

Approaches for Integrating Sustainability into Introductory Courses

A Discussion Paper prepared by the
2013 USI Sustainability Teaching Fellows
UBC Sustainability Initiative

INTRODUCTION

The UBC Sustainability Initiative (USI) is dedicated to increasing student exposure and education in the field of Sustainability. UBC's ultimate goal is that every student has access to, and hopefully pursues, a sustainability learning pathway¹ alongside their disciplinary education. These pathways are intended to ground students in the four UBC Student Sustainability Attributes: Holism, Sustainability Knowledge, Awareness & Integration, and Action for Positive Change (USI, 2013). A critical step towards achieving this goal is to stimulate student interest in sustainability early in undergraduate programs. In order to reach students in first year, the USI is encouraging and supporting instructors, departments and faculties to revise a broad spectrum of existing introductory courses by **inserting sustainability content** and **using teaching methods that support sustainability learning** (Figure 1). The intent is that these transformed courses will motivate students to enroll in a sustainability learning pathway early in their undergraduate education at UBC.

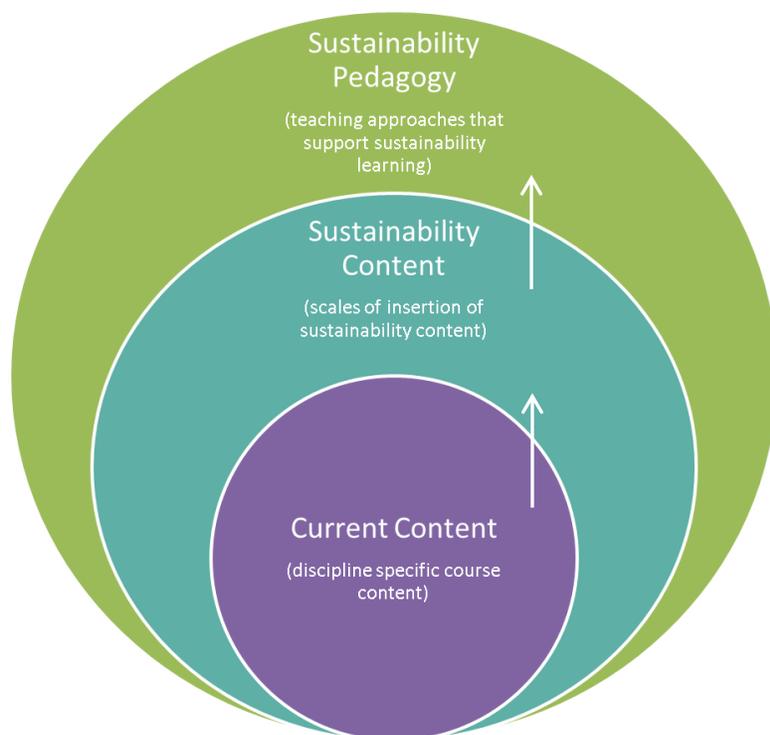


Figure 1. Part 1 of this paper examines how to insert sustainability content into an existing first year course. Part 2 highlights pedagogies that support sustainability learning. The ultimate goal is to revise an existing discipline-specific course (purple circle) to include sustainability content (blue circle) and also ideally to employ pedagogies that support sustainability learning (green circle).

There are a myriad of ways in which sustainability content can be inserted into discipline specific learning, however first year introductory courses present unique challenges because they are typically large (many have multiple sections and multiple instructors) and instructors may or may not rely on a common source of content for teaching (i.e., syllabus, text book). The successful insertion of sustainability content must thus take into account the structure and context of the course. **Part 1 of this paper presents four approaches of how UBC instructors have inserted sustainability content into**

¹ A "Sustainability Learning Pathway" is a collection of sustainability-oriented courses that students take alongside their disciplinary major. The model currently under discussion in the faculty of Science proposes that a pathway includes the following 5 components: fundamentals course (3 credits), real world experience (0-3 credits), sustainability electives (12 credits), capstone course (6 credits), and a sustainability "learning community" (0 credits). The type of accreditation a student would earn for a pathway will be determined by individual faculties.

different types of large, first year courses. We provide one approach for how to insert sustainability content into courses which are taught by instructors who do not share a common source of content. For courses which are taught by instructors who share a common source of content, we present three examples in order of the scale of the course revision (from moderate revision to a complete course redesign).

The insertion of sustainability content into courses is useful and necessary for teaching sustainability, but there is a growing consensus in the sustainability education literature that teacher-centered and transmissive models of education, which are particularly common in large first year courses, are not sufficient for effectively teaching sustainability issues. **In order to help instructors employ teaching methods that support sustainability learning, Part 2 of this paper summarizes a range of pedagogies that relate to sustainability and transformative education.** Many of these learning approaches are contextual, constructivist, and collaborative, and focus on students developing solution options to real-world sustainability problems (Brundiers & Wiek, 2013). Transformative educational approaches that spark students to adopt different values, attitudes, habits, and behaviors are also critical (Frisk & Larson 2011). These pedagogies can be applied at many different scales and within many different course contexts. We urge instructors to explore the different pedagogies and determine which methods are most useful for their particular needs.

PART I: APPROACHES FOR INSERTING SUSTAINABILITY CONTENT INTO INTRODUCTORY COURSES

We outline four approaches of how to insert sustainability content into large, introductory courses. The first approach applies to courses which have multiple sections taught by different instructors who do not rely on a common source of content, such as a shared syllabus or text book (Figure 2, left panel). The remaining three approaches apply to large courses which have multiple instructors that rely on a shared teaching approach (Figure 2, right panel). A shared teaching approach across sections can be implemented in different ways. For example, multiple instructors may teach independent modules across all sections of the course, or multiple sections may be taught by separate instructors who each rely on a common syllabus and teaching plan. As long as a large course has a shared teaching approach, sustainability curriculum can be inserted either by changes made by one (or more) instructors who teach across all sections, or by changing the syllabus and teaching plan which is shared and used by all instructors (see Fig 2, right panel). The approaches are presented in order from a low degree to a high degree of sustainability content insertion.

