

AC 2009-2092: DEVELOPMENT OF AN INTRODUCTORY COURSE ON “SUSTAINABILITY” AS PART OF THE CORE CURRICULUM

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Development of an Introductory Course on ‘Sustainability’ as Part of Core Curriculum

Abstract

This paper presents an educational effort to develop an introductory course on Sustainability, environment and technology at a university in the southeast United States. The course development was the direct outcome of an internal ‘College of Sustainability Grant’ awarded to the author.

The course content includes diverse multidisciplinary factors that relate directly to sustainability such as Environment conscious manufacturing, economics of sustainability, soil geology etc. The newly developed course also takes advantage of audio-visual media to facilitate instruction. The novel aspect of this course is that students from across campus are involved in mini-design projects to make some aspect of any chosen system more sustainable. The principal constraint in this case is cost. The course seeks to expose students from different educational backgrounds to the common concept of sustainability.

Introduction

The issue of sustainability and environmental conservation has been a front page topic of late. It has been discussed on various forums including academic, economic as well as political. There has been widespread agreement on the fact that something needs to be done in order to conserve our natural environment for future generations so they might be able to inherit a cleaner environment replete with healthy air, clean water and abundant natural resources¹⁻⁵. There has been a lot of talk and so called ‘lip service’ on this issue. However, very little attention if any has been paid to build environmental consciousness into the public psyche at an early age. This can take the form of an institution wide effort to drive the point home.

While on the one hand, there has been a hue and cry over conservation of resources and cleansing the environment, practically no attention has been paid to the ‘how to’ approach that seeks to accomplish this noble objective. If it can be unequivocally proved that environmental consciousness actually does make business sense and in the long run could be cost effective, that would help in widening the umbrella of the conservationists. Additionally, it would also impart the idea of sustainability more universal appeal.

This paper presents just such an effort. The project that has been described in the following pages was undertaken at a university in the Southeast United States. The university has been undergoing a metamorphosis on various levels. One of those levels is the recognition of the ‘Green’ concept as well as an undertaking that seeks to incorporate the idea of sustainability in all aspects of campus life.

The chief objective of this paper is to inculcate in students the principal theme that a balance between environmental, economic as well as social considerations needs to be sought in all spheres of design. This point will be stressed through the incorporation of interdisciplinary teams

of students working creatively in order to seek sustainable solutions to real life problems. More on this approach has been clearly presented in the ‘methodology’ part of this paper. The entire objective of having students from different disciplines and majors in cross disciplinary teams is to achieve a holistic perspective on addressing design problems. A solution that is not viable from either the technological perspective or is economically non-viable or creates social issues is not a truly sustainable solution. This is one very important point that will be stressed out throughout the time span of this course.

This paper is the result of a ‘sustainability’ grant awarded by the college of sustainability on campus. There is but one principal objective of this project. This objective is to develop a university wide course that seeks to introduce students from different majors on campus to the concept of sustainability. In order to have mass appeal of this nature, the course has to be designed in such a way that it appeals to engineers and biologists, to chemists and economists, to finance majors and arts students alike. It can be appreciated that in light of the aforementioned discussion, designing such a course is quite a tall order. The steps followed in achieving this objective are described in this paper.

Background

The objective of this project was to address demonstrable need to upgrade course TCGT 1530 entitled “Science, Technology and the Environment” within the technology department of a university in the southeast United States. The aforementioned course is part of the core curriculum at GSU. Enrolment in this course has routinely been approximately 400 students per semester. Being part of the core curriculum, students from diverse educational backgrounds and educational objectives typically take this course in their freshman year. The course is an excellent introductory gateway for non-science/technology majors into the world of science, technology and sustainability.

