Towards a revolution in sustainability education: Vision, architecture, and assessment in a case-based approach

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Abstract

The challenges of sustainability and sustainable development are multifaceted and complex. Addressing them in the long run requires a revolution in the training of future generations of learners so that they can devise solutions for sustainability dilemmas in environments characterized by uncertainty, information deficits, and asymmetric power relationships. Such a revolution is under way in many disciplines. Within the field of sustainability studies, there is much promise in a problem-driven, solution-focused approach that emphasizes experiential learning in the best tradition of case-based teaching. The Michigan Sustainability Cases initiative builds on the familiar case-based approach by adapting it in three ways to support active, engaged learning: integration of audiovisual elements into the conventional text-based case narratives; strong partnerships among students, faculty, and practitioners to flip the curriculum; and a digital platform for enhanced flexibility to configure case-based curriculum design. A competitive funding mechanism and writeshops for case development teams promise to open the case-based approach through imaginative appropriation for sustainability learners in diverse educational and organizational contexts globally.

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1. Introduction

Sustainability challenges are multifaceted and complex as witnessed even in a cursory review of the dimensions of climate change, toxin loads in ecosystems, competing demands associated with food–water–energy security, ecological restoration, sustainable lifecycles of consumer durables, and long-term socio-ecological transformation. Sustainability science, however, can afford neither just to analyze such complexity nor to suffer paralysis in its face. More than is true, perhaps, of any other field of scientific investigation, sustainability scholars must also identify both how to solve the myriad challenges that confront future generations, and how to train a new generation of learners in devising solutions.

Indeed, the complexity and connectedness of human–environmental interactions demands that educational institutions, non-profits, corporations, and government agencies implement strategies that help the next generation of scientists, policy makers, entrepreneurs, and engineers learn to acknowledge the difficulties in solving sustainability dilemmas, but also become accustomed to thinking through these difficulties. Operating effectively in a context of information deficits, uncertainties, and social asymmetries of wicked sustainability dilemmas requires a greater focus on decision-making in these contexts, from the very beginning when decision makers arrive in classrooms (Skerlos, 2015). Innovative pedagogical methods must focus on enabling decision makers to think systematically, conceive of how human and natural processes interact across temporal, territorial, and social scales, and craft solutions drawing upon insights from multiple relevant disciplines and fields of knowledge.

In response to widespread and urgent calls for innovative sustainability pedagogies (Cotton & Winter, 2010; Segalas, Ferrer-Balas, & Mulder, 2010), Wiek et al. (2011) have identified key competencies expected from professionals in the sustainability field. They conclude that future sustainability professionals are expected to craft cost-effective solutions, design and implement strategic interventions, communicate effectively, and work collaboratively to solve problems. One might add that many of the problems they confront are likely to occur in environments with low information,
high uncertainty, and multiple competing interests. Conventional pedagogical methods, focused often on information delivery and communication of factual knowledge through lectures and problem sets, are ill-equipped to support the development of these core competencies.

We call for the adaptive application of a familiar and tested approach to learning—the case-method pioneered at the Harvard Business School at the turn of the twentieth century for management professionals (Bennis & O’Toole 2005; Merseth, 1991)—as a means to advance the theory and practice of engaged learning in the context of the sustainability science. Although the case method has come to be viewed as being almost synonymous with business education, it is of course as old as the apprenticeship model that predates formalized higher education in university settings (Allchin, 2013: 364–65). Valued for its focus on the concrete and the specific, student focus, thinking capacities, and decision making in “messy” contexts, the case method is used extensively in both business and medical instructional settings among others, albeit in very different ways. Suitably reimagined and transformed, it holds substantial promise to meet and address the challenges represented by the complexity of sustainability dilemmas.

2. Engaged learning for sustainability education

The argument for a case-based, active learning approach is particularly compelling for sustainability education where both students and learning styles are diverse (De Vita, 2001; De Vita & Case, 2003; Tracey & Phillips, 2007). Students are diverse in training and knowledge, but also in career goals, professional paths, and interests in sustainability. Indeed, a changing workplace, new knowledge about effective learning strategies, increasing diversity in the training and skills foundations of incoming student cohorts, and availability of new technologies for engagement make it necessary to transition towards more active and engaged forms of learning. Sustainability courses and instructions, to respond to the needs of students and learners who will be making decisions to solve sustainability dilemmas, need to focus more on experientially oriented, problem-solving models of learning. But for the most part, schools and programs of education for sustainability and sustainable development continue to rely on a model of learning that combines lectures, discussions, problem sets, and written assignments in a long-standing approach to imparting education.