For each approach we present the: 1) course structure and context, 2) insertion model, 3) case study example(s), and in some cases 4) a commentary on other useful information associated with the approach. We follow with a comparison of the advantages and disadvantages of the different approaches in a format intended to help decision makers decide with method of course revision is most useful and practical for their particular context and goals. Many of the case studies presented are the funded projects from the 2013 USI Spotlight competition (Appendix 1). This annual competition funds proposals from UBC instructors to infuse sustainability into existing courses (<http://sustain.ubc.ca/courses-teaching/support-educators/spotlight-program>).

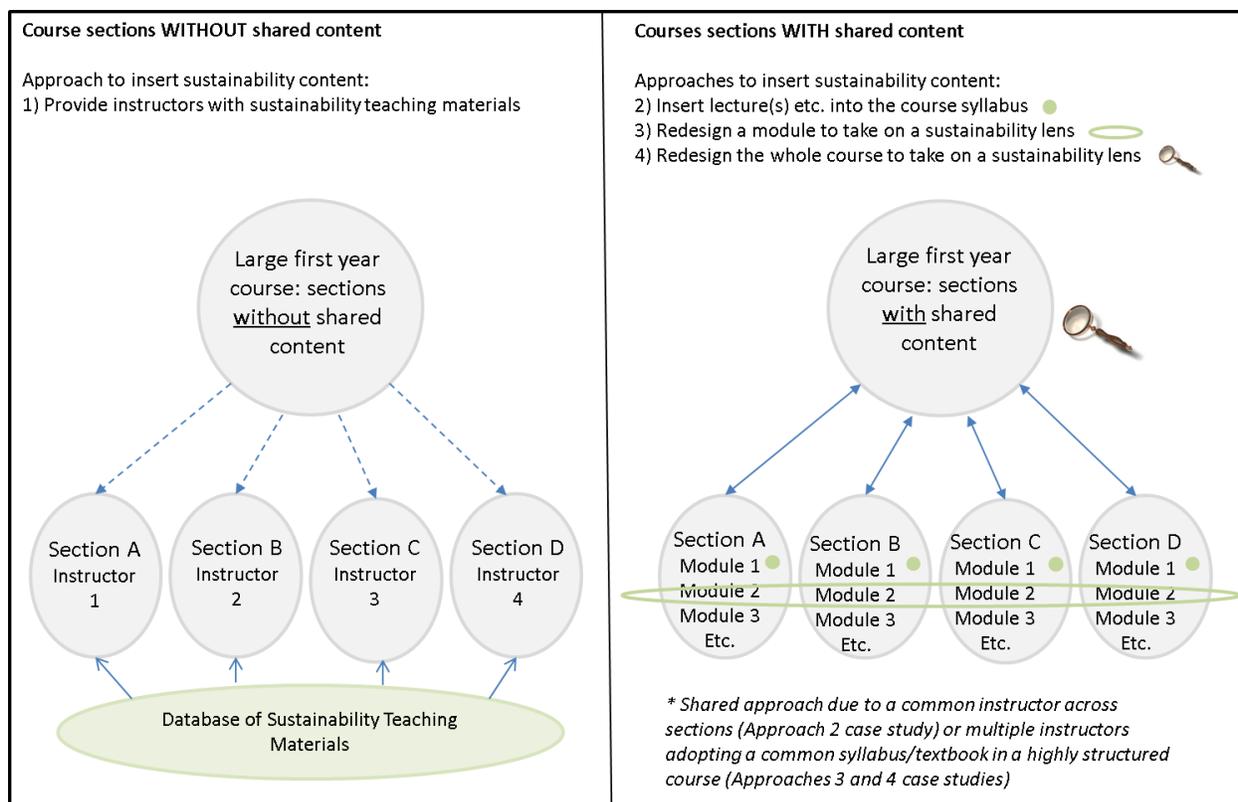


Figure 2. Four approaches described in this paper for inserting sustainability content into a large first year course. The left panel describes Approach 1 that applies to courses where instructors operate independently and do not rely on shared content, thus each section is taught differently. The right panel describes Approaches 2-4 that apply to courses with shared content among instructors/sections.

Approach 1: Provide instructors with sustainability teaching materials

Course structure and context: Large, introductory courses with multiple instructors independently teaching multiple sections with no shared textbook or other source of common content.

Insertion Model: Develop a relevant and useful set of sustainability-related teaching materials that can be leveraged by independent instructors for their teaching (Figure 2, left panel). One example is to develop a database of studies on sustainability from the given discipline (e.g., psychology) related to the core topics covered in the introductory course. Instructors can draw on the database to include one or more sustainability-themed studies as an illustration of a core disciplinary concept or be spurred to independently identify appropriate sustainability content for their specific context.

Case Study: PSYC 101 (Introduction to Biological and Cognitive Psychology) and PSYC 102 (Introduction to Developmental, Social, Personality, and Clinical Psychology)

Introductory Psychology at UBC consists of a pair of multi-section courses (PSYC 101,102), that service over 3000 students every year, and the courses are mostly taught by sessional lecturers and/or graduate students. Sustainability does not tend to be a “core topic” in general psychology journals, or in graduate training. Thus, it is a challenge getting sustainability materials incorporated into the curriculum. A similar situation exists for a variety of other social sciences disciplines – such as sociology, anthropology,

economics, and political science – and perhaps additional disciplines in the social sciences and humanities.

