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Building Interdisciplinarity into Teaching

A Dream Course on Sustainability and
Global Environmental Change

JEFFREY M. WIDENER AND TRAVIS J. GLIEDT

From Dream to Reality

Imagine the chance to design an upper-division and graduate course with funds to invite world-leading experts to present and exchange research and ideas with students and faculty. That opportunity exists at the University of Oklahoma's (OU) Norman campus. OU calls it the President's Dream Course. Specifically, faculty have the opportunity to apply for a grant from the provost in order to attract three to five distinguished speakers from outside the university. Each speaker participates in activities on the OU campus for one week, which typically consist of the speaker delivering two to three lectures to the Dream Course and giving a public lecture. This format allows the core instructors to bring in experts who complement each other and the core instructors. As well, the public lecture fosters an opportunity for the community to engage with researchers who are exploring the planet's most pressing problems.

The provost granted two faculty members from the Department of Geography and Environmental Sustainability (DGES) the opportunity to teach a Dream Course entitled Sustainability and Global Environmental Change during the fall 2013 semester. The core instructors capitalized on this format to create a National Science Foundation-style interdisciplinary course based on a combination of humanities scholars and social and physical scientists. The core instructors are social scientists: one specializes in sustain-

ability science and economic development, while the other specializes in political geography. Two of the distinguished speakers were social scientists who draw upon cultural, economic, and social theories to conduct interdisciplinary research on sustainable development and climate change mitigation. A third speaker concentrated on geopolitical and cultural issues in the context of climate change adaptation. The fourth distinguished speaker was a world-renowned climate scientist with over 350 publications. In addition, the chair of the DGES, a hydrologist, and the dean of the College of Atmospheric and Geographic Sciences, a climate scientist and author of a past report by the Intergovernmental Panel on Climate Change (IPCC), presented their research and taught a lecture in the Dream Course. Finally, the course included students with a diverse mix of classifications and majors: six graduate students and twenty-nine undergraduate students from the Department of International and Area Studies and the DGES.

Here we explain how we designed a single interdisciplinary course, which utilized project- and problem-based learning principles, to effectively teach the multifaceted concepts enmeshed in sustainability and global environmental change. Our approach contrasts the emerging integrated degree programs that require students to take multiple courses that often separate out the interrelated subject matter that, taken together, provide an interdisciplinary perspective. We find that the pedagogical techniques utilized in the Dream Course are an effective means of teaching sustainability and global environmental change from a coupled human–natural systems perspective, which, in turn, may be a good approach to engage students (and faculty) in the environmental humanities.

Global Environmental Change, Sustainability, and the Environmental Humanities

Understanding complex coupled human and natural systems requires interdisciplinary collaboration.¹ The National Science Foundation's Directorates for Geosciences; Engineering; and Social, Behavioral, and Economic Sciences and the US Department of Agriculture's National Institute of Food and Agriculture have ingrained an interdisciplinary perspective into the solicitation for their Water Sustainability and Climate research program.² While researchers from different backgrounds are successfully synthesizing their knowledge and methods to create new models and approaches that could not have been created by any discipline independent of the others, teaching within an interdisciplin-

ary framework in the context of sustainability and global environmental change is a relatively novel and unproven concept.³

Interdisciplinary teaching in general is not new. Since the 1960s, instructors in the United States have utilized various pedagogical techniques.⁴ Typically, interdisciplinary teaching occurs through collaborative or team teaching, which can be meritorious for broadening a subject area beyond a single professor's expertise.⁵ For decades, geographers have identified team teaching as an effective means of geographic instruction.⁶ The challenge, however, is for geographers to provide myriad perspectives without losing the cohesiveness that students need to effectually learn within a single class. Geographers often use problem- and project-based learning techniques, which is a potentially effective interdisciplinary pedagogy for sustainability and global environmental change.⁷