The state in which this course has existed in the past had the following prominent drawbacks which were in absolute need of rectification:

1. Recent technological advancements such as fuel cells, smart materials etc which are an integral part of environment consciousness and sustainability were not given any exposure.
2. Product Design, which forms an integral component of sustainability, didn’t receive any exposure.
3. The course delivery method was lecture based followed by a multiple choice exam. Study after study has demonstrated that ‘students learn best by doing’. Such being the case, there has been no provision for critical thinking and innovation within the course.
4. Innovative ideas are often the result of brainstorming and group activities. This facet was in sore need of incorporation into the course.
5. Sustainability cannot exist in isolation from the economics of cost. The course had no provision to include the business (and therefore practical) aspects of sustainability.
6. The course was always offered by the Mechanical Engineering Technology department. Definite room existed to have guest lecturers from different departments within the College of Science (such as Chemistry, Biology and Physics) as well as externally to speak to

students on the state of the art in their specific fields. Imparting to students the idea that “Sustainability is multi-disciplinary” is crucial.

The very idea of ‘Sustainability’ has now reached a stage where it fires up the public imagination. Many universities around the country are beginning to incorporate ‘Sustainability’ into their engineering programs. Today’s students who consider themselves as responsible members of the community want to know what is *really* happening as they turn to the scientific community for answers.

This is precisely the need that this effort sought to address through the complete overhaul of TCGT 1530 and bringing it in step with state of the art in sustainability and related technologies.

Methodology

The new course will aim to bring students up to date with current trends in sustainable thinking. It will instill in students the idea that ‘Sustainability’ is more than just recycling. The new course will seek to encourage critical thinking, innovation and problem solving skills in students through the incorporation of mini-projects and case studies taken from real life situations. In short, the new course will seek to achieve the following principal objectives:

1. Impart to students a holistic view of the environment and the fragile nature of the earth’s natural resources. Instill in them the idea that “the earth has sufficient resources to satisfy everybody’s needs but NOT everybody’s greed”
2. Encourage innovative thinking and problem solving in terms of sustainable product design.
3. Serve as a stepping stone to arouse students’ interest in a potential *sustainability oriented major* within the College of Science and Technology. Major concepts such as Carbon footprint, Product lifecycle, and cradle to grave design, alternative sources of energy, wind, solar and thermal power and the Commodity super-price cycles will be stressed on.
4. Encourage students from non science/technology majors (such as the arts, business etc) to get involved with the larger issue of sustainability.

In order to achieve the aforementioned objectives, we have sought to adopt a three pronged approach that centers of the following characteristics:

- **Method of instruction:** Compared to the routine lecture based method of instruction, we propose to change that format to an audio-visual system of instruction involving videos and short film documentaries. This approach serves to impart to students a real life feel of topics pertaining to sustainability. The following is a list of common audio-visual material that will be used to facilitate instruction:

The Business case for Sustainability (DVD)

NOVA: Solar Energy: Saved by the Sun (DVD)

The Future of Food (VHS)

NOVA: World in the Balance: The Population Paradox (DVD)

National Geographic: The Population Footprint (DVD)

E2: Energy (DVD)
Earth Aid: Water Conservation (DVD)
Earth Aid: Recycling (DVD)
Power Shift: Energy and Sustainability (VHS)
Alternative Energy Sources (Geothermal and Water) (DVD)

- **Incorporation of hands on techniques:** Most introductory courses on sustainability tend to rely too much on lecturing students and little else. We have sought to change this format. The new format will rely heavily on critical thinking which will be encouraged through the incorporation of small hands on projects that seek to find solutions to simple problems related to sustainability.
- **Examples of some hands on techniques:** Some related examples of such techniques include hands on experience with simple projects in which students calculate lifecycle costs of a product and compare it with revised lifecycle costs of an improved product after the implementation of sustainable solutions.

Another example could involve a project in which a team of students develop an innovative product or refine a process which leads to improved productivity (this means lower costs and higher profits) that utilizes entirely recyclable materials.

One more example of hands on techniques could involve an examination of energy consumption of common household appliances. Cross disciplinary teams of students will work on innovative solutions that will not only decrease energy consumption but also minimize associated costs through adoption of better design solutions.

- **Cross disciplinary groups to enhance creativity:** Given the fact that this course is part of the core curriculum, students from all across campus and belonging to different majors are required to take this course. As a result the amount of diversity in this class is unparalleled anywhere else on campus. The authors consider this diversity an asset and the course builds on this fact. The class population is divided into small groups of 3-4 students which will seek to find creative solutions to solving problems pertaining to sustainability. Each group consists of students from different majors across campus. No group for instance will contain two engineers or two biologists or two finance majors. It is intended that such group composition will enable students to learn from each other and bring a unique perspective to problem solving thus enhancing collective as well as individual creativity.