For Introductory Psychology at UBC, core topics include: quantitative research methods, learning, memory, consciousness, biological psychology, language and thought, sensation/perception, developmental psychology, intelligence, social psychology, personality psychology, clinical psychology, emotion/motivation. To create a database of sustainability-related materials for these courses, 2 to 3 studies for each major topic area in Psychology 101 and 102 will be selected. Selection of studies will consider methodological rigour, and focus specifically on published scholarly studies that utilize quantitative methods. Each study will then be re-packaged for use in the classroom. Examples of materials to be included in the data base are:

- PowerPoint slides and notes to summarize each study
- Brief discussion of the study's relevance to illustrating at least one introductory psychology core concept
- Other supporting material (e.g., a related i>clicker question, videos, online resources, images)
- Search-friendly metatags or keywords to facilitate instructors finding the resources they need quickly. A sample list of potential tags for a given study: social psychology, persuasion, marketing, experimental design, behavioral dependent variable.

The database design will allow for easy access to view, search, download and update materials via an online website interface.

Commentary:

Strategies for searching for materials: This case study provides a useful model for incorporating sustainability material into the curriculum for certain types of courses, especially where there a large number of instructors with varying teaching materials and approaches to delivering the course content. The context for Introductory Psychology is probably similar to that faced by a number of other disciplines. For example, in sociology, economics, psychology, political science, and anthropology, the topic of “environment/sustainability” does not tend to be a core area in introductory textbooks, in general journals, or in graduate training. This contrasts with the situation for some other disciplines, such as geography.

Never the less, in most of these disciplines there are significant sub-sections of the major associations that focus on these topics, and there are relatively important sub-disciplinary/specialty journals that focus on these topics. For example in sociology, the American Sociological Association has a section on “Environment and Technology”. Also in sociology, there are a number of specialty journals that focus on sustainability topics including Society and Natural Resources, Organization and Environment, Rural Sociology, and Ecology and Society to name a few. Likewise in psychology there is Environment and Behavior, the Journal of Environmental Psychology; in economics, Ecological Economics; in political science there is Environmental Politics and so on. Focusing searches on these types of journals should help to build a relevant and useful sustainability database. Also, there may be other types of useful peer reviewed material, other than quantitative empirical studies, that might be useful – such as theoretical works, policy works, and so on.

In addition to peer-reviewed publications, many disciplines have professional societies designed to support teaching and learning in that area. The American Psychological Association has produced a

report focused on Psychology & Climate Change which addresses the phenomenon and its unique challenges. Likewise, the American Psychological Association Task Force produced materials on the interface between psychology and climate change.

Bringing these different types of materials into a database allows for a variety of methodological approaches to be considered. At UBC, the database being developed for PSYC 101 & 102 will focus on studies using quantitative methods, typical of the teaching approach of that course. Of course, within the discipline a mix of quantitative and qualitative approaches exist and as a result it is desirable for the sustainability databases to pursue methodological pluralism to provide a variety of different types of methodological examples – and thus make such examples more likely to be adopted by instructors who might have differing methodological inclinations.

Examples of existing databases of materials: There are some examples of databases that have been set up for providing access to teaching resources. For instance, the American Sociological Association has a resource called TRAILS (Teaching Resources and Innovations Library for Sociology). This database has a wide variety of teaching resources – from course syllabi, to PowerPoint slides, to assignments – that are searchable by subject area. The URL for the data base is: <http://trails.asanet.org/Pages/default.aspx>. This particular resource is subscription based.

The faculty members creating the sustainability database for PSYC 101 & 102 identified another online resource provided by the Society for the Teaching of Psychology (<http://teachpsych.org/otrp/resources/index.php>). They propose to develop a static version of their database for this site. Currently the site has one resource specifically developed for teaching about sustainability in psychology: Teaching Psychology for Sustainability: A Manual of Resources (2006). Author: Britain A. Scott (University of St. Thomas) & Susan M. Koger (Willamette University). The URL for this resource is: <http://www.teachgreenpsych.com/>.

Approach 2: Insert new lectures/tutorials on sustainability (plug-in model)

Course structure and context: Large introductory courses composed of multiple sections, taught by multiple instructors, with a shared teaching approach (Figure 2, right panel).

Insertion Model: The plug-in model of integrating sustainability into introductory courses can be in multiple forms. At its simplest, it could be in the form of a single lecture, guest lecture or tutorial exercise. Larger plug-in efforts may necessitate multiple lectures or a series of connected lectures (i.e., module), over a period of time, with specific tutorials, readings, and/or lab exercises.

Case study #1: APSC 150 (Engineering Case Studies)

At UBC, sustainability content is being inserted into APSC 150 using this plug-in model. APSC 150 is a mandatory first year course for approximately 800 applied science students. The course is taught by 4 instructors who each teach one 3-week module across all sections. The course also has several tutorial instructors (faculty) and the instructor to student ratio is very high, i.e., > 1:100. Dr. Yonemitsu (Nobu) has introduced sustainability concepts in 1 core lecture and 1 tutorial during his 3-week module. The lecture given to the whole class introduces the concepts of sustainability, life-cycle analysis, perspective-taking techniques, and stakeholder analysis. Students are then exposed to a two hour exercise in the tutorial, with the instructor to student ratio of 1:55. The tutorial is conducted covering the following activities:

- in class video viewing to introduce the case study;
- in smaller groups, conduct role-play and debate;
- whole class debate and role-play;
- reflection and discussion.

Online materials and instructional video clips are also being compiled (and created) to support the course's increased focus on attitude development towards the engineering profession, and the process of engineering including its environmental and societal implications. A project-based, apprenticeship model is being considered where a case study package is available to the tutorial instructors including slides covering basic triple bottom line concepts, background information (scale, politics, economy, environmental factors, and social factors), key questions, stakeholders information for role play, and discussion points. A handout explaining the goals of the two-hour tutorial (with break down on marks) is provided. These compilations of materials created for the sustainability module are available to all the tutorial instructors allowing all students to receive the same content and participate in the dedicated tutorial exercise.

