Title:

Teaching a Social Science Course on Climate Change: Suggestions for Active-Learning

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Teaching a Social Science Course on Climate Change: Suggestions for Active-Learning

Abstract:

Previous research indicates the importance of interdisciplinary approaches when teaching about climate change. Specifically, social science perspectives allow students to understand the policy, economic, cultural, and personal influences that impact environmental change. This article describes one such college course that employed active-learning techniques. Course topics included: community resilience, environmental education, historical knowledge timeline, climate justice, social vulnerability, youth action, science communication, hope versus despair, misinformation, and climate refugees. To unify these concepts, engaging activities were developed that specifically address relevant individual, local, state, national, and international climate resilience themes. Students assessed their personal climate footprint, explored social/cultural influences, wrote policy requests to relevant local/state government officials, studied national policy options, and learned about previous global initiatives. The course culminated in a mock global climate summit, which was modeled on a Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC). This final activity required each student to prepare a policy report and represent a nation in negotiating a multilateral climate agreement. It is accepted that climate change education must include physical data on the impacts of anthropogenic emissions. It is also essential that students appreciate the interdisciplinary nature of climate adaptations, become hopeful about addressing change, and gain skills necessary to engage as informed climate citizens.

Key Words: Climate Change, Education, Policy, Resilience, Social Science, Societal Impacts

"People" in Climate Change Education

Research indicates that several problems hinder climate change education, including: complexity of scale, strict disciplinary divisions, lack of professional training, curriculum constraints, and controversy (Robinson 2011, Sharma 2012, Shepardson et al. 2012). In addition, climate change topics are multidimensional and some science teachers say they lack confidence in teaching social, policy, or action components. Despite these challenges, research underscores the importance of climate change education, and the necessity of integrating climate change issues throughout educational programs and curriculum (Leal-Filho and Hemstock 2019, Molthan-Hill et al. 2019). Specifically, the inclusion of social science skills and perspectives is crucial to climate change education, as informed citizens need to decide how to balance climate change mitigation, adaptation, and suffering in the face of evident impacts (McKeown and Hopkins 2010, UNESCO-UNFCCC 2016, Wuebbles 2018). In fact, research underscores the need for "holistic climate change education" that includes not only knowledge, but also values, worldview, participation, hope, and other emotions (Cantell et al. 2019).

Effective teaching strategies for environmental education include active-teaching methods that emphasize information that is relevant to students at the personal level (McKeown and Hopkins 2010). One-way communication of climate science, exemplified in lectures to passive listeners, does not elicit thorough understanding or changes in behavior. On the other hand, active-learning closes the perception-action-learning loop. Games and simulations empower participants to make decisions that mimic meaningful real-world situations, which allows for intuitive understanding of complex systems (Creutzig and Kapmeier 2020.) Four approaches particularly promote climate change learning: guided discussions, interaction with scientists, addressing

misconceptions, and implementing local projects (Monroe et al. 2017). Further, climate education is most successful when it focuses on tangible, individual behavior at the local level and with clear presentation of actionable interventions (Anderson 2013). Thinking geographically, climate change education is urgently needed to address complex ecological and sustainable development challenges at the local-to-global scale (UNESCO 2010).

A common challenge in teaching climate change (and other environmental crises) is the sense of hopelessness (or "eco-anxiety") such topics carry; thus, teachers often seek methods that will foster hope and action among students (Pihkala 2020). Based on Petersen and Barnes (2019), four specific methods may be incorporated into the classroom to reduce such anxiety. First, focus on "agency" or the capacity of individuals to create change by emphasizing active-learning that promotes personal empowerment. Second, help students learn to identify hope through critical thinking and positive examples of issues from local-to-global scales. Third, teach students to set personal goals that are feasible actions to infuse hope into the classroom. Finally, focus on collective action to encourage a mentality of collaboration in class assignments and projects. All of these methods must be implemented with consideration for how students are influenced by personal beliefs, family, and peers (Stevenson et al. 2019).

Hopelessness regarding climate change is quite common among young people, but teachers must seek to pragmatically engage them rather than just provide superficial optimism (Ojala 2011). This is particularly important as scientists seek to understand whether hope concerning climate change is actually correlated to pro-environmental behavior, in which case future climate action would be more likely. Indeed, some research shows that constructive hope has a positive

influence on pro-environmental behavior while denial-based hope is negatively correlated with positive actions. This indicates that hope is motivational, if one can control for denialism by emphasizing scientific facts (Ojala 2011).

In the current social landscape, climate denial must be acknowledged and discussed in the classroom. In fact, understanding climate change denial from a psychological, economic, cultural, and political perspective is particularly useful in teaching climate change topics (Bentley et al. 2016, Monroe et al. 2017). One analysis developed a model to describe five categories of anthropogenic climate change dissenters: 1) naive (promoting scientific misconceptions); 2) sophisticated (using science to imply warming is not caused by humans); 3) natural (warming is out of human control); 4) beneficial (warming climate is good); and 5) global cycle (current warming is an acceptable part of the Earth's system) (based on Bentley et al. 2016). Understanding these perspectives can help teachers (and even classmates) connect with a wide variety of students.

