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Focus on Social Learning in a First-Year Technical Writing Class: a Canadian Case-study

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Focus on Social Learning in a First-Year Technical Writing Class: a Canadian Case-Study

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Abstract: Incorporation of writing assignments into the first-year curriculum is a key opportunity for engineering educators. The topics of sustainable consumption and design, environmental issues and global engineering were introduced into a first-year engineering communication course in the Faculty of Applied Science at the University of British Columbia, Vancouver. This successful initiative was further expanded to include writing reflection papers, proposals and research reports on community service learning and sustainable engineering projects in developing countries.

Keywords: Writing, Reflection, Professional Identity, Education for sustainable development, Engineering, Communication, Global citizenship, Community service learning

Introduction

Recent reviews[1, 2] suggest that the vast reform that happened in engineering education in the two decades since the Brundtland Report[3] has seen a widespread inclusion of sustainability topics in engineering programs across North America and the globe. In response to the Report's call to embrace sustainability in higher education, many universities have infused sustainability into their programs[4]. In Canada all engineering schools require that students should be familiar with the concept of sustainability. The Canadian Engineering Accreditation Board (CEAB) lists sustainability as one of the key graduate attributes. In particular, Attribute 3.1.9 "Impact of engineering on society and the environment" includes the concepts of sustainable design and development and environmental stewardship[5]. Engineering schools face a constant need to improve the teaching of graduate attributes and fundamental competencies. Their importance has been extensively discussed in the industry-academe dialogue[6,7,8,25]. It has resulted in the adjustment of accreditation criteria for engineering programs by the national engineering accreditation boards [5,9]. Yet, it has been observed that universities do not provide students with systematic training in these competencies [7,10,11], and there are warnings that "we're teaching the wrong stuff"[12].

Pedagogy

This paper presents a pedagogical approach that enables instructors to incorporate a substantial emphasis on global citizenship and sustainability in a first-year course on technical communication. It describes the evolution of students' academic needs, new accreditation criteria, and the institutional move towards outcomes-based assessment. The multi-dimensional methodology involves action research based on data drawn from observation, surveys, interviews, and discourse analysis of students' assignments. Choosing the first-year course as a case-study for education for sustainable development (ESD) is crucial because students learn to value sustainability at the very beginning of their university studies. This approach provides for the introduction of important values, concepts and assignments that are "grounded in processes which can lead to sustainability"[13]. This paper also highlights the challenges of teaching in an interdisciplinary space located at the crossroads of education for sustainable development (ESD), composition studies, activity theory and community service learning.

The described pedagogical approach strives to promote the transition to sustainability through social learning[14], i.e., by including community service learning projects that allow students to explore human and social dimensions of sustainability through the perspectives of various stakeholders. Starting with local projects, subsequent assignments involve projects based in the global context. In this way, students move from community service projects to the exploration of global implications of engineering practice. This process helps them to develop an understanding of global citizenship.

The Institutional Context

The University of British Columbia (UBC) is the leading university of the Province of British Columbia, and it has been consistently ranked among the top 5 universities in Canada and top 40 universities in the world. This four-year university serves about 60 thousand students in a broad range of programs, from undergraduate liberal arts and sciences to professional programs, including engineering, law, medical and doctoral programs. Publicly funded, it caters to students from a wide variety of socio-economic levels and has a significant ethnic diversity among students and professors[15]. Located in the multi-national metropolis of Vancouver, Canada, UBC sees it as its duty to promote global citizenship in the education of students and "to prepare students, educators and future leaders for the globally interconnected societies they must serve"[15].

The Faculty of Applied Science at UBC has about 6000 students enrolled in 12 engineering programs. The Faculty is "going global", i.e. developing programs and courses that contribute to the global connectivity of engineering education. The following important aspects of its core purpose are listed on the Faculty website[16]: responsibility, professionalism, promoting global citizenship, and enactment of positive change. A lot of attention is devoted to teaching engineering students about sustainability, sustainable development, and sustainable design, especially in the Departments of Civil Engineering, Geological Engineering, Environmental Engineering, Chemical and Biological Engineering. Sustainable engineering is the topic of a growing number of new courses; sustainability-focused modules are also added to existing courses. These initiatives usually take place in senior level engineering courses[13]. Obviously, it is important to embed ESD in senior courses in order to provide students with ample exposure to sustainability topics before they start their professional career. However, there are much fewer attempts to introduce the theme of sustainability in first-year courses[4,17], particularly in an engineering communication course.

