ENERGY AND THE ENVIRONMENT: DEVELOPMENT OF A SUSTAINABLE EDUCATION COURSE

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Abstract: A recent focus in course development has been climate change, and the role of engineering in the sustainable world. There is an increasing concern about the impact of human activities on the earth, and a desire to learn about those effects. This paper details the development and evaluation of course content for EGEE101: Energy and the Environment. EGEE101 is a hybrid course, conducted both in the classroom and online, which is a novel environment and has necessitated new methods of communicating information to the students. It is desirable to produce engineers, scientists and energy business personnel who understand the energy system at a holistic level, and yet, still retain the appropriate engineering/science/business skills to meet the challenges ahead. This course provides this holistic experience and introduces the students to the many aspects of energy/environmental engineering in a novel classroom environment. Students found the dual nature of the course to be more rewarding than a single course either online or in the classroom. Students who would normally be reluctant to contribute to discussion in person felt comfortable contributing online, which added to the richness of the course environment.

1 INTRODUCTION

The changing nature of education necessitates novel approaches for teaching the next generation. Scientists must often cross interdisciplinary boundaries to develop solutions to environmental problems, and researchers must share knowledge across pedagogical borders (Kurland et al., 2010; Michener et al., 2001). Sustainability, and climate change in particular lend themselves to a non-traditional course approach, as the data is current and evolving (Parker, 2010). Non-traditional students must also be engaged by course delivery, and one way in which to reach this audience is to provide outside the classroom (in this case online) content. These users benefit from interacting with their peers in ways which the traditional classroom can lack, as those students often feel that their opinions go unheard in the class “group-think.” The term non-traditional student refers to adult learners, or those who may have been away from the classroom for an extended length of time. Tilbury and Wortman have identified several skills that should be evident in sustainable education environment, in particular systemic thinking and critical reasoning (2004). This course focuses on using the hybrid model to reinforce and encourage these traits among students.

2 COURSE DESCRIPTION

EGEE 101 is a course that has been offered at Penn State Greater Allegheny for several years in traditional format. The course is offered as a science for non-science majors and typically receives primarily business students. EGEE 101 is a hybrid course, conducted partially at Penn State Greater Allegheny and partially online. The student pool is primarily first year, first generation college students. As it is a small campus, the total number of students enrolled in the course was not large (10), and
students were primarily freshman and sophomore level. Students were required to attend regular class meetings as well as participate in the online portion of the course. There was a lesson activity each week that they were expected to complete as well as to participate in the discussion forums. Participation in the online forums is a major portion of the course. There was also a midterm paper and a final project as well, which were also major portions of the course. The approach here was to develop a course that could stand on its own outside of the classroom while fostering discussion within. Throughout the course, students reflected upon their learning and were surveyed as to their thoughts regarding the unique nature of the course.

Course topics included climate change, worldwide energy usage, and hydraulic fracturing. In order to engage students outside the classroom, this class was offered as hybrid course, consisting of both an in-class lecture portion, and an online discussion forum. The main objectives of the course are to: provide basic understanding and appreciation of energy and environmental concepts and interconnectedness; analyze energy consumption patterns; discuss various energy resources that power the modern society; examine the energy conversion processes; explore interrelationships between energy use and industrial progress and environmental consequences; discuss future energy alternatives. The architecture of this environment has been to scaffold the student with a foundation of knowledge so that they not only understand the material, but interact actively with it. In the online portion of the course, students completed activities designed to foster discussion and build knowledge of in class topics. Students were required to both attend in class lecture sessions and participate in the online portion. No student was independently taught.

2.1 Novel Course Modules

The course consists of varied lecture modules that detail topics related to understanding energy and climate change. Modules included discussion of El Nino/La Nina, global temperature modeling and sea level rise. Students also explored energy in the developing world through construction of solar ovens and discussion of alternative energy sources. The solar oven project used pizza boxes sourced from a local vendor and other found materials to emphasize that even the simplest project could be beneficial. An example of the solar ovens being tested by students is shown in Figure 1.

Other course material included an in-depth look at hydraulic fracturing as it is a burgeoning market in the area and critical reading of a scientific paper. For the capstone project, students wrote a research paper on an alternative energy topic (wind, solar, etc.) and presented a three slide introduction to their work to the class. In addition to each lecture module, there was also an online activity. For example, when talking about hydraulic fracturing, students were required to take a stand on the issue in the online forum (either pro or con) and support their argument with examples from the news and academic literature. To encourage discussion, students were required to comment on each other’s work in order to receive credit for the activity. Each activity was constructed to further expand upon the topic discussed in class, while enhancing students’ communication and research skills.

Students were periodically questioned using a short survey with a Likert scale of 1-5 (strongly agree to strongly disagree) about course activities and discussion. An example of the survey format is shown in Figure 2. There was also a space for comments.
3 DISCUSSION

3.1 Student Response

Students were engaged with the material more intimately by interviewing each other using the questions posted in the forums as prompts for discussion. For example, a lively discussion ensued regarding the
prompt: “If a company offered you $1 million dollars to do hydraulic fracturing in your backyard, would you say yes? Indicate why or why not, and cite both an academic (journal article) and non-academic (news article) source to support your argument.” This particular question resulted in 30 student posts on the forum, along with an extension activity discussing the articles cited in class. Students requested additional class time to talk about the topic, and were each granted 5 minutes to clarify and defend their responses in class.

Students responded positively to the inclusion of the online activities as a way to enhance interaction with course materials, all (n=10) citing either agree or strongly agree in answer to the question “Did the online activities enhance your learning in this course?” In response to the query “Did the online portion of the course help you feel more comfortable with the material?” all students except for one who responded neutrally cited either agree or strongly agree as a response. Students also noted in the comments portion of the survey that participating in the discussion forums helped them to better voice their opinions comfortably, particularly those students who do not often feel comfortable speaking in class. One student put it thusly “Often in class I feel that the loudest voices are the prevailing opinions. In the online forum, everyone speaks at the same volume.”

4 CONCLUSION

This novel course approach has resulted in an engaged student experience that provides in-depth topic exploration and familiarity with the material. Students benefited from non-traditional interactions in the discussion forums as well as discussion of material by their peers to provide enhanced understanding. Students responded overwhelmingly positively to the dual nature of the course, and it is planned to continue to offer this course in the hybrid module form rather than the traditional lecture section.

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References