Case study #2: COMM 101 (Business Fundamentals)

COMM 101 is an introductory first year, first term course taught to all ~720 incoming commerce students. Two course designers (Sauder School of Business instructors Paul Cubbon and Jeff Kroeker) developed and prepared the material for the six instructors who deliver the course. One stand-alone module is on sustainability; while, several other classes integrate sustainability concepts to issues such as ethics, balanced scorecard, etc. Sustainability themes often arise based on student interest from their background readings and experience in areas such as new ventures and social enterprises. Pedagogies involve: readings and videos and comprehension test (online, pre-class); in-class discussion and application of concepts to current relevant news; peer discussion and in-class worksheets; and in-class back-channel and personal blogging reflections.

For COMM 101, the lead instructors have an interest in and some knowledge of sustainability principles, and developed the sustainability module to be implemented by the various course instructors. The common lecture ensures that all students are exposed to the same material introducing the key concepts related to sustainability, and the focused sustainability lectures do not rely on specialist knowledge from the instructor.

Commentary:

In this model, the insertion of a sustainability lecture, or group of lectures (module), is relatively straight forward on the assumption that the sustainability plug-in material is already developed (or in the case of APSC 150, support is being provided by USI to prepare the material). In order for these new lectures and associated materials to be well-received and readily employed by instructors, they should be designed to be accessible to instructors who do not have a deep knowledge of sustainability.

Approach 3: Redesign an existing course module with a sustainability lens

Course structure and context: Large introductory courses composed of multiple sections which are modular in structure, taught by multiple instructors, with a shared teaching approach (Figure 2, right panel).

Insertion Model: This approach requires an examination of the existing course modules to determine which module(s) have the best potential for being recast using sustainability as a lens. A sustainability lens is applied to one (or more) of the selected course module(s). Using this lens-based approach, learning objectives of the original module (s) are modified to accommodate the new content.

Case Study: Chemistry 121 (Structural Chemistry, with Application to the Chemistry of the Elements)

CHEM 121 at UBC serves 1800 students. It is a mandatory course for all B.Sc. students and is also a requirement for students in programs in the faculties of Forestry, Land and Food Systems and others. The course is offered via multiple sections (i.e., 9 sections in 2013) and is taught by multiple instructors who share a common syllabus and textbook. The content of this course deals with establishing a foundation for chemical knowledge using atomic and molecular models, bonding theories and the periodic table.

In addition to these fundamental topics, an important component in the course is the use of exemplary reactions to demonstrate reactivity trends within the periodic table. This two-week section (Chapter 6 in the custom Chemistry 121 textbook) has historically been used to connect the fundamental concepts of periodicity and bonding to real world chemicals and reactivity. The core instructor team of CHEM 121 assessed all modules in the course and decided that this section on chemical reactivity was the most appropriate for reframing with a sustainability lens.

A Chemistry graduate student whose research area and interests overlap with sustainability is being hired to implement the redesign of the Chapter 6 module. The content of the module will stay mostly the same, but the intent is to reframe the chapter on how advances in chemistry have supported advances in sustainability.

Commentary:

Different approaches can be used to redesign an entire module to adopt a sustainability theme; examples are given in approach 4 below.

Approach 4: Redesign the Whole Course with a Sustainability Lens

Course structure and context: Small to large introductory courses composed of one or more sections, taught by one or more instructors. If the course is taught by multiple instructors, then they rely on a shared teaching approach (Figure 2, right panel).

Insertion model: This approach requires the complete revision of an existing course from start to finish with the goal of adopting a sustainability lens. We examine two case studies to identify the methods that were used to integrate sustainability content throughout the course, as well as lessons learned from these experiences.

Case Study #1: GEOG 121 (Geography, Globalization, and Modernization I)

GEOG 121 is a core course within the Faculty of Arts, Department of Geography, and has a relatively large enrolment (average of around 300 students) that draws students from a wide range of departments and disciplines from across the campus. The course is co-taught by two faculty from the Department drawn from a small pool of instructors (and occasionally sessionals) who rotate yearly through the course. The curriculum is made up of flexible module sets, some of which are taught on a yearly basis, and others that are taught depending on who is teaching that year.

The Department of Geography is currently revising and retooling *GEOG 121: Geography, Modernity and Globalization I*, with a view to shift its core focus to exploring questions of environment and sustainability from a historical and geographical perspective. With sustainability as one of the central organizing themes, this revised course traces evolving human-environment interactions across space and time, with a view to how and why societies have experienced environmental crisis in the past, and thus draw out lessons for a sustainable future. The objective of the course is to provide students, within Geography's Environment & Sustainability program and others, with a strong historical and contemporary grounding in key theoretical concepts and disciplinary lexicon in the field of Environment and Sustainability.

The course review and retooling is still ongoing, being carried out by a team comprised of one graduate student research assistant (RA), a project leader (Brown), and a consulting faculty member (Evenden). In consultation with faculty, the graduate student is responsible for identifying learning objectives and outcomes for the course, design and develop learning modules to address these objectives, and develop teaching support materials to assist in the effective delivery of the course material.

The project is divided into four phases, each with specific objectives and outcomes. They are as follows:

- I. Identification of Learning Outcomes & Course Framework
 - a. Revise the core learning objectives for the course integrating an environmental and sustainability focus.
 - b. Draft a 'strawman' course schedule identifying and sequencing potential additional topics to be covered to meet these objectives.
 - c. Identify effective pedagogical approaches for delivering the course material.
- II. Design and Development of Learning Modules
 - a. Design and develop a series of sequenced learning modules that address and integrate key concepts in the field of environment and sustainability into the existing course material.
- III. Developing Teaching Support Materials
 - a. Develop support materials to enhance student learning and interactivity. These support materials will include:
 - i. the development of assessment materials for each module
 - ii. the development of a clicker-based question bank in order to further increase student participation and open opportunities for a flipped-classroom approach
 - iii. development of online tutorials and discussions to complement readings and lectures
 - iv. the development of a course website that will provide a sustainable course platform from which new instructors who rotate into the course can teach
- IV. Course Evaluation
 - a. Evaluation plan to assess the success of the course.