Teaching environmental and climate change separately from sustainability or sustainable development may be imprudent owing to the inherent interconnectedness between these issues.⁸ Institutions, however, are integrating sustainability and climate change in single university curriculums, such as those for business, chemistry, and engineering, as well as in some doctoral programs.⁹ This approach typically requires students to take a string of courses that narrowly define research methods and research results in global environmental change and sustainability. Meanwhile, international teams of professors and researchers are demonstrating the importance of interdisciplinarity to sustainability teaching by integrating innovative, cross-cultural collaborative approaches.¹⁰ As such, interdisciplinary schools of sustainability are emerging, which engage students with disparate social, economic, and ecological principles in a coherent educational approach.¹¹ As we designed and delivered the course, we considered these thoughts, as we tried to provide students with multifarious dimensions of global environmental and sustainability science in an attempt to engage them with the environmental humanities. We combined problem- and project-based learning with collaborative teaching and learning approaches.

Course Design

Given the diversity of expertise and the variety of topics that would be covered, the core instructors created a syllabus that was designed to highlight the speakers' strengths and provide a coherent thread of

learning that built upon itself throughout the course. There were three key focal points for the course:

1. What are the likely impacts of global warming on Earth's environment throughout the world? How will these impacts affect local societies, economies, and cultures?
2. In a rapidly globalizing world faced with large-scale environmental change, how can societies address these issues from a perspective of environmental sustainability? How can knowledge of economics, sustainability, policy, and ecosystems help in the creation and development of effective policy solutions?
3. What can we do to reduce the human carbon footprint, with an eye toward creating a more sustainable global environment? How can the international community develop policies and promote cultural and economic changes oriented toward worldwide environmental sustainability? How can these changes be implemented given the increasing gap between wealthy and poor countries, and to what extent can community-oriented activity help to address this problem?

The first month of the course provided students with background in sustainability science, climate change science, the economics of sustainability, policy and politics of climate change, an understanding of climate change through cultural studies, and the relationship between climate change mitigation, adaptation, and sustainable development. The required readings consisted of three journal articles per week, supplemented by readings from Stephen Peake and Joe Smith's *Climate Change: From Science to Sustainability*. Additionally, the instructors used the Fourth and Fifth IPCC Assessment Reports. The lectures in the second month of the course progressed to more in-depth analyses of the political geography of climate change, the role of energy systems in global environmental change, and discussions of how vulnerability, risk, and adaptive capacity link climate change and sustainability.

The four distinguished speakers taught the third month of the course. Their topics included: green economic development; turning sustainability research into practice; state-level and community-based solutions to climate change; new models of learning for sustainability; environmental behavior and community-based social marketing; integrating sustainability principles into a water and climate change study; global climate change

models for understanding future climate changes; techniques of measuring historical climate changes; integrated models for understanding climate and pollution changes at the community level; a critical discussion of the relationship between borders, culture, and climate change; and a dialogue to flesh out a new conception of nature in the context of climate change and the Anthropocene. The students were also able to continue the discussion on these topics with the distinguished speakers after the class time, during organized lunches, dinners, and small group meetings. The distinguished speakers even gave impromptu lectures to other students in the college who were not part of the Dream Course but who were interested in the sustainability and global environmental change interface. The chapter groups from the Dream Course also met with one or more of the distinguished speakers for a critical thinking session designed to provide early feedback on a draft of their chapters. This was essential to the interdisciplinary format for the course, because the students were able to delve deeper into the motivations for the research conducted by the speakers throughout their careers and connect those diverse perspectives into their assignments.

The final few weeks of the course involved the core instructors facilitating discussions on adaptive co-management, polycentric governance approaches and the Ostrom model of coupled socio-ecological systems, and the potential of a world government to complement community-based approaches for adaptation.¹² The chair of DGES gave a lecture on climate change and water in Africa, and the dean of the College of Atmospheric and Geographic Sciences gave a thought-provoking concluding lecture to the course that focused on climate change: what we know, what we think we know, and what we do not know.