Even where faculty in sustainability education-focused programs are aware of the need to deliver more applied and engaged education, the costs of the transition to a new curriculum are high at both individual faculty and university-wide levels. High costs of new creating curricular materials and becoming familiar with their use pose major obstacles to the transformation of curriculum and learning. Rapid advances in sustainability science, data sciences, resilience theory, environmental impact evaluations, social-ecological systems, and other emerging problems in the Anthropocene also mean that many existing cases are ill-suited for instructional purposes.

3. The Michigan Sustainability Case initiative

The Michigan Sustainability Case (MSC) initiative is an innovative attempt to equip the next generation of scientists and professionals with the competencies necessary to understand, analyze, and solve wicked sustainability challenges. By harnessing the immersive pedagogical approach characteristic of a case-based approach to learning, and marrying it with deep student engagement in case development, communicative efficiency, flexible structuring of pedagogical materials through web technologies, and peer knowledge exchange across learning communities at multiple campuses, the MSC initiative seeks to meet head on the challenges of twenty-first-century learning for sustainability.

The power of case-based teaching has been clearly established (Hudson & Buckley, 2004; Lee, 2007; McDade, 1995; Scholz, Lang, Wiek, Walter, & Staffacher, 2006; Srinivasan, Wilkes, Stevenson, Nguyen, & Slavin, 2007). Part of a move towards active learning, the superiority of different engaged learning methods in comparison to more conventional lecture oriented instruction has been demonstrated in a range of contexts in scientific educational fields (Freeman & et al., 2014; Prince, 2004).

Many universities have responded to the weight of scientific evidence on active learning by encouraging faculty to “flip the classroom” (Brunsell & Horejsi, 2011). Flipping the classroom essentially means redefining the relationship between the classroom and learning. Instead of the classroom being the means to impart information through lectures, it becomes the place for the application of learning information. Like all active learning approaches, the technique is founded on the principle that students “cannot passively receive material in class… Instead, they gather information largely outside of class… And when they are in class, [they] do what is typically thought to be homework… solving problems and applying what they learn to new contexts” (Berrett, 2012: 43). Rewarding when it succeeds, flipping the classroom can also leave students and faculty feeling frustrated in efforts to ensure that education is value added beyond conversations with peers—that is, that the agency of students in their own education does not preclude their hunger for rigor and mastery (Baxter Magolda, 2008; Zimmerman, 1990).

Michigan Sustainability Cases, in contrast, aim to “flip the curriculum.” They achieve this by progressive and continuing inclusion of students in the creation of content for future students and course offerings. Student involvement in content development is an advanced means of engaged learning, and has substantial ramifications for how learning communities work in and outside the classroom, at and beyond the university campus through the involvement of practitioners, and in current and future offerings of a course. Students, as they create course content by strengthening existing sustainability cases and developing new ones, bring a very different sensibility—that of a learner—to the selection and use of course materials compared to a faculty member. Such a perspective is both complementary and integral to active learning approaches.

4. Creating Michigan Sustainability Cases

Currently, 25 sustainability cases for classroom use are in different stages of production. Our goal is to create between 125–200 cases over the coming four years. Each case will be presented via the MSC website, and will be complete with a narrative description of a sustainability dilemma and decision situation, integrated audiovisual content, background readings, problems and in-class exercises, teaching notes for instructors, and presentation materials for the case. MSCs are at present primarily being created by teams of faculty and students at the University of Michigan together with a practicing decision maker. But two additional strategies will support the development of new cases with broader participation of sustainability researchers, scholars, and students nationally in the United States as well as globally.

The first of these will be based on annual case development workshops, organized in collaboration with other universities and institutions with an interest in case-based, experientially oriented active learning. Interested faculty–student–practitioner teams will be selected through a competitive process, and will come together at case-development workshops at the University of Michigan to finalize their sustainability cases. The first
workshop at the University of Michigan will also yield an advisory toolkit for creating effective cases for use in sustainability education settings (Kim et al., 2006). The toolkit will be revised with the benefit of experience in successive workshops.

The second strategy borrows from case writing competitions organized by a number of different business schools. Competitions to produce sustainability cases will be global in nature and will solicit case submissions from faculty and students in programs of environment and sustainability, as well as from interested scholars in schools of management, public policy, social work, public health, business, and engineering. Winners will travel to the University of Michigan to present their cases and work with the MSC multimedia team to ensure consistency with cases produced in face-to-face settings. An international jury, comprising members from leading international organizations with an interest in sustainability will determine the winning cases in these annual competitions.

