

Building Trans-disciplinary Sustainability Studies into the College Curriculum

Introduction

Sustainability has been defined as using resources to meet the needs of today without jeopardizing the ability of future generations to be able to do the same. However, different disciplines have different perceptions with regard to sustainable practices. Many academic disciplines have adopted and integrated the term “sustainability” as a “new and improved” addendum for 21st century curricula. Students are often exposed to a range of science and social science explanations without cohesion of content, leading to a vague concept of their application. This critical issue transcends individual disciplines but is rarely offered as a bridge between them. Daniel J. Sherman, the Luce-funded Professor of Environmental Policy & Decision Making, University of Puget Sound, Tacoma, Washington, wrote about the relationship between the concept of sustainability and higher education in the journal, *Sustainability*:

For sustainability to realize its full transformative potential in higher education and society, it must transcend an association with prescribed practices and even specialized areas of study. Sustainability must become a pedagogical big idea, capable of complementing and connecting avenues of inquiry across the academic disciplines that organize and prioritize teaching and learning on campus. If sustainability is employed as a method of examining the relationship between environmental limits and the human values, decisions and actions that shape the future, it will transform not only what we do on campus, but also how we think (2008).

Sustainability literacy can be defined as the skills, attitudes, competencies, dispositions and values that are necessary for surviving and thriving in the declining conditions of the world in ways which mitigate that decline as far as possible. Gaining practical skills requires a form of learning which goes beyond memorization. It requires *active learning*, a broad term used to refer to self-reflection, self-directed inquiry,

learning by doing, engagement with real life problems and issues, and learning within communities (Stibbe, 2009). To be sustainability literate is to have a basic understanding of present and anticipated environmental challenges, as well as present and potential individual and societal responses to those challenges.

Sustainability education emphasizes learning and working to secure a stable future with respect to natural resources, society and the economy. Sustainability literacy, therefore, requires an explicit consideration of the interconnectedness/ interdependence of its major components or spheres of influence. A curriculum emphasizing sustainability literacy in an integrated learning environment will enable students, faculty and community partners multiple opportunities to engage in meaningful and relevant exchanges. This type of approach has shown to make a difference in students' caring, beliefs and intentions (Rowe, 2002).

While some universities, such as Arizona State and the University of Michigan, have large-scale interdisciplinary sustainability programs with significant funding (Fogg, 2006; George, 2007), few have incorporated team teaching across disciplines and applied service projects at the undergraduate level, all with minimal resources. Texas Woman's University (TWU) has attempted to pursue these initiatives in an environment with limited funding or structural support. The purpose of this paper is to examine the challenges and possible solutions to integrating sustainability literacy and action in a collegiate environment of limited resources.

TWU was relatively late in moving toward more sustainable practices. There was no more than a cursory recycling program until 2009, and there is only one LEED certified building, although one other new building was designed according to LEED

standards. However, the last few years have produced several initiatives, including single stream recycling across campus, replacement of old inefficient vehicles with new electric and energy efficient ones, and facility changes that have significantly reduced electricity and water consumption. These improvements came at a time when groups of faculty and students were trying to push more serious advancement in environmental sustainability on campus. A new student organization, Texas Recycling and Environmentally Ethical Students (TREES), was formed to focus on environmental issues. These students focus on more education and action to protect the environment. Additional momentum came from a faculty learning community focusing on sustainability and a finalist Quality Enhancement Plan proposal centered on sustainability literacy.

The TWU College of Arts & Sciences became involved in the SENCER program (**Science Education for New Civic Engagements and Responsibilities**, www.sencer.net). SENCER is the signature program of the National Center for Science and Civic Engagement. SENCER is a faculty development and science education reform program supported by the National Science Foundation (NSF). SENCER has established and supported an ever-growing international community of faculty, students, academic leaders, and others to improve undergraduate STEM (science, technology, engineering and mathematics) education by connecting learning to critical civic questions and responsible citizenship.