Climate change educators should not only reach each student with facts, but must also communicate complex societal factors affecting climate action and inaction, viable economic solutions, and pragmatic policy options (UNESCO 2013). Comprehensive climate education helps protect students from misinformation. Overall, an emphasis on the scientific process helps students understand the fundamental basis of overwhelming scientific consensus on anthropogenic influences on climate change (NASA 2021). For example, specifically teaching students about the scientific publication peer-review process increases their confidence in published climate change research and helps them identify sources of misinformation on social

media and elsewhere. As outlined here, many important climate change topics are related to human actions and perspectives. Indeed, social science approaches to climate change education are increasingly vital.

Case Study: Class Outline

This case study describes a university-level social science climate change course (Duram 2019). Of course, each instructor must develop materials within their area of expertise to target their specific student population. Individual courses will vary in terms of topic coverage, assignments, goals, and learning objectives. This Case Study seeks to encourage teachers to engage students in the social science aspects of investigating, understanding, learning, and (ideally) addressing climate change.

"Global Climate Change" is a geography course for upper-level undergraduate and graduate students, that is broad enough to encompass many topics. Three concepts unify this course: understanding the interdisciplinary complexity of climate change, emphasizing that knowledge can provide hope and lead to meaningful action, and practicing necessary skills to engage as informed climate citizens. A local-to-global perspective integrates the six lecture/reading topics for the course:

1) Climate Change in People's Lives (background, timeline, today, our campus)
2) Opinion, Denial, & Information (media, scientific data sources, misinformation)
3) Obstacles to Action (media coverage, discrediting science, fossil fuel subsidies)
4) Policy & Agreements (local/state/national/global)
5) Activism & Climate Justice (refugees, vulnerability, impacts)

6) Working toward Sustainable Solutions (mitigation, adaptation, actions)

The lectures were pre-recorded and students were required to do background reading, watch the lectures, learn, study, and take a quiz on each topic prior to the classroom meetings. Readings were drawn from peer-reviewed journal articles, non-governmental organizations, scientific websites, and key national and international science and policy websites (NASA, US Environmental Protection Agency, European Union, United Nations, etc.). In this "flipped" classroom, lectures did not take up class time, so there was ample opportunity to engage students in a variety of other coursework to promote active-learning.

Invited guest lectures were given by professionals to bring specific expertise into the classroom and to encourage students to consider real-world employment opportunities related to relevant climate skills. Students wrote a structured two-page report following each guest lecture. First, the university's sustainability coordinator spoke about various climate change mitigation efforts that are underway on campus, which underscored opportunities for students to get involved in projects with tangible local results. Second, the campus engineer spoke to the class about energy usage on campus because it mirrors a small town in terms of its supply, demand, and energy sources. The third guest lecturer was a technical salesperson from a local solar panel installation company. She explained the process of providing solar panel estimates, understanding rebates and tax incentives, and general information about solar power in the region.

To unify the course concepts, several activities were developed that allowed students to build their research and writing skills while exploring interdisciplinary information and assessing their personal motivations and willingness to adopt climate friendly behaviors. The activities

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emphasized climate citizenship at each geographic scale: local to global. The focus of Activity 1 was "Personal, Local, and State" so students learned about and evaluated their personal climate footprint. Then, after conducting research and completing a detailed worksheet on actual initiatives, students wrote a phone script in which they asked their city and state politicians to take specific local and regional action on climate mitigation. Making the call was optional. Activity 2 addressed "National U.S. Climate Policy," so data from NASA, NOAA, and USGCRP was introduced, along with policy initiatives such as the Energy Innovation and Carbon Dividend Act. Students wrote a research-backed letter draft to their congressional representatives in Washington DC, explaining their personal views and suggestions for action. Sending the letter, of course, was optional. Activity 3 was to prepare a "National Policy Document for a Summit." Each student was assigned a country to represent in the mock Global Climate Summit at the end of the semester. At this meeting, students played the role of national representatives working to negotiate an International Climate Change Agreement. The final exam was a mock meeting of the Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC) similar in concept to the Paris meeting of 2015, for example. After a two-hour meeting to discuss and negotiate, the country representatives (i.e. students) voted on a mock Climate Change Agreement as the final action in the class.

Conclusion

Overall, a social science approach to teaching climate change encourages students to explore the broader context of the United Nations Sustainable Development Goal (UNSDG) #13: "Take urgent action to combat climate change and its impacts." By employing active-learning approaches, students can explore their personal climate footprint, learn about social influences,

write policy requests to relevant government officials, study national policy options, and learn about the complexity of global climate initiatives.

Understanding interdisciplinary perspectives and social science contexts is fundamental to comprehensive climate change education. Teaching students relevant information can motivate them to address climate change and give them hope for the future. Building research and communication skills enables students to become informed climate citizens. This case study describes how interdisciplinary knowledge, hope, and skills provide an effective framework for a social science course in climate change education.