5. Key features of the Michigan Sustainability Cases

Three features enable MSCs to contribute to the current moment of potential revolution in pedagogies for improved sustainability problem solving, but also dramatically reinvent platforms for case-based teaching more generally. These include the relatively uncommon partnership of scientists, learners, and practitioners in the authorship, development, and implementation of cases, the multimedia nature of published online sustainability cases coupled with the availability of the narrative text component as journal articles, and finally the design of the interactive user platform for all sustainability cases. These features resonate with the core competencies that are the goal of active learning: intercultural, collaborative, and civic engagement.

First, in the place of the traditional case as narrative text document available online as a file for download, authored primarily by a faculty member with a student serving in an assistant position, MSCs are based on a partnership for case creation that links professors, students, and practitioners/ media professionals to create compelling materials interactively. This partnership is reflected in part in the engaged learning component of each case, which provides analytical or experiential depth that comes from field-based, simulation-based, or blueprint “maker” exercises in building and adapting tools. Such forms of training move beyond mere reading and discussion, and prevent the case from being contained in the category “online learning.”

This engaged learning component fosters a key competency relevant to sustainability education: social/civic responsibility and ethical reasoning. It encourages students to develop an understanding of the human, social and environmental impacts of actions, and deploy the ethical reasoning tools necessary to responsible decisions. Indeed, such decision making needs also to be attentive to the perspectives of multiple stakeholders.

Second, MSCs incorporate multimedia elements that complement the narrative content of the case and provide a deeper understanding of decision constraints and the context of the problem, but also provide a learning experience with lower cognitive load and higher retention and performance metrics for users of various ages and educational levels (Kennedy et al. 2016). That is to say, we have adopted a mode of publishing cases which integrates text with podcasts and “Edgenotes” in the form of videos, blogs, interviews, infographics, and maps for a learning environment. Such integration of diverse written, aural, and visual materials appeals to diverse audiences. It also extracts from each learning case a novel contribution to our partner journals in related fields that are moving in directions that enable video abstracts and context rich descriptions of real sustainability challenges.

The expansive relationship of teaching to publication, and of text to digital media, fosters a second core competency for sustainability education: communication, collaboration and teamwork—students must have the ability to communicate with many audiences and to utilize varied formats and styles that will most effectively convey their messages. They must appreciate and leverage diverse contributions to a task, and know how to cooperate with others towards common purposes.

Finally, we have designed a platform for delivering our cases that is a dynamic, interactive user interface called Gala (learnmsc.org), which allows for stratified fora of case users exchanging tips and reactions, and enables rapid access to cases in multiple languages. Tethered to a back end called “orchard” and to a spatially explicit relationship graph of sustainability practitioners worldwide called “chapman,” Gala is not merely a library of case content for sale, but a Case Crossroads which allows users to also propose real time updates or revisions to cases, or extend use of them into languages and learning environments previously unimagined, thereby uniting in new ways the disciplinarily disparate and geographically far flung community of sustainability experts worldwide.

In that expansive reach, enabled by recent breakthroughs in web development and coding capacities, we meet the third sustainability competency: intercultural engagement. Intercultural engagement. Our learners must understand the role of values and culture in driving decisions and learn to be flexible when working with others with different values. Of course, each of these three overarching goals also relates to the mastery of specific skills and content inherent in each case.

6. Initial assessment results for an Ethiopia climate adaptation case

This issue of World Development Perspectives includes a publication about one of the first of the MSCs to be developed and piloted in University of Michigan classrooms, “National Adaptation Programmes of Action (NAPAs): Ethiopia Plans Responses to Climate Change.” This case is based on a real-life decision challenge where Mr. Kidane Asefa, the chairman of Ethiopia’s NAPA, and focal point for the United Nations Framework Convention on Climate Change (UNFCCC) in Ethiopia, is faced with the task of prioritizing among different national climate adaptation projects. His goal is to select the project that will generate the greatest benefit for his country.

Two classrooms at the University of Michigan used the Ethiopia case on climate adaptation planning in early 2016: one at the graduate and the other at the undergraduate level. This also enabled us to pilot both formative and quantitative assessments of the learning outcomes from the cases. Rich qualitative responses from both undergraduate and graduate student audiences have already improved the web presentation of the case and the design of the platform for presenting cases. Formative data from that course are drawn from both focus groups conducted after study of the case, and a qualitative survey instrument (with a response rate of approximately 82%, or 33 out of 40 students).