The core instructors designed the course assignments from an interdisciplinary perspective. Students formed small groups and held formal debates on topics related to the course themes, which included: solar power can solve climate change; the number of people living along coastlines should be limited in light of projections for rising sea levels; carbon taxes should be used as an intervention to solve climate change; a pipeline should be built from the Great Lakes to the US Midwest as an adaptation strategy for more frequent droughts anticipated by modeling studies; and genetically modified organisms (GMOs) should be used as a sustainable solution to climate change. Students had to prepare arguments both for and against each topic, as the core instructors flipped a coin on the day of the debate to determine sides.

Students also presented a critique of a journal article to the class.

This assignment required students to analyze an article from outside their discipline. The article had to focus on sustainability or climate change, and the student had to assess the article based on other articles they had read in class. The third assignment had students summarize and compare two of the distinguished speakers in the course. The goal was to have students see the disciplinary differences between each of the speakers but then synthesize the speakers' work into a single argument about climate change mitigation or adaptation or about sustainable development.

The fourth assignment was a term-long project. Specifically, students had to write a chapter in teams of four or five. Each chapter focused on a different potential mitigation or adaptation solution to climate change: renewable energy, adapting to sea level rise, reversing deforestation, sustainable agriculture, climate change and cultural lessons from indigenous peoples, and the geopolitics of climate change. The core instructors acted as editors and wrote introductory and concluding chapters to what became a coherent book based on the team chapters. The process mimicked the IPCC, whereby each chapter represents a standalone contribution but linked together the common threads of the course: sustainability principles, risk, vulnerability and adaptive capacity, and sustainable development. Teams had to go through multiple rounds of edits, which engaged them in an ongoing learning process often absent in many university courses but characteristic of the level of critique and synthesis that is necessary to produce a document based on an interdisciplinary research perspective. Students learned the challenges and rewards of working as a team as well as the collaborative responsibility for producing a single integrated document of publishable quality within tight timelines.

Discussion and Observations: Interdisciplinary Teaching for the Environmental Humanities

Problem- and Project-Based Learning

Based on an extensive literature review, Spelt and others identified subskills of interdisciplinary higher education and mapped them onto Biggs's model of teaching and learning as an interactive system, which included student conditions, learning environment, learning process conditions, and interdisciplinary thinking.¹⁵ Following Spelt's recom-

mentations, the Dream Course instructors aimed to cultivate the following subskills:

- Curiosity and social learning among the *students*
- Team teaching to achieve active and collaborative learning within an integrated and interdisciplinary *learning environment*
- A phased *learning process* that builds knowledge week-by-week and assignment-by-assignment, including a multistage editing process for the major chapter assignment, in order to incorporate feedback and allow for reflection
- *Interdisciplinary thinking*, both directly through teaching the strengths and weaknesses of key disciplines for solving climate change (e.g., economics, cultural studies, policy studies, technology innovation, environmental sciences) as well as indirectly through lectures by the core instructors and distinguished speakers that were designed from an interdisciplinary perspective so as to develop cognitive skills for comprehending and thinking in a coupled human–natural systems perspective¹⁴

The core instructors followed the *problem-based* approach to interdisciplinary learning, whereby the integrative process takes the form of problem-centered investigation of urgent or tangible issues that can only be solved by collaboration between multiple disciplines.¹⁵ The instructors framed the course in the context of global environmental change having significant impacts on human societies and therefore needing solutions that are socially just, economically feasible, and environmentally effective. The course exposed students to economic, social, cultural, political, sustainability science, and climate science studies. In their assignments, students were required to interpret, critique, and synthesize materials from multiple disciplines. The instructors also utilized *contextualizing*, which involves identifying core concepts that are central to multiple disciplines and establishing a connection between them.¹⁶ In this case, the instructors used the core themes of change, uncertainty, complexity, and conflict, which are important to both social and physical scientists in their study of sustainability and environmental change.¹⁷ These themes were repeated in the core instructors' numerous lectures, in the required readings, and in the distinguished speak-

ers' discussions. Furthermore, the teams had to include the themes in their chapters to weave the finished document together.