Graduate Attributes

Communication instruction at the Faculty of Applied Science started with a stand-alone mandatory second-year course, APSC 201: Technical Communication. The topics of this course did not include sustainability. At first the learning objectives were limited to CEAB graduate attributes outlined in Criteria 3.1.7 and 3.1.6: communication skills, as well as individual and teamwork skills. In 2010-11 they were expanded to include three additional attributes[5] : 3.1.8 -

professionalism, 3.1.9 - ethics and equity, and 3.1.12 - life-long learning[1]. These new objectives resulted in the inclusion of the discourse on sustainability and social learning and an in-depth discussion of integrative skills (a.k.a. “soft” skills).

The New First-Year Course

Later we developed a first-year course with a theme of sustainability, APSC 176: Engineering Communication. Its objectives are to provide students with research, critical thinking and advanced communication skills necessary for success in the study and practice of global engineering.

We believe that a first-year communication course is uniquely positioned for integrating education on sustainability (ESD) with graduate attributes. APSC 176: Engineering Communication was developed as a response to the new ethical and democratic imperative to prepare our students for “going global”: “Our students must be able to navigate throughout cultural diversity not merely so that business can thrive, but so that our interacting societies can be enriched and our ideas made available across the globe. Our educated students move across many boundaries, and our faculty are enabled to live and work internationally. The ideas we create flow globally. Our service commitments are not limited by state borders”[15].

In the expanding global workplace our students will need knowledge of contemporary issues, including sustainability and cultural competence, as well as advanced communication skills[18]. In addition to analytical reading and interpretive skills, persuasion, ability to adapt messages for complex and varied audiences[7], the new requirements for getting hired are collaboration within cross-functional teams, management of virtual projects, and intercultural communication . In order to promote the global nature of engineering work, several international case-studies were developed for APSC 176.

Courses that are intended to help students develop professional attitudes and skills are notoriously difficult to promote and develop.

For transfer credit and articulation purposes, it was important to get multiple stakeholders on board. Course content, learning objectives and outcomes were developed in consultation with the UBC Department of English, the Communication Articulation Committee of British Columbia, and Engineering Communication Program at Simon Fraser University. This course would create an opportunity to address our own standards, disciplinary values and pedagogical practices. The goal was to promote a more inclusive use of communication that enables engineering students to draw upon their interest in engineering and their own communicative resources.

The plan was to vertically integrate the two courses, APSC 176 and APSC 201, by moving introductory modules and assignments from the second-year course to the first-year course. This integration would lay a solid foundation for continuous instruction in communication throughout the four years of studies for the Bachelor of Applied Science degree. It is now offered as a three-credit elective first-year course that requires completion of an English language competency pre-test, LPI (Language Proficiency Index), as a pre-requisite.

The Novelty of the Course

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[1] See *CEAB 2010 Accreditation Criteria and Procedures Report* , “Accreditation criteria”, Part 3, pp.12-135[5].

The course emphasizes graduate attributes, including sustainability and global citizenship. Learning objectives connect the course topics to important themes in engineering education. Initially, the theme of the course was "Can technology solve society's problems?" Assignments were related to "ethical principles that underpin many engineering decisions, whether in the realm of communication, design, or professionalism"[18]. Students were encouraged to explore and report on recent research initiatives in their intended engineering departments. For their in-class written persuasive proposals, students were assigned to a team and asked to choose an *Engineers Without Borders* project, conduct research and then present the problem and their solution. Students learned to use summary, definition and comparison to structure an argument; to write a research or design proposal; to prepare a collaborative research report and an individual portfolio; to make a collaborative oral presentation. The course included in-class, take-home and online components, and extensive use of educational technology.

Social Dimensions of Sustainability

Sustainability has multiple definitions: it is a concept, an ethical belief, a condition, and a competency, to name but a few. It unites scholarship and practice, local and global perspectives, and a range of disciplines, from natural and social sciences to engineering. An important definition that emphasizes its human and social aspects is provided by the US Environmental Engineering Body of Knowledge. Sustainability is "a condition in which the use of natural resources and cycles in human and industrial systems does not lead to a diminished quality of life due either to losses in future economic opportunities or to adverse impacts on social conditions, human health and the environment"[19].

Human and social dimensions are also emphasized in the definition of sustainable engineering from the American Society of Civil Engineers. Sustainable engineering is "the challenge of meeting human needs for natural resources, industrial products, energy, food, transportation, shelter, and effective waste management while conserving and protecting environmental quality and the natural resource base necessary for future development"[20]. An important social dimension is communication, and many documents stress its value for successful practice of sustainable engineering. Engineers must "successfully collaborate with experts from other disciplines and communicate with society and stakeholders in the pursuit of sustainability"[19].