Case Study #2: BIOL 321 (Morphology and Evolution of Bryophytes)

A second example of a complete course redesign (BIOL 321) is within UBC's Department of Biology as part of their development of a Sustainability Pathway that seeks to offer all its students the opportunity to study sustainability alongside their regular biology degree program. Within this broader program objective, they developed a framework for integrating sustainability into a biology course which followed the following methodology:

- I. Identify Big Ideas around Sustainability that apply to your class
 - a. Examples can include:
 - i. Definition of Sustainability
 - ii. Global Issues that relate to course content
 - iii. Regional and/or Local Issues that relate to course (opportunity for CSL projects)
 - iv. Course specific Ideas that relate to sustainability (Roles/uses of Bryophytes, Importance of Herbaria and Collections, etc)
 - v. Sustainability Focused Activity
 - vi. Communicating Sustainability
- II. Outline Topics that relate to each Big idea. Pair topics to those that could potentially apply to the course. Customize topics.
- III. Develop Learning Objectives that support intended outcomes.
- IV. Plan modes of Delivery (Activities, Discussions, Lecture, Assignments, Readings, etc). Identify areas of overlap.
- V. Identify the Sustainability Attributes and Pillar(s) addressed in each category.
- VI. Assess Attributes/Pillars coverage.
- VII. Integrate Sustainability Learning Objectives in with rest of course Learning Objectives and Content.

This course redesign, in addition to development of course content, produced a "Template for Sustainability Integration into a Course" which was designed to potentially assist other faculty members, within Biology and in other units across UBC, who are attempting to integrate sustainability into their curriculum (see APPENDIX 2). Note however that BIOL 321 is an upper-level boutique course taught by one instructor, who was personally motivated to apply a sustainability lens to her course. The applicability of the methodology to the redesign of large introductory classes warrants further investigation.

Case Study #3: ITAL 101/102 (First-Year Italian I)

A third example of a complete course redesign (ITAL 101/102) consists of a first year Italian course taught by Anneliese Schultz at UBC's Department of French, Hispanic, and Italian Studies. Anneliese has over time infused her first year introductory Italian language course with themes of environment and sustainability. Her rebuilding of the course occurred over five or more years, starting with providing small incentives for sustainable behaviour among her students before moving on to redesigning assignments, activities, and course evaluations to incorporate themes of Sustainability. There was no clear methodology to the way in which sustainability was incorporated into her course, but rather sustainability education was adapted and adopted to the course organically over time in ways that complemented language teaching. The course instructor also actively seeks to raise awareness of sustainability issues and events by making students aware of resources, initiatives and events around sustainability at UBC and within the broader Vancouver community. *Box 4.1: Sustainability Education and Italian 101* presents a range of in class activities and assignments developed by A. Schultz, listed in chronological order of their development and adoption in her course.

Box 4.1: Sustainability Education and Italian 101

1. **Punti Verde - Bonus Grades for Sustainable Behaviour:** A. Schultz rewarded eco-points to students who exhibited sustainable behaviours such as bringing travel mugs and reusable water bottles to class.
2. **Sustainability Themed Field Trips:** Field trips that involved trips to environmental or sustainable operations, such as UBC Farm, where students also practiced their Italian.
3. **Climate Change Teach-In:** Drawing on outside support and resources, A. Schultz dedicates one class, and associated activities, to climate change; in Italian of course.
4. **Sustainability Themed Assignments:** Incorporating research and reflection on sustainability into existing course assignments. For example, an assignment to plan a family get together in Italian, was altered to include specific need to address how you would make this gathering “Green”.
5. **Sustainability Class Projects:**
 - **Project 1: Azioni Verdi (Green Actions):** Students develop a vocabulary list of 25 words in Italian about a Green Action they are currently taking. Students then explore other peoples “Green Actions” and adopt 4 more. Final assignment is to list the actions and talk about the most challenging one and why it is challenging.
 - **Project 2: Sustainability Themed Book/Film Review and Presentation:** Students choose from a resource list of sustainability-related books, films and videos in English, and they write simple reviews and prepare group presentations for the class. “Wall-E” and “Avatar” are popular choices, as is the “The Lorax”.

Two interesting results of the incremental approach to incorporating sustainability into ITAL 101 is that, according to A. Schultz, this has not resulted in any additional workload for either the students or for her; “I still cover exactly the same chapters as before in the Italian textbook. They would be doing reviews and presentations anyway. There is no double burden on the students or on me because the concept, the consciousness raising, the activities have all been, exactly, embedded in the course.” She also feels that this approach to engaging with sustainability in the context of language learning is effective at fostering a culture of sustainability within the class.

Commentary:

A number of general comments can be made regarding the three methods outlined above for redesigning a complete course with a sustainability lens. First, the development of core learning objectives around sustainability is an important first step. However, it became apparent in the course revision of GEOG 121 that some of the UBC Student Sustainability Attributes (USI, 2013) are more easily, or at least concretely, integrated into course learning outcomes than others. Some attributes such as *Sustainability Knowledge*, and an increase in this knowledge through the students’ time at UBC, can be (relatively) easily measured. However, the degree to which other sustainability attributes, such as *Agent of Change*, can be integrated into the course is harder to determine and more difficult to access and perhaps should be targeted/flagged for other courses within the program.

On the other hand, ITAL 101 demonstrates that the development of core learning objectives are not required for the complete transformation of a course. While this course was completely transformed, from “Italian” to “Green Italian”, it was gradual and as the result of many incremental small scale changes to different aspects of the course; this transformation could therefore best be described as the cumulative applications of approaches 1 through 3 outlined above. In the case of ITAL 101, the increase in *Sustainability Knowledge* among students is hard to systematically assess. However, the focus of the

course on sustainable behaviour and building a student lexicon around sustainability suggests that this course is more likely to speak to other sustainability attributes such as *Agent of Change*.