As part of its mission to bring more students and teachers into science and math, in January 2010, the National Center for Science and Civic Engagement established a new center for science education in the College of Arts and Sciences at Texas Woman's

University: the SENCER Center for Innovation (SCI)-Southwest. This program led to multiple science courses being designed as SENCER courses, including several with experiential learning components connected to environmental issues.

Despite recent progress, the university still had room for improvement in terms of sustainable action and education. The faculty learning community instigated the idea of an innovative, upper-division undergraduate certificate in sustainability. The TWU “Science, Society and Sustainability” certificate begins with a gateway course taught by a team of science, business, and law instructors. The certificate requires building block courses from a variety of disciplines and culminates in synthesis of a potential solution to an actual civic sustainability problem in the capstone course. Goals for the program include: (1) prepare students for jobs in different disciplines that require an understanding of sustainability principles, (2) allow students to use critical thinking and applied learning in a multidisciplinary way, and (3) implement local, student-led sustainability initiatives. The program integrates the principles and values of sustainable practices into all aspects of education and learning so students have the necessary skills to address emerging social, economic, legal, cultural and environmental problems.

Critical challenges to this type of program include limited funding, lack of a team teaching structure, restrictions from being a state school, and a non-traditional campus with numerous commuters, online students and working students. These challenges will be addressed as the new programs are explained in more detail.

The Certificate Program

Program Description

The goal of the Science, Society and Sustainability Certificate is to integrate the principles and values of sustainable practices into all aspects of education and learning in order to enable our students to address the social, economic, legal, cultural and environmental problems facing humanity in the new millennium. Therefore, this certificate program incorporates a multidisciplinary approach into a coherent program of study and civic engagement. Students completing this program enhance their academic majors by developing their ability to make thoughtful life choices and address problems from multiple perspectives.

This program is different from related majors or minors in that it is an integrated course of study among a variety of disciplines. We expect this program to enhance our students' ability to understand how their formal education is related to other knowledge, and to their future careers. Finally, the certificate program allows us to incorporate SENCER ideals (see www.sencer.net) in a substantial way into the curriculum and provide a formal vehicle to teach civic engagement skills.

Measurable Student Learning Objectives

The objectives of the certificate program are that students will develop critical thinking, problem solving, and written and oral communication skills, and be able to:

1. Define scientific, sociological and economic sustainability;
2. Evaluate a variety of sustainability issues, along with their risks and benefits;
3. Predict impacts of modern lifestyles on earth's material and energy resources;
4. Relate knowledge of scientific, sociopolitical and economic aspects of sustainability to a civic issue within the community;

5. Synthesize sustainable solutions to complex civic issues;
6. Communicate civic issues and sustainable solutions to the general public and policymakers.

Benefits to Students

Consistent with these certificate objectives and upon completion of this program, students will be able to understand the nature of sustainability from a variety of perspectives. Students will also be equipped to analyze sustainability problems from different disciplinary points of view. Further, they will extrapolate their knowledge and experience to global issues and perspectives. Moreover, this program of study will develop critical thinking, communication, and leadership skills that will benefit students in their chosen careers.

Jobs & Graduate School Opportunities

Jobs related to sustainability are growing across many fields. The web site www.jobsinsustainability.com recently posted nearly 900 jobs related for individuals with degrees in sustainability. There is also a growing number of academic programs in sustainability, including several graduate programs. For example, the University of Texas at Arlington is offering professionals the opportunity for advanced education in sustainability issues leading to a new master's degree beginning in fall 2012. Training in sustainability is increasingly in demand in the workplace, leading to a need for more degree and certificate programs.