The course structure is depicted in figure 1. The authors have tried to take a holistic approach to designing the course by involving cross disciplinary topics. It has been our effort to try and point out to students that environment consciousness and sustainability cannot exist in a vacuum. In order to be successful, all concerned entities need to have a stake in the issue.

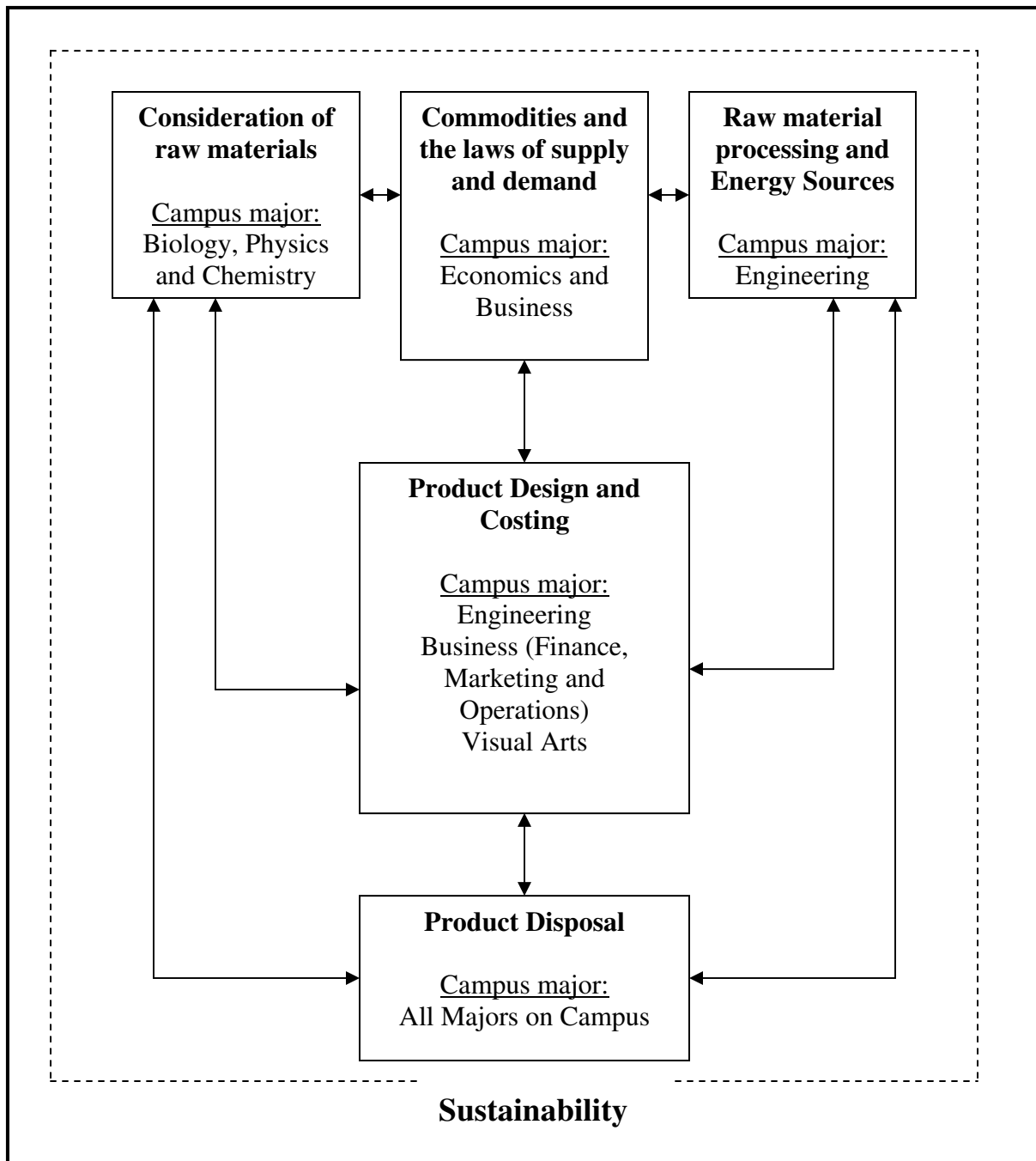


Figure 1: The Course Structure Depicting a Holistic Approach to Sustainable Product Design

The method of instruction is graphically depicted in figure 2. Notice the use of small cross disciplinary groups to achieve practical solutions to sustainability problems. This is intended to make students truly aware of the problems facing the environment and get them involved in order to seek realistic solutions to those problems.