Team Teaching: Difficulties and Rewards

Team teaching by the core instructors enhanced the problem- and project-based approach to interdisciplinary teaching. Both instructors delivered every lecture and discussion; while one instructor took the lead for a given class, the other provided complementary and critical perspectives throughout the lecture. This allowed the students to see that there are multiple views on sustainability, climate change, and governance options and that there is not just one single way to solve global environmental issues.¹⁸ A healthy debate between the two instructors often took place to encourage the students to partake in the discussion. Students frequently mentioned that they enjoyed this form of teaching because they got to see their professors challenging each other's ideas and delving deeper into the material than usually occurs in a mono-instructor class. This supports the suggestion that multidimensional solutions are needed for sustainability teaching rather than a "single truth answer."¹⁹

The compatibility between team teachers is a key component in student learning. In particular, it is important that instructors have different but complementary teaching styles, and the core instructors used a variety of lecture formats to give students diverse learning mechanisms. Having different areas of expertise (e.g., sustainability science and economic development on one hand and political geography on the other) is also important to enhancing student learning. Having different genders of the teachers may also improve learning outcomes; and while both core instructors were male, the distinguished speakers represented both genders. An additional component that may create a positive learning dynamic is the age difference between the core instructors. One core instructor is an early career assistant professor, while the other is a full professor nearing the end of a distinguished career. This was particularly evident during in-class discussions of sustainability solutions, where the expertise of the early career instructor was juxtaposed to that of the later career instructor, who, for example, pointed out factors that may inhibit certain demographics from participating in community-based and social solutions introduced by the early career instructor. It was clear from the student feedback that team teaching was critical to the learning environment as well as helpful in facilitating

a collaborative learning process for students via class discussions and group work projects.²⁰

Student Evaluations and Feedback

As part of the formal course evaluations, some students expressed confusion from having two instructors, with regards to communicating evaluation expectations and assignment deadlines throughout the term. While the instructors coordinated the creation of the course syllabus, met prior to every class to synchronize topics and logistics for that day, and repeatedly mentioned assignment deadlines and required readings to the students, some students pointed out that expectations from previous classes that they had taken with one or the other core instructor sometimes overpowered the messages from the core instructors in the Dream Course. These students were inclined to follow what they believed to be the norm for grading by the core instructor from whom they had previously taken a class, rather than the expectations outlined on the Dream Course syllabus.

Another challenge of team teaching is the process of team marking. Ensuring that both of the instructors independently assessed all the assignments, coordinated their marks after a detailed discussion of the merits of each individual in the class, and did so in a timely manner was a difficult and sometimes frustrating process. Some students commented that they wanted the grades recorded and returned more rapidly throughout the course. A trade-off was evident in that the instructors were able to provide more frequent and detailed feedback about assignment progress during the term but took longer to finalize the grading than mono-taught, disciplinary courses. Finally, some students commented that they wished the Dream Course included a practitioner who was an expert in government policy or community solutions from a developing country, which scholars have recognized as being critical for furthering the connections between research and practice.²¹

Conclusion

In summary, the environmental humanities can benefit from a team-teaching approach for interdisciplinary subjects such as sustainability and global environmental change. Team teaching is a key component of a constructivist-teaching pedagogy, a didactic that focuses on the con-

