings and class discussion of portions of the National Climate Assessment (USGCRP 2018) specifically addressed the impact of climate change on heat and ocean pH. **Outcome:** Student scores on the end-of-course survey reflect that students learned that CO₂ dissolved in seawater caused ocean acidification (18% more correct answers reported on final survey) and that warmer waters were the leading cause of coral bleaching (35% more correct answers).

- **Scientific Consensus on Climate** More than 97% of climate scientists will tell you that global warming is happening and caused by human activities (Oreskes, 2004). Almost half our students understand the consensus on this issue, with an increase by the end of the course. At the same time, if you consider numbers of students who recognized that the majority (>50%) of scientists agree, 82% of our students (age 17 to 22 yrs) recognized this at the end of the course, which curiously was lower than the 91% at the start of the course (data not shown). These numbers can be compared with the national data, where 73% of Americans age 18 to 34 (Gallop, 2018) understand this, and 55% of Americans overall understand this (Leiserowitz et al. 2019). **Teaching outcome:** Because misunderstanding the extent of scientific consensus that global warming is human caused could be a gateway belief to supporting action on climate change, this result motivates us to include an explicit discussion of scientists’ opinion in our next offering of this course.

Conclusion

We clearly perceived shifts in student attitudes, opinions, understandings and feelings about climate change from the beginning to the end of this course. There are certainly difficulties in interpreting these shifts including a potentially large impact of the interruption to teaching by the unprecedented emergence of the Covid19 pandemic. At the 8th week we restructured our programming to work with students online, and the situation likely flavored survey results given in the 10th week of class. We do feel that for these 49 students we have opened a pathway to addressing climate change. We look forward to modifying and improving our content for future students and will forever refer back to the Covid-stunted winter quarter of 2020.

References

- Chryst, B., Marlon, J., van der Linden, S., Leiserowitz, A., Maibach, E. & Roser-Renouf C. (2018) Global Warming's "Six Americas Short Survey": Audience Segmentation of Climate Change Views Using a Four Question Instrument. Environmental Communication, 12:8, 1109-1122. DOI: 10.1080/15240392.2018.1508947
- CLEAN: Climate Literacy and Awareness Network. <https://cleanet.org/index.html>
- Cli-fi: A Companion, edited by Axel Goodbody and Adeline Johns-Putra (Oxford: Peter Lang, 2019) 235pp.
- Hanselman, J., Oches, R., Silko J. and Wright, L (2017) Cli-Fi: Climate Science in Literary Texts. InTeGrate. Retrieved March 30, 2020, from https://serc.carleton.edu/integrate/teaching_materials/climate_fact/index.html
- Leiserowitz, A., Maibach, E., Rosenthal, S., Kotcher, J., Bergquist, P., Ballew, M., Goldberg, M., & Gustafson, A. (2019). Climate change in the American mind: November 2019. Yale University and George Mason University. New Haven, CT: Yale Program on Climate Change Communication.
- Meyer, Robinson “The Unprecedented Surge in Fear about Climate Change” January 23, 2019. The Atlantic 2019
- Oreskes, N. 2004. The Scientific Consensus on Climate Change. Science Vol. 306, Issue 5702, pp. 1686. DOI: 10.1126/science.1103618
- Reinhart, R.J. (2018) Global Warming Age Gap: Younger Americans Most Worried. Gallop.
- USGCRP. 2018. Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment. Volume II (Reidmiller, D.R., C.W. Avery, D.R. Easterling, K.E. Kunkel, K.L.M. Lewis, T.K. Maycock, and B.C. Stewart (eds.)). U.S. Global Change Research Program, Washington, DC, USA, 1515 pp. doi: 10.7930/NCA4.2018.