All three of these case studies are interesting in terms of process, and how they approached the integration of sustainability into courses. However, GEOG 121 is still at such an early stage that it does not yet provide much insight for others seeking to do the same. Biology on the other hand has, as part of their work on a Sustainability Pathway, developed an interesting tool to help facilitate the integration of sustainability into course curriculum, and has even provided an example completed template for BIOL 321 (see Appendix 2).

Scale of Course Revision: Advantages and Disadvantages

The method and scale of sustainability content insertion must be considered when revising a course, as different approaches have different advantages and disadvantages. To help guide instructors and administrators to determine which approach best suits their course and curriculum context, Table 1 highlights some key pros and cons of the four different approaches described above.

Table 1. A description of the key pros and cons, with respect to implementation of the revision and potential impacts on student learning, of the four course revision approaches described in this paper.

| Approach | Pros | Cons |
|--|---|---|
| 1. Provision of sustainability teaching resources to instructors | <ul style="list-style-type: none"> - flexible, accessible and practical for instructors: instructors can choose how, what, where, when, and to what degree they incorporate sustainability materials into their course - small resource commitment by instructors: the provision of context-adapted sustainability teaching resources support instructors that are keen to incorporate sustainability but do not have the resources (time, etc.) to revise their course - support for instructors: motivates and supports faculty who feel they are not well equipped to teach sustainability related topics as it does not pertain to their area of expertise (Schultz 2013, Jones 2010) - instructor professional development: exposes instructors to new ideas and tools for teaching sustainability | <ul style="list-style-type: none"> - course revision is not mandatory: individual instructors decide to use (or not use) the teaching resources, so insertion of sustainability content is not guaranteed - awareness and usability of the resource: proponents of the sustainability teaching resource must effectively reach the course instructors to inform them of the tool and encourage them to actively use it. User support may also be necessary - initial resource commitment: the initial creation of the database requires significant financial resources for both content development and database creation and population. The user interface (i.e., website) must also be created - ongoing resource commitment: to ensure ongoing maintenance and utility |

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| | <p>- student experience: students gain some perspective on how sustainability is connected to a discipline and may be inspired to learn more about sustainability in and outside the classroom</p> | <p>of the teaching tool, the database and user interface should be “owned” by an individual or unit to ensure they are kept up-to-date an useful</p> <p>- student experience: exposure to sustainability issues and concepts varies depending on the degree of revision by the course instructor. Coverage may be minimal and concepts/issues may seem disconnected to other course content</p> |
| 2. Insertion of new lectures and/or tutorials on sustainability (plug-in model) | <p>- modest resource commitment: development of one or a few new lectures and/or tutorials (and the associated materials) is a much smaller resource commitment than redesigning the whole course (Rusinko, 2010)</p> <p>- guaranteed revision to the course: all students will be exposed to sustainability issues via the new lectures/tutorials</p> <p>- freedom to create new course materials: no constraints around having to repurpose existing materials</p> <p>- teaching effort is only modestly increased: instructors only need to become familiar with new material associated with one or a few lectures</p> <p>- instructor professional development: exposes instructors to new ideas and tools for teaching sustainability</p> <p>- student experience: students gain some perspective on sustainability, and potentially how it is connected to a discipline, and may be inspired to learn more about sustainability in and outside the classroom</p> | <p>- impacts on course design: insertion of one or a few new lectures and/or tutorials necessitates that some prior course material is either omitted or repurposed. The impact on the overall course design will be context dependent</p> <p>- instructor buy-in: someone must be responsible for enlisting the course instructors to engage with and use the new course materials. Ideally the authors and/or proponents of the new materials would be available as a resource for the instructors</p> <p>- possibility for sustainability to be cast as a separate topic: concepts and learning objectives around sustainability may seem fragmented and not connected with other course material, potentially diminishing the student experience and perceived relevance of the sustainability-oriented materials</p> |
| 3. Redesigning an existing module with a sustainability lens | <p>- modest to medium resource commitment: recasting an existing module with a sustainability lens is likely more resource intensive than simply adding a few new lectures, but a simpler</p> | <p>- coordination and instructor buy-in: revision of a module requires instructor buy-in and a shared vision of how to incorporate sustainability. A coordinator/lead is required who can</p> |

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| | <p>task than redesigning the whole course</p> <ul style="list-style-type: none"> - guaranteed revision to the course: all students will learn about sustainability via the redesigned module - sustainability learning a substantial component of the course: students will gain a more in depth understanding of sustainability topics and issues as a module is a significant focus of the course. More time spent on sustainability may also provide more opportunities to integrate different pedagogies - explicit connection between sustainability and the discipline: the disciplinary content of the existing module is augmented with sustainability examples, explanations of related issues, case studies etc., so that the connections between sustainability and the discipline is explicit and relevant - impacts on original course content is minimal: in principle, nothing of the original course content needs to be omitted | <p>manage the consultation process and lead the revision</p> <ul style="list-style-type: none"> - constraints of working with existing course material: the incorporation of sustainability content must work with the current course content - possibility for sustainability to be cast as a separate topic: concepts and learning objectives around sustainability may seem fragmented and not connected with other the other modules in the course, potentially diminishing the student experience and perceived relevance of the sustainability-oriented materials |
| <p>Redesigning a whole course with a sustainability lens</p> | <ul style="list-style-type: none"> - course design is integrated and unified: redesigning a whole course allows for the systematic integration of sustainability content. The student experience of sustainability is unified and connected to all other aspects of the course - course design can be incremental and progressive: a whole course revision offers the opportunity to methodically and incrementally build student knowledge of sustainability over the course of the semester. It also allows for creative and longitudinal use of case studies, problems, or examples within the course. A single case study can be used repeatedly throughout the course, allowing students to revisit and re-engage with the material from multiple perspectives. As a result, students should | <ul style="list-style-type: none"> - resource intensive: a complete course-level revision is very labour and resource intensive. It requires either strong financial and staff support, or a dedicated faculty member who commits to revising their whole course using their own resources. Currently at UBC there is little incentive for instructors or faculty members to take on large course revisions on their own. |