Certificate Details

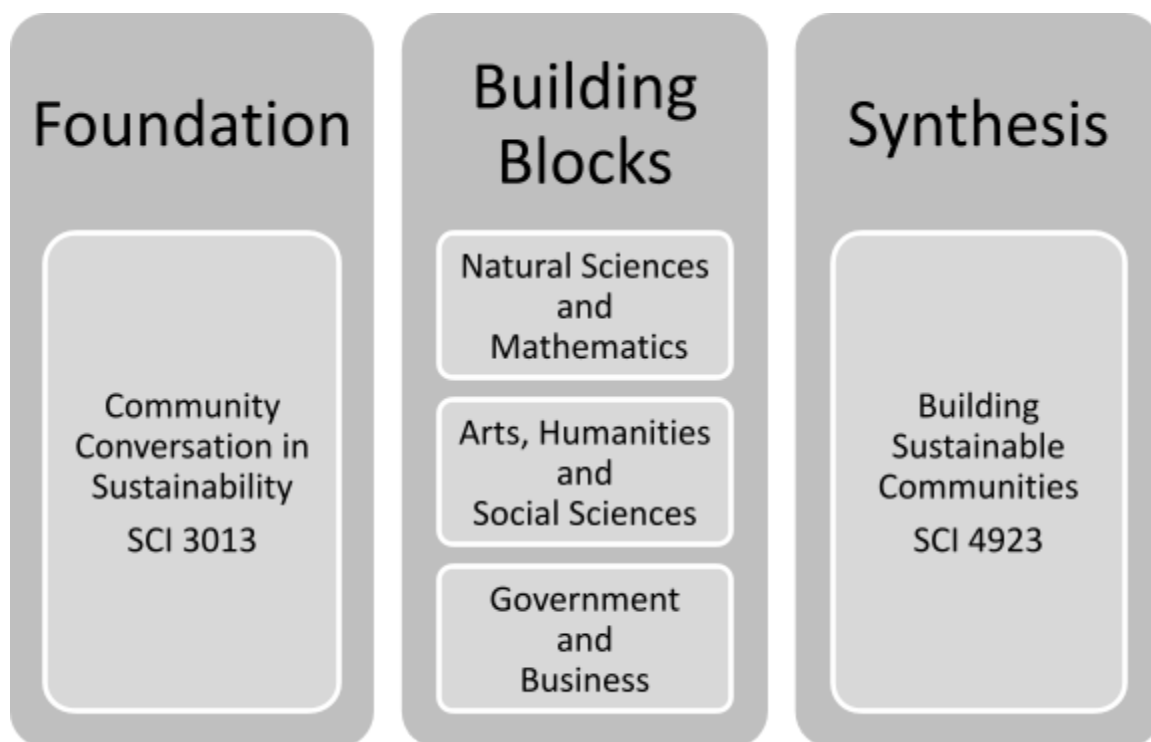
Program Name: Science, Society and Sustainability

Academic Unit: Department of Chemistry and Biochemistry

Delivery Mode: Face-to-face, online, hybrid and lab courses, and travel abroad

Requirements: Completion of 15 to 18 hours of approved upper-division courses
Coursework must include SCI 3013 (foundation) and SCI 4923 (capstone), with a capstone civic engagement project

Students should maintain a GPA of 3.0 or better and meet any prerequisites for



courses required for the certificate. The capstone course requires completion of a civic engagement project addressing a local sustainability issue.

Foundation Course

The first course serves as a foundation for the certificate. All students pursuing the certificate will be required to take this course. ***Community Conversations in Sustainability (SCI 3013)*** is a multidisciplinary course discussing all aspects of sustainability from scientific, sociopolitical, legal and economic points of view. Topics include the impacts of energy production, food production, industry and modern lifestyles on our local and global community with an emphasis on systems and possible

Community Sustainability Project

solutions. The course is formatted as a three credit seminar. It was team-taught by the
Figure 1. Diagrammatic representation of the Science, Society and Sustainability
CO- Certificate program initiated in 2011 at Texas Woman's University in Denton, Texas.

Building Block Courses

The building block courses will examine sustainability in specific disciplines within the College of Arts and Sciences. Students will be required to take at least one 3000 or 4000 level course (3 credits each) in each of the three areas of focus (Natural Sciences and Mathematics; Arts, Humanities and Social Sciences; Government and Business) from an approved list.