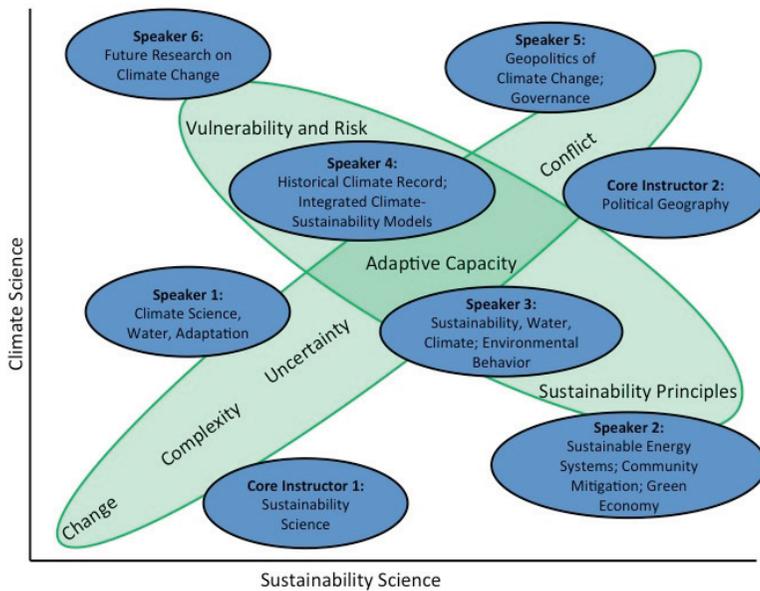


Fig. 1. Interdisciplinary course on sustainability and global environmental change. Photo courtesy of the authors.

struction of new knowledge and building on knowledge that already exists.²² Constructivist teaching was central in the course design and course delivery. The instructors collaborated well, drew on each other's perspectives, and encouraged students to engage in the learning process of other students by helping to facilitate the teaching process.²³ The instructors chose lecture topics that were edgy and controversial in order to challenge students' preconceived notions about sustainability and climate change. The core instructors designed the course to address problems of societal relevance and to build each lesson around the key concepts woven throughout the course.²⁴ The instructors provided support for the integration of disciplinary knowledge throughout the course during the class discussions and the group assignments.²⁵ Professors should further explore constructivist-teaching principles to contribute to interdisciplinary courses on sustainability and climate change, which may play an important role in the teaching of the environmental humanities.

We found that the key to delivering a successful interdisciplinary

course is to carry throughout the course central threads and themes, which connect the core instructors, distinguished speakers, and course assignments. In the Dream Course, the central themes were change, complexity, uncertainty, and conflict; and the central threads were vulnerability, risk, adaptive capacity, and sustainability principles (fig. 1). These themes and threads are important both to climate science and to sustainability science and therefore acted as the glue to the course. Adaptive capacity became a recurring topic that was evident in many lectures, and the class examined this trait as a cultural, economic, and institutional component of solutions to climate changes as part of the group chapters.

The challenge, as Spitzer pointed out, is that while interdisciplinary classes can be effective, they tend to disappear from colleges once the initiators retire or discontinue their classes.²⁶ If interdisciplinary teaching is to continue, it must follow a similar path to interdisciplinary research programs and become ingrained into curriculum committees, department course offerings, and college-teaching pedagogies. On a final note, the opportunity exists for faculty at nearly every university to teach a similar course. The monetary benefit of bringing in specialists from around the world is extremely nice, but it is not necessary. Professors just need to reach out across campus to gather specialists in other disciplines who can deliver guest lectures. Indeed, some professors may decline, given the extra workload; but the extra mile is rewarding for students, faculty, and the university community.

ABOUT THE AUTHORS

Jeffrey M. Widener is the geospatial information systems (GIS) librarian and an assistant professor of bibliography at the University of Oklahoma in Norman. As well, Jeff is a PhD candidate in geography and environmental sustainability at the University of Oklahoma. His research interests vary, but chief among them are exploring processes of cultural landscape change as it relates to ethnic groups, land tenure, and environmental conservation, particularly in the American West, and studying the interplay between geographic education and sustainability education.

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within organizations. His interdisciplinary teaching approach has led to experimental course designs, including a graduate seminar titled *The Geography of Sustainability*, which explored the extent to which sustainability and geography can be integrated in teaching. He is a member of the Association of American Geographers and the National Council for Geographic Education.

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