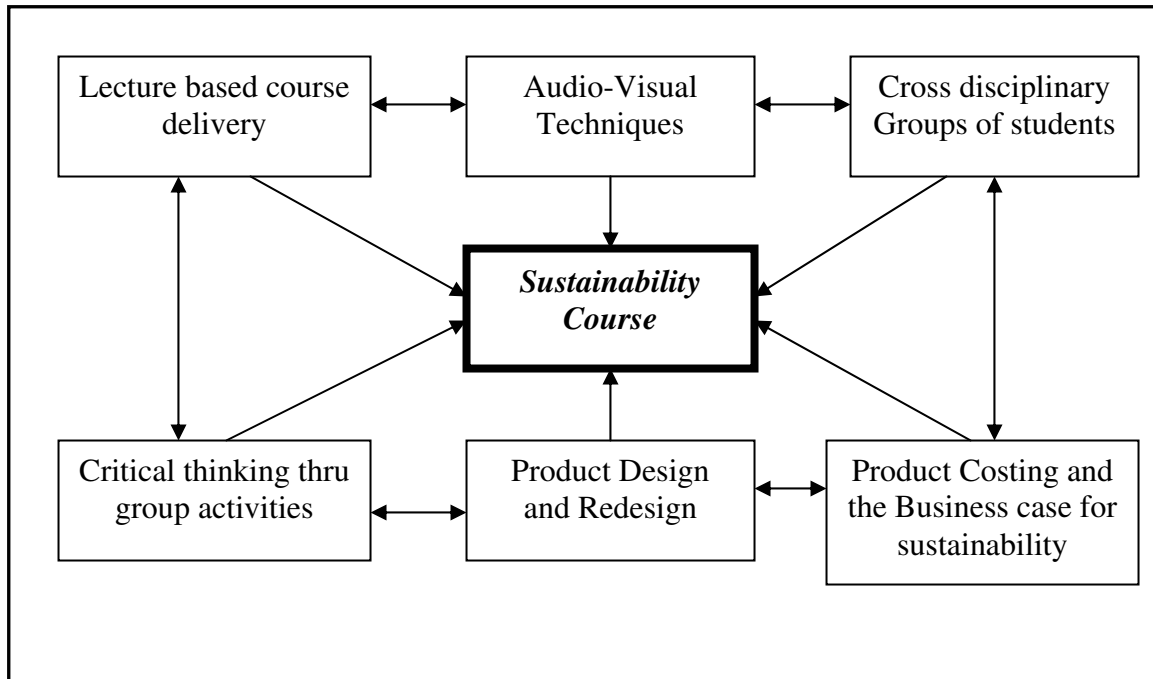


Figure 2: Different Methods of Instruction and Creative Activities Adopted within the Course Structure

Conclusion

This paper demonstrated the re-design of a course on sustainability. The course will be offered to all students across campus. It seeks to build on this singular strength: diversity of educational backgrounds. This is done to try and enhance creativity of students insofar as the decision making process is concerned. The authors intend to share the results of this unique experiment in future publications at this forum.

References

1. S. L. Hart, *Beyond Greening: Strategies for a sustainable world*, Harvard Business Review, 1997.
2. E. Barbier, *The concept of sustainable economic development*, Environmental Conservation, 1987.
3. C. Oliver, *Sustainable Competitive advantage: Combining institutional and resource based views*, Strategic management Journal, 1997.
4. P. Shrivastava, *The role of corporations in achieving ecological sustainability*, Academy of Management Review, 1995.
5. J. Pezzey, *Sustainable Development Concepts: An economic analysis*, World Bank, 1992.