Opportunities for Student Travel

As students select building block courses, they will find offerings that include both regional travel and study abroad options. We anticipate these will be popular choices and the hands-on experiences will increase both enthusiasm and learning for those students. Among the expected benefits are greater knowledge of human cultures and

the physical and natural world, stronger intellectual and practical skills, and integrative learning as demonstrated through the application of discrete knowledge, skills and responsibilities in new settings and complex problems (Ramaley 2011).

A promising example of a travel course incorporating interdisciplinary team teaching regarding sustainable development is the collaboration between Roberta Lessor of Chapman University, and Margaret Reeves and Enrique Andrade of the Institute for Central American Studies in Costa Rica (Lessor, et. al, 1997). This course integrated social and environmental studies, as well as Spanish language classes, with three blocks of study. The first block built the theoretical base for subsequent field work, the second included on-site studies in diverse ecosystems, and the last entailed independent study projects involving topics such as schools, forest reformation, health clinics, and youth ecology projects. Of special significance to our school, the course explored how a shift from subsistence farming to industrial production has changed the lives of women in Costa Rica. This model could perhaps be integrated into the summer capstone discussed below.

Capstone Course and Civic Engagement Project

Building Sustainable Communities (SCI 4923) is a three credit seminar course which requires completion of a civic project with a public presentation of sustainable solutions for a selected complex civic issue involving sustainability. The synthesis course will be a capstone in which students use knowledge from all previous coursework to investigate and synthesize solutions to the selected issue. The project

presentation will then be made to an appropriate decision-making body. All students earning the certificate will be required to take this course.

Assessment

A variety of traditional and innovative assessment tools will be used to evaluate student learning in the certificate program. Table 1 displays how these assessments relate to the learning objectives for the program. Traditional assessments include exams, papers and class discussions. Innovative tools are pre/post surveys, projects and civic engagements. Pre and post surveys will allow students an opportunity to make their own assessment of personal learning gains. This feedback will be used by program faculty to refine the program over time.

In both the foundation and capstone courses, projects will be used as a vehicle for students to learn and communicate new knowledge of course content materials and/or synthesis of new ideas. These may include individual and small group assignments on various topics related to sustainability issues. Presentations will be made to class members and to various decision-makers, as appropriate for the particular project.

Assessment of Certificate Program Objectives	E x a m s	P r e & P o s t S u r v e y s	P a p e r s	C l a s s D i s c u s s i o n s	P r o j e c t s	C i v i c E n g a g e m e n t
1. Define scientific, sociological and economic sustainability.	X		X	X		
2. Evaluate a variety of sustainability issues, along with their risks and benefits.	X	X	X	X	X	X
3. Predict impacts of modern lifestyles on earth's material and energy resources.	X	X	X	X	X	
4. Relate knowledge of scientific, sociopolitical and economic aspects of sustainability to a civic issue within the community.	X	X	X	X	X	X
5. Synthesize sustainable solutions to complex civic issues.	X		X	X	X	X
6. Communicate civic issues and sustainable solutions to the general public and policymakers.		X	X	X	X	X

Table 1. Potential assessments for the certificate program's student learning objectives.

Program Support

Although the proposed program will use existing courses, it still required the creation of new courses. Three new courses relevant to the certificate program were approved in December, 2010. We offered the inaugural foundation course during the fall 2011 term. Existing facilities were more than adequate as we have a new, state-of-the-art science building. Most courses from other disciplines within the College

of Arts and Sciences already exist. This program is expected to enhance enrollment in sparsely populated upper division courses for those departments. Because of recent changes in course offerings, current faculty members are expected to be adequate to sustain this program indefinitely with little or no increased workload.