In the interconnected world, global engineering practice should not be limited by regionalism or national boundaries. One of the goals of the course was to implement education in global citizenship into our pedagogical approach. Sustainability is at the heart of the working definition of global citizenship adopted in the course: "A global citizen is someone who feels a duty to respect and protect the Earth, the global community of fellow human beings and all other living creatures. We envision global citizens as individuals who have developed an understanding of the interconnected world and who deeply appreciate and value ecological sustainability and social justice. Global citizens are individuals who are willing and enabled to take action to make the world a fairer place for ourselves and other living creatures"[15].

The Development Process

In 2009, the course theme at UBC Vancouver was changed to incorporate a greater emphasis on sustainability. Course readings for APSC 176 were assigned from the textbook "Fundamental Competencies for Engineers" (published by Oxford University Press in 2006) which was written by our engineering and communication professors. To give students a sense of the value and appeal of engineering work, this book uses a conceptual model that is inspired by actual engineering practice. The concept of an international engineering consulting firm, called The Brunel Group, was used in APSC 176. This fictitious company is working on six projects described in the course textbook[21]. Using this concept helped educators draw the students' attention to global and local perspectives on engineering design. Many engineering companies are active internationally and have formal mentoring programs for new employees. Students were asked to adopt the rhetorical persona of an engineer-in-training who is a member of the mentoring program at the Brunel Group. The following fundamental competencies were selected: sustainable development, ethics, and integrative skills, such as teamwork and communication, designing and evaluating projects. These particular competencies are applicable across all disciplines of engineering.

Students began by learning the definition of sustainability and then examined its importance in engineering practice through the following activities:

- Conducting research and writing a formal report about the sustainability of 20th century engineering achievements.
- Investigating the ethical issues involved in sustainable technologies.
- Reflecting on the human and social dimensions of sustainable design.
- Exploring the concept of global citizenship and sustainable engineering practice.

Several themes that interact with sustainability were identified: sustainable consumption, respecting others, communicating effectively, and creating sustainable solutions. Course assignments were designed with respect to the graduate attributes required of graduating engineering students: an ability to formulate or design a system, process, or program to meet desired needs; an ability to function on multidisciplinary teams; an understanding of professional and ethical responsibility; an ability to communicate effectively; the broad education necessary to understand the impact of the solution in a global and societal context; knowledge of contemporary issues[5].

Students made collaborative oral presentations on two engineering topics throughout the semester: engineering achievements of the 20th century and ethical dimensions of engineering practice. For their collaborative formal report, students researched one of the Greatest Engineering Achievements of the 20th century, as determined by the National Academies of Sciences[21]. Instead of reporting only on the history of an engineering achievement, students analyzed current and future implications of that achievement. They considered the social, environmental, and economic issues of the technology and commented on sustainability of that achievement for future generations.

Recent research[22,23] indicates that the inclusion of human and social dimensions is critical for achieving a balance of societal issues in engineering education. Our students assumed the rhetorical persona of a trainee, were "paired up" with a "mentor" and "assigned" to a sustainable design project in Kyrgyzstan, Peru, Brazil or Canada. The purpose of this assignment was to point out that only technologies appropriate to local culture, skill level and environment of a country would be sustainable. In particular, students were asked to comment on a sustainable design of a biogas generator for a secondary school in rural Kyrgyzstan, the ore slurry pipeline for the new mine in Peru, the new "green" building at a Brazilian university, and the run-of-the-river hydroelectric power plant in the coastal mountains of British Columbia.

Students were asked to evaluate the designs and write a series of assignments. This activity aimed to encourage innovative ideas and solutions. It also allowed us to further explore the social aspects of sustainability, such as attention to the needs of local stakeholders, equity and diversity. It helped students to consider the human dimensions in engineering design, including the important question[21]: "What does bringing local input have to do with sustainable design?" Students learned that local stakeholders who are affected by the design must be involved in project evaluation. They were encouraged to conduct further research on the issue, its local and global implications, and determine whether or not the designs were sustainable.