The results provide initial positive evidence in favor of the active learning, problem solving curricular materials embodied in the MSC, particularly for audiences of non-traditional students. One such student, from a farming family in northern Michigan, commented, “To be honest, this case is the first assigned reading I have actually completed all the reading for this term. It was more contained, easier to focus on, more fun to read because of the videos and the visual aids.” Our exam graders checked essay questions against student profiles used to verify our randomized sample groups, and found that minority and non-traditional students made more detailed use of Kidane and his story in their essays than did students with more conventional backgrounds and family
histories of strong higher education access. The latter were more likely to explain abstract concepts from scholarly articles and apply them to ethnographic texts or journalistic examples, while the former were more likely to illustrate those concepts with reference to the decision maker and the case context. Further, first generation student survey responses indicated that they gained more depth and breadth of knowledge from using the cases than did other students (see Fig. 1).

First generation students also felt more in control of the pace of learning in the student group that used the case approach (see Fig. 2).

Equally interesting information comes from a comparison of the learning outcomes for the larger undergraduate class in which the Ethiopia adaptation case was used in 2016 compared to the same class in 2015 when no case method was used. Assuming comparability between the 2015 and 2016 classes on several dimensions, we find that case-based learning leads to a mean improvement in test scores of approximately 5% compared to the student cohort that did not use the case method (a mean increase of 1.12 points out of total available 20 points for the midterm examination in 2016 compared to 2015—see Fig. 3 below for a distribution of the scores for the class). The difference between student midterm scores in 2015 versus 2016 is 7.5%, statistically significant at the 95 percent confidence level. Student testing controlled for several potential additional sources of variability that may affect the course grades by using the same questions in the same order for the test, employing the same rubric for grading, and using the same graders for the examination in both years.

Finally, the Master’s level students who created the case expressed in interviews that they honed writing, analytical,
content, communication, and professional networking skills through their work on the case in 2014–2015, and further gained presentation and facilitation skills in implementing the case for undergraduates in 2015–2016. This is proof of concept that our notion of “flipping the curriculum” is value added in education or professional training, enabling today’s students to partner with professors, practitioners, and media design specialists to create not mere final projects but actual learning materials for future students and professionals. MSC materials can be effectively created and then adopted, adapted or updated across the sometimes sterile separate categories of “applied” and “basic” science, or communities of undergraduate, professional, and graduate students or even students and alumni from a given program or campus. Such interconnections bear the most promising possibilities for revolutionizing education at a pace that is commensurate with the severity and spread of sustainability challenges.

7. Conclusion

The MSC initiative constitutes a forward-looking response to the twenty-first century challenges of training in sustainability sciences to strengthen the capacity of decision makers to address complex and emerging challenges. Building on the case-based approach to learning, MSCs are problem-driven, solutions-oriented tools to enable experiential learning inside and outside the classroom. In creating partnerships between students, decision makers, and faculty mentors, they seek to flip the curriculum, and thereby move beyond the goal of flipping the classroom. The initial experience with their use in the classroom has been positive, as supported by both formative and qualitative, but also experimental and quantitative evidence.

Although beginning from partnerships of University of Michigan students and faculty with sustainability professionals in the current phase, the initiative has more encompassing, outward looking ambitions to engage with sustainability professionals, researchers, faculty, and students globally. Central to this outward focus are three strategic, community-building efforts. One critical effort is represented in the development of an extensive network of researchers, scholars and professionals interested in sustainability who can be connected to each other through the online offerings of the Michigan Sustainability Cases. The second are sustainability case-development workshops that will bring together teams of students-professionals-faculty members, with support from a multimedia team. The third is a funding mechanism to invite case development proposals from sustainability educational, non-profit, and government agency teams with winning entries receiving substantial levels of prize money and support for converting their entries into state-of-the-art exemplars of case-based learning.

The development of cases for improved learning and training in sustainability and sustainable development is relevant not just to students in institutions of higher learning. Such development is as, and perhaps even more, critical for continuing learning among professionals in the private and non-profit sector, civil servants in government agencies and professionals in non-government organizations. Their creation is part of a collective journey towards more vigorous exchanges among faculty and students, professionals and decision makers so as to connect science to practice in a more immediate sense, and to enable more effective learning from practice for science.

References

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