Potential existing courses will be reviewed by a small multidisciplinary committee, chaired by the chair of the Chemistry and Biochemistry department, which is tasked with selection of building block courses (see diagram below). Syllabi for proposed courses should describe how the course addresses a minimum of three of the certificate learning objectives included above. A new course in the School of Management will include travel to Belize to participate in hands-on sustainability workshops taught by a former Peace Corps volunteer. Topics will address agricultural, architectural and economic sustainability efforts in a small, poor village.

Application to Quality Enhancement Plan (QEP) Experiential Learning Initiative

As noted earlier, because we live in a trans-disciplinary world with multi-dimensional challenges such as sustainability, higher education institutions must re-think their approach to education, including more integrative, cross-discipline learning experiences (Conceicao, *et al.*, 2010). This type of innovation lends itself to Quality Enhancement Plans required of universities by accrediting bodies such as the Southern Association of Colleges and Schools (SACS). Florida International University, for example, developed a global sustainability interdisciplinary course for a QEP dealing with Global Learning (Butchey, *et al.*, 2009). A QEP is designed to address student learning outcomes in a focused area.

On December 1, 2011, the TWU QEP Selection Committee recommended a QEP topic originally entitled "Bringing Education to Life: Experiential Learning and Student Success at TWU." The working definition of experiential learning at Texas Woman's University is "purposeful education through real-world experiences such as service learning, internships, practica, or civic engagement outside of the classroom to acquire enriched knowledge, skills, and personal efficacy." According to TWU's Provost, Dr. Robert Neely, "[t]his project seems particularly appropriate to TWU because it aligns directly with our mission, is in step with recent changes to the Texas core curriculum, and is broadly applicable across the University." TWU's mission includes preparing women and men for leadership and service, and encouraging them to lead personally and professionally fulfilling lives. Moreover, the experiential learning QEP will be able to incorporate key aspects of another QEP proposal on sustainability literacy.

TWU has already gained national recognition by being selected in 2010 as one of only six regional SENCER (Science Education for New Civic Engagement and Responsibility) centers in the country. Thus, civic engagement in the context of science education is a focus of the university, and will be a vital aspect of the integration of sustainability into the experiential learning QEP. Specifically, the following **student learning outcomes** integrate experiential learning in the context of sustainability:

- **Explain how individual, institutional, and community actions impact sustainability.**

Moving beyond individual assessment of how using personal resources impacts other living systems, students will acquire leadership skills through experiential learning and community based research activities.

- **Evaluate a variety of civic issues, along with their risks and benefits.**

Dealing with actual civic issues will provide students with opportunities to develop practical competence, commitment, and skills needed to disseminate knowledge (Alvarez and Rogers 2006; Holden *et al.* 2008). TWU students will participate in the investigation of a multidimensional sustainability issue and will critically examine both potential risks and benefits to insure a response or solution is evidence based.

- **Engage in civic actions regarding sustainability.**

Educators must encourage students to become active citizens in their communities. As stated in the Association of American Colleges & Universities report (2007) from the National Leadership Council for Liberal Education & America's Promise (LEAP):

The higher education community needs to match its commitment to educating responsible and ethical citizens with learning practices, in both the curriculum and co-curriculum, that help all college students engage their responsibilities to self and others. Further, vigorous efforts are needed to build new understanding that civic development—in all the forms described here—is an essential rather than an elective outcome of college (p. 38).

An aspect of the sustainability literacy QEP proposal that could be integrated into the broader experiential learning one adopted by TWU is the formation of working groups, including a “civic engagement working group” to oversee and coordinate student activities related to the learning outcomes described above. Students, faculty,

business community members, non-profit constituents and others can collaborate on projects and thus link classroom theory to “real-world” experience and practice.