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| | <p>develop a more in-depth, nuanced, and complex understanding of both the physical and/or social processes involved.</p> <p>- pedagogies that support sustainability learning are easier to incorporate: relevant pedagogies can be built into the new course design, especially those requiring time-intensive activities such as project work and cycles of reflection</p> <p>- course design can be linked to the larger program within which it is embedded: opportunity to plan course-level learning objectives that complement program-level learning outcomes to maximize learning in the area of sustainability (i.e., achieving student sustainability attributes)</p> | |
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PART II - EDUCATIONAL APPROACHES FOR SUSTAINABILITY TEACHING & LEARNING

Below is a summary of example pedagogies and UBC programs that are effective for teaching and learning about sustainability issues, with a particular emphasis on how to foster change agent skills. The list is not exhaustive, but is intended to be a starting point for curriculum developers keen to include pedagogies which support sustainability learning into their course revisions. Both academic references and online resources are provided for each pedagogical approach. This is a living document, so please send any comments and/or additional resources to jean.marcus@ubc.ca.

| Pedagogies that relate to sustainability and transformative education* | | References and Resources |
|--|---|--|
| Action Learning | A form of experiential learning that enlists peers to help learners question their assumptions and (optimally) experience a paradigm shift before applying their learning in new situations. | In Sipos et al. 2008 Jiusto et al. 2013 All About Action Learning (Free Management Library) http://www.learnfizz.com/dale/all-about-action-learning |
| Community-Based Experiential Learning (CBEL) | An overarching term that encompasses a number of community-based pedagogical practices and a guiding principle that allows us to provide students with opportunities to apply their academic knowledge to real-world issues. The most effective CBEL opportunities provide collaborative learning experiences where all parties take part in the teaching and learning process. Major approaches are community service learning and community-based research. The heart of these pedagogies include 4 principles: 1. The projects must be volunteer (unpaid) experience for students, 2. They employ subjects learned in the course and that link back to course content, 3. Students participate in critical reflection after the project, 4. And the project is evaluated collaboratively by the professor and community partner. | UBC Centre for Community Engaged Learning http://wiki.ubc.ca/Community-Based_Experiential_Learning Benefits and Models of CBL/CBR—Clark University http://www.clarku.edu/community/pdfs/Part%20III%20Benefits%20&%20%20Models.pdf List of Publishers for CSL, Community Engagement and Experiential Education http://communityservicelearning.ca/csl-bibliography/publishers/ |
| Community Service Learning (CSL) | An educational approach that integrates community service with intentional learning activities. Within effective CSL efforts, members of both educational institutions and community organizations work together toward outcomes that are mutually | In Sipos et al. 2008 Canadian Alliance for Community Service-Learning (has a lot of resources) http://www.communityservicelearning.ca/en/ |

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| | beneficial. | Michigan Journal of Community Service Learning http://ginsberg.umich.edu/mjcs/ |
| Participatory Action Research | A summary of terms in social sciences that refer to involvement of participants in the research process, commitment to social change, and that include aspects of social learning. There are many ways to define try participation, action and exactly what constitutes “true” research. | In Sipos et al. 2008 International Institute for Sustainable Development Participatory Research for Sustainable Livelihoods (guide) http://www.iisd.org/casl/caslguide/par.htm Jacques M. Chevalier and Daniel J. Buckles Handbook for Participatory Action Research, Planning and Evaluation (comprehensive) http://www.sas2.net/sites/default/files/sites/all/files/manager/Toolkit_En_March7_2013-S.pdf Rachel Pain, Geoff Whitman and David Milledge (Durham University) Participatory Action Research Toolkit https://www.dur.ac.uk/resources/beacon/PARtoolkit.pdf |
| Community-Based (Action) Research (CBAR) | CBAR engages in iterations of learning and change that require community collaboration to define the problem, generate locally-produced knowledge, and devise and implement locally-appropriate actions to create mutually acceptable change. CBAR principles include open communication, participation, inclusion, relationship-building, and capacity building. The intent is to produce locally generated knowledge which leads to locally relevant action and change, the evaluation of which leads to the production of further knowledge, and so on, in an iterative process. At UBC, the three core LFS courses (LFS 250, 350, 450) adopt this method to engage students in the UBC Food System Project. | Rojas et al. 2007, UBC TLO/Fellows (Attributes doc) Centre for Community Based Research http://www.communitybasedresearch.ca/Page/View/Publications_Resources Community Based Research Canada http://communityresearchcanada.ca/resources |
| Place-Based Education (PBE) | Also called pedagogy of place or place-based education. This approach is seen to reclaim “the significance of the local in the global age”. It immerses students in local heritage, cultures, landscapes, opportunities and experiences, using these as a foundation for the study of various topics. Place-based education | Semken & Brant 2010 Promise of Place (mostly K-12) http://www.promiseofplace.org/ |