References

Anderson A. 2013. Climate change education for mitigation and adaptation. *Journal of Education for Sustainable Development*. 6:191–206. https://doi.org/10.1177/0973408212475199

Bentley, A., H. Petcovic and D. Cassidy. 2016. Development and validation of the anthropogenic climate change dissenter inventory. *Environmental Education Research*. 25 (6): 867-882. https://doi.org/10.1080/13504622.2016.1250150

Cantell, H., S. Tolppanenb, E. Aarnio-Linnanvuoric and A. Lehtonena. 2019. Bicycle model on climate change education: presenting and evaluating a model. *Environmental Education Research.* 25(5): 717–731. https://doi.org/10.1080/13504622.2019.1570487

Creutzig, F. and F. Kapmeier. 2020. Engage, don't preach: Active learning triggers climate action. *Energy Research and Social Science*. 70 (101779) December. https://doi.org/10.1016/j.erss.2020.101779

Duram, L. A. 2019. GEOG 429 *Global Climate Change*. Course taught at Southern Illinois University Carbondale. www.Geography.siu.edu.

Leal Filho W., and S. Hemstock. 2019. Climate change education: an overview of international trends and the need for action. In: Leal Filho W., Hemstock S. (eds) *Climate Change and the*

Role of Education. Climate Change Management. Springer. https://doi.org/10.1007/978-3-030-32898-6_1

McKeown, R., Hopkins, C. 2010. Rethinking climate change education: everyone wants it, but what is it? *Green Teacher*. 89: 17–21.

Molthan-Hill, P., Worsfold, N., Nagy, G.J., Leal Filho, W., Mifsud, M. 2019. Climate change education for universities: a conceptual framework from an international study. *Journal of Cleaner Production*. 226, 1092–1101. http://dx.doi.org/10.1016/j.jclepro.2019.04.053

Monroe, M., R. Plate, A. Oxarart, A. Bowers and W. Chaves. 2017. Identifying effective climate change education strategies: a systematic review of the research, *Environmental Education Research*. https://soi.org/10.1080/13504622.2017.1360842

NASA. 2021. Scientific consensus: Earth's climate is warming. Global Climate Change: Vital Signs of the Planet. United States National Aeronautics and Space Administration. https://climate.nasa.gov/scientific-consensus/

Ojala, M. 2011. Hope and climate change: the importance of hope for environmental engagement among young people. *Environmental Education Research*. 18, 625–642. http://dx.doi.org/10.1080/13504622.2011.637157

Petersen, B., and J. Barnes. 2019. From hopelessness to transformation in geography classrooms. *Journal of Geography*. 119, 3–11. http://dx.doi.org/10.1080/00221341.2019.1566395

Pihkala, P. 2020. Eco-anxiety and environmental education. *Sustainability*. 12(23), 10149. https://doi.org/10.3390/su122310149

Robinson, Z. 2011. Teaching climate change in higher education: barriers and opportunities. Pages 36-50 in: Haslett, France & Gedye (Eds). *Pedagogy of Climate Change*. York: Higher Education Academy.

Sharma, A. 2012. Global Climate Change: What has science education got to do with it? *Science & Education*. 21, 33–53 (2012). https://doi.org/10.1007/s11191-011-9372-1

Shepardson, D., D. Niyogi, A. Roychoudhury, and A. Hirsch. 2012. Conceptualizing climate change in the context of a climate system: implications for climate and environmental education. *Environmental Education Research*. 18(3): 323–352. https://doi.org/10.1080/13504622.2011.622839

Stevenson, K., M. Peterson, and H. Bondell. 2019. The influence of personal beliefs, friends, and family in building climate change concern among adolescents. *Environmental Education Research*. 25(6): 832-845. https://doi.org/10.1080/13504622.2016.1177712

239 UNESCO. 2010. Climate change education for sustainable development. United Nations
240 Educational, Scientific and Cultural Organization. Paris, France.
241 http://unesdoc.unesco.org/images/0019/001901/190101E.pdf
242
243 UNESCO. 2013. Climate change in the classroom: UNESCO course for secondary teachers on
244 climate change education for sustainable development. United Nations Educational, Scientific
245 and Cultural Organization. https://unesdoc.unesco.org/ark:/48223/pf0000219752
246
247 UNESCO and UNFCCC. 2016. Action for climate empowerment: guidelines for accelerating
248 solutions through education, training and public awareness. United Nations Educational,
249 Scientific, and Cultural Organization and United Nations Framework Convention for Climate
250 Change. https://unesdoc.unesco.org/ark:/48223/pf0000246435.locale=en
251
252 Wuebbles D. 2018. Climate change in the 21st Century: Looking beyond the Paris Agreement.
253 In: Murphy C., Gardoni P., McKim R. (eds) *Climate Change and Its Impacts.* Climate Change
254 Management. Springer, Cham. https://doi.org/10.1007/978-3-319-77544-9_2
255

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