Challenges

Our early efforts to introduce sustainability studies, through the context of an undergraduate certificate program, face challenges similar to those described by others (e.g., Kurland, *et al.*, 2010). These include (1) recruiting other faculty to support the certificate program by adapting suitable courses to address sustainability certificate learning outcomes, (2) integrating diverse teaching styles and emphases in our gateway team-taught course, and (3) dealing with the difficulty of teaching the courses we are responsible for within our disciplines, while adding, on a regular basis, the gateway sustainability course. This may require us to teach the course as an overload to our usual teaching workload, but we have a strong commitment to getting the program off the ground. Our initial gateway course enrolled only 10 students, whose majors included Biology, Management, and Government. Studies suggest that including students from different disciplines is important to help them inform each other regarding different perspectives, and to help motivate them to explore unfamiliar areas (Little and Hoel, 2011).

Our own students offered several comments at the end of the first course that will help in planning the second offering. One stated, “I would stick to one book and just reference the parts of the other books in the lectures. The amount of reading was overwhelming and did not flow with the lectures very well.” Faculty have already anticipated this, and decided to replace two textbooks with one for the next course

offering. Finding appropriate textbooks is challenging, because no one text includes all of the core materials (dealing with science, business, and politics and law) we want to integrate into the course. The first semester texts were an environmental law book, a text that combined sustainability science with business applications, and a popular press book. During the coming term, a single book has been chosen. Actual length of the readings will not be significantly less, but the new selection does a better job of combining multiple points of view.

Another student expressed [s/he] “would like more discussion, particularly about the readings.” Despite significant in-class discussions, the class will now require comments in a monitored online discussion forum. This will allow more discussion on additional readings. Eventually we may explore creating a tailored course package including appropriate articles, book excerpts, cases, public domain materials, and the like (see, for example, Moore, 2005).

A third student complimented our course delivery, saying, “The instructors are knowledgeable and excited about the subject. The reading materials were very informative, helpful, and well written. The paper and poster project were a great way to culminate the accumulation of knowledge.”

We believe that we will be supported by our administration and the community in growing the program, and our goal is to learn from our missteps and continually improve the quality and value of the certificate credential for our students.

Recommendations

Based on our early experiences in developing an undergraduate sustainability certificate program, some recommendations can be made for other programs in similar situations.

1. In a smaller university with limited resource support, creative cooperation across departments is needed. This includes team teaching (maybe as an overload at first) and working as much as possible with existing programs and curriculum. Moore (2005) suggests a participatory workshop using value-focused thinking to engage faculty in various disciplines to address the same issues from differing perspectives.
2. An administrative supporter is necessary. Whether it is a dean, provost or other administrator, someone who cares about the program and issues must be in a position to influence budgets and workload policies.
3. Outside partners and support are essential. In our case, the SENCER program provided helpful direction and funding. As we move forward, experiential learning will require working relationships with local businesses and city governments.
4. Student involvement and initiative will accelerate the process. If students are given a voice in the process and can express their interest in the program, success will follow more quickly.
5. All aspects of program planning should be tied to accreditation expectations and student learning outcome measurement. Ideally, the program can be incorporated into a Quality Enhancement Plan or other strategic planning. This can help overcome obstacles typical of state institutions and disparate departments.

6. Promotion is critical. Even if students would be interested, they need specific information about how the certificate program will fit with their major and how it will help them in their life and career.

Conclusions

Based on the development of the sustainability and related efforts described here, several implications can be made for other universities. Using the SENCER approach helped us discover multidisciplinary aspects of sustainability and improved the use of applied learning. Developing a certificate program provided a framework that helped bring together efforts from different disciplines. Finding applications for sustainability literacy in the Quality Enhancement Plan added a dimension of university-wide relevance and legitimacy.

By developing the initiative with multiple partners and programs, more ideas emerge and efforts can have exponential applications. This is clearly superior to teaching sustainability in a single department silo. Sustainability in practice, whether in the world of business, government or science, necessarily requires people to understand multiple aspects of the challenges. A multidisciplinary approach with experiential learning will best prepare students to succeed in that arena. This approach to teaching requires flexibility in academia, including models for supporting team teaching, cooperation between diverse departments, and mechanisms for developing experiential learning.

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