It is important to note that our students are in their first year of the engineering program, and, therefore, they lack the course background necessary to create theoretically sound engineering solutions. For this reason, all calculations and descriptions were provided for them. Similar to results previously reported by C. Labun[18], our students' design proposals were "entirely conceptual – students are not required to develop a prototype, but rather to work with a team to develop (and subsequently, explain and market) a concept in response to an RFP"[18]. Students were also encouraged to investigate the economic, environmental, societal and cultural aspects of the country as part of their background research. As a result, solutions they proposed considered these important aspects of sustainable design. Their design proposals explained in what way their designs were economically feasible, socially acceptable and environmentally friendly. Students also expressed an interest in investigating the differences of sustainable technologies in developing and developed countries.

This assignment had two important outcomes. It provided an opportunity for the educators for achieving a balance that integrates environmental, human and social dimensions of sustainability. For students it proved to be an important step in furthering their understanding of their professional identity. Critical reflection on human and social dimensions of sustainability and "learning about oneself and others" is important in engineering education because it "informs engineers about the human significance of what they are learning"[23]. Student reflection papers were very creative. They not only responded to a particular case-study, but also demonstrated their understanding of human and social dimensions of sustainable engineering. For example, one first-year student decided to create a strategic plan for the Brunel Group, complete with the Vision and Mission Statements, Goals and Objectives. The following Values Statement was included in this strategic plan: "The Brunel Group relies on determined and innovative engineers who think outside the box while considering how their solutions might affect people and the environment. In particular, we value steadfast observance of the engineering traits of integrity and ethical conduct; a steady profit in order to continue operating; exceptional treatment of our customers, as they are integral to our existence; sustainable development to preserve the world for future generations".

Further Development

The topics of global citizenship and global development intersect with community service learning. It has been reported in literature that "service learning experience influences students' attitudes towards sustainable engineering"[24]. In 2011 the focus of APSC 176 was enhanced by adding topics related to community service learning (CSL). For their research report, students had a choice of investigating either the CSL projects at UBC or the reports of *Engineers Without Borders* (EWB Canada). Working collaboratively, students researched CSL and EWB projects and learned about the work of other charitable organizations, such as *Engineers for a Sustainable World* [21]. They interviewed CSL administrators, participants and community partners, as well as EWB overseas volunteers, attended presentations and workshops, and developed their own research topic. Their reflection papers indicate that students start to understand the essence of their professional identity. Most students report that they learnt a lot about themselves as future engineers, about sustainability and community, and about communication in the global context.

Our findings are consistent with those recently reported by engineering educators engaged in ESD[2,4,13,17,24, 25]. At the end of the term, as evident in their reflection papers and course assignments, 90% of the students were able to write an expanded definition of sustainability and explain the need to protect the environment for future generations. Nearly 95% of students agreed that sustainability was important and were interested in learning more about it. Some students expressed an interest in taking a dedicated course on sustainability and engaging in an extracurricular activity related to sustainability, such as projects of Engineers Without Borders or Engineers for Sustainability. After completing their research projects and evaluating their classmates' presentations, most students were able to identify and explain the sustainability attributes of an engineering project. They demonstrated an increased awareness of sustainability in subsequent course assignments and discussed aspects of sustainability in their research reports and reflection papers.

Conclusion

The theme of sustainability and emphasis on social learning were incorporated into an existing 3-credit first-year course, APSC 176: Engineering Communication, in the Faculty of Applied Science at the University of British Columbia, Canada. Our goal was to increase students' awareness of social dimensions of sustainability and give them the opportunity to comment on sustainability issues in engineering design. Dimensions of sustainability were investigated through the use of design proposals, student presentations about engineering achievements, case-studies set in the global context, and research reports about local and global community service learning projects.

Implementing the emphasis on sustainability in a first-year communication course proved to be an important way to embed ESD in the first-year engineering curriculum. The assessment process involved analysis of students' assignments and focus group discussions. As demonstrated by students' comments from their reflection papers, the focus on sustainability in APSC 176 raised students' awareness about the importance of sustainability. Another important outcome resulted from the successful use of case-studies set in the global context. The course textbook, "Fundamental Competencies for Engineers"[12], was instrumental for enriching our pedagogical approach because it had six case-studies set out in the global context, and they were interesting for our multi-cultural classroom. Our first-year students were able to identify sustainability issues in case-studies. Further, they managed to obtain some problem-solving experience through their design proposals. We believe that through this experience they developed the ability to assess and comment on the sustainability of a technological achievement for future generations. They learned to consider the human, social, environmental, and economic aspects of a technological innovation in a developing country. Engaging in a meaningful dialogue with diverse community partners and volunteers helped them start thinking about their future professional identity and the global engineering work, which is a significant outcome for a first-year course. We believe that the pedagogical process used in this course is transferable to other educational contexts.

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