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| | emphasizes learning through participation in service projects for the local school and/or community. | Place-Based Education Evaluation Collaborative (some of the links in their resources section are stale) http://www.peecworks.org/index |
| Problem-Based Learning | A framework for learning that is focused, experiential and organized around investigation of real-world problems. Authentic experiences foster active learning, support knowledge construction and integrate school learning and real life. | In Siops et al, 2008; UBC PBL Network (resources) http://ctlt.ubc.ca/programs/communities-of-practice/problem-based-learning-network/ PBL@UD (University of Delaware resources for instructors) http://www.udel.edu/inst/resources/ Edutopia (focus on K-12) http://www.edutopia.org/project-based-learning |
| Project-Based Learning | PBL integrates knowing and doing. Students learn knowledge and elements of the core curriculum, but also apply what they know to solve authentic problems and produce results that matter...PBL refocused education on the student, not the curriculum – a shift mandated by the global world, which rewards intangible assets such as drive, passion, creativity, empathy, and resiliency. These cannot be taught out of a textbook, but must be activated through experience. | Brunetti et al. 2003 PBL Lab (Stanford University) http://pbl.stanford.edu/index.html Buckman Institute for Education (Project Based Learning) http://bie.org/ Edutopia (resources, focus on K-12) http://www.edutopia.org/project-based-learning Global Schoolhouse Network (PBL resources) http://www.gsn.org/web/pbl/resource.htm |
| PPBL (Problem- and Project-Based Learning) | Includes various teaching-learning settings that comply with basic principles of PPBL. PPBL courses employ constructivist and experiential learning approaches, in particular approaches of <i>problem-based learning</i> and <i>project-based learning</i> . In these settings, learning shifts from passive (instructor delivers, students receive) to active (students deliver, instructor receives and provides feedback). Students investigate a real-world problem and work on <i>solution options</i> to this problem by engaging in <i>small-</i> | Brundiers & Wiek 2013 Making Learning Real with Problem Based Case Learning http://www.makinglearningreal.org/ |

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| | <i>group work</i> (ideally in an interdisciplinary team) to which instructors contribute as <i>coaches</i> for the teams. | |
| Sustainability Pedagogies | | |
| Transformative Sustainability Learning | Head, heart and hands framework. TSL is presented as a unifying framework amongst related sustainability and transformative pedagogies that are inter/transdisciplinary, practical and/or place-based. The paper presents a “pedagogical landscape” of sustainability and transformative learning models based on the organizing principle or head, heart and hands (Fig 2). | Sipos, Battisti and Grimm 2008 |
| Burns Model of Sustainability Pedagogy | Comprehensive approach for designing or redesigning sustainability courses based on ecological principles. The aim is to provide practical ways, based on ecological systems, for designing postsecondary sustainability courses that encourage transformative learning. Key elements are: 1) <i>content</i> that is thematic and multidisciplinary, 2) <i>perspectives</i> that are diverse and critically question dominant paradigms and practices, 3) <i>a process</i> that is participatory and experiential, and 4) a <i>context</i> that is place-based. | Burns 2011 |
| UBC programs related to sustainability education | | |
| SEEDS | Using the campus as a living lab, the SEEDS program brings undergraduate and graduate students, faculty and staff together to work collaboratively on applied, accredited research projects that address real-life campus sustainability issues. | http://sustain.ubc.ca/courses-teaching/seeds |
| Integrate CBEL into a course | At UBC, the Centre for Community Engaged Learning works with instructors to help them integrate CSL and CBR into their course. This year there are 6 courses at UBC that incorporate community projects through support from the CCEL. | http://www.students.ubc.ca/communitylearning/experience-community/course-based-opportunities/ |

*Sipos et al (2008) also review other pedagogies that relate to sustainability and transformative education not included here: critical emancipatory pedagogy, environmental education, pedagogy for eco-justice and community, and traditional ecological knowledge.

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APPENDIX 1. Summary of UBC case studies reviewed in this paper

| Course | Enrollment (2013 W) | UBC Faculty leading the course revision | Approach |
|----------------|---------------------|---|----------|
| PSYC 101 & 102 | >3,500 | Catherine Rawn, Department of Psychology | 1 |
| APSC 150 | 800 | Noboru Yonemitsu, Department of Civil Engineering | 2 |
| COMM 101 | 720 | Paul Cubbon, Sauder School of Business | 2 + |
| CHEM 121 | 1,800 | Anka Lekhi, Department of Chemistry | 3 |
| GEOG 121 | 300 | Loch Brown, Department of Geography | 4 |
| BIOL 321* | 22 | Shona Ellis, Department of Biology | 4 |
| ITAL 101 | 180 | Anneliese Schultz, Department of French, Hispanic and Italian Studies | 4 |

* This is an upper level course, but the methodology the instructor developed to apply a sustainability lens to an existing course can be applied to introductory courses.

APPENDIX 2: Template for Sustainability Integration into a Course (Biology)

| Big Ideas | Topics | Delivery (Activities, Discussions, Lectures, Assignments, Readings, etc) | Learning Objectives/ Attributes and Pillars | Unit(s) Topic Addressed |
|---|----------------------------------|--|---|-------------------------|
| Sustainability and the three pillars | | | | |
| Global Issues | System Thinking (Systems theory) | | | |
| | Habitat Loss | | | |
| | Ecological Footprint | | | |
| | Loss of Biodiversity | | | |
| | Global Climate Change | | | |
| | Poverty | | | |
| | Energy | | | |
| | Nutrient Cycles (N, C, S) | | | |
| | War and Conflict | | | |
| | Population Growth | | | |
| Gender Equality | | | | |

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| | Sustainable Agriculture/Forestry | | | |
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| | | | | |
| Regional/Local Issues | Deforestation (loss of habitat) for Campus Development - Historic | | | |
| | Natural Disturbance | | | |
| | Green City | | | |
| | | | | |
| | | | | |
| Roles of _____ role in: | | | | |
| (depends on course topic) | Biodiversity | | | |
| | Water and Nutrient Cycling | | | |
| | Nutrient Cycling (Carbon) | | | |
| | Nutrient Cycling (Nitrogen) | | | |
| | Temperature Regulation | | | |
| | Economic uses | | | |
| | Research and Development | | | |
| | Impacts to human health | | | |
| | Remediation | | | |
| | Water Quality | | | |
| | | | | |
| | | | | |
| Other Course Specific Idea: _____ - | | | | |
| | | | | |
| | | | | |
| Sustainability Focused Activity | | | | |
| Communicating Sustainability | | | | |

Attributes:

- 1 = Holistic Thinking
- 2 = Sustainability Knowledge
- 3 = Awareness and Integration
- 4 = Agent of Change

Pillar coverage:

- Envir = Environmental
- Econ = Economic
- Soc = Societal
- Sust = Sustainability Focus