

AC 2008-2301: INTEGRATING GLOBAL WARMING INTO A FRESHMAN ENGINEERING INTRODUCTORY COURSE

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Integrating Global Warming into a Freshman Engineering Introductory Course

Abstract

Managing the problems that global warming is being forecast to cause is going to require the educated attention of many disciplines. One of these has to be engineering as engineers are trained in the practical application of science and technology to meet human needs. What is being presented here is how we have restructured part of our course to provide lecture content and laboratory experiences on global warming.

We are fortunate to have a course that provides the framework to accomplish this, our freshman course *EGR 190 Fundamentals of Engineering and Computer Science* (FECS).

This course has been modified to include pre and post global warming perception surveys, an introduction to global warming using the video “An Inconvenient Truth”, mini lectures on alternative energy and two lectures and labs involving solar, wind, and hydrogen fuel cells as energy sources and a writing across the curriculum assignment on global warming.

The paper includes the revised structure of the lectures and labs, how the video is integrated, and the response of the students through their writing across the curriculum assignment. Details on the pre and post perception survey has been submitted as a separate paper.

Introduction

The emphasis for this effort came about because the common freshman book chosen at our university for the 2007-2008 academic year had its focus on global warming. This was former Vice President Al Gore’s “An Inconvenient Truth”. [1] The book has a compelling presentation of data related to the causes and effects of global warming. There is also a companion DVD that presents the data in a format that is easily understood and keeps ones attention. There is also an update on the DVD. In addition, Mr. Gore shared the Nobel Peace Prize with the Intergovernmental Panel on Climate Change (IPCC) for his efforts in being at the fore front in presenting the issue to audiences around the world. IPCC also published four reports that helped in understanding the problems of global warming and measures needed to counteract them. [2, 3, 4, 5] These events and the emphasis on global warming in the daily press and popular magazines convinced us that the subject matter was very important and should be incorporated into our existing freshman course. Therefore, we wrote a grant proposal to the university to do this and received local funding to proceed.

Methodology

Our FECS course is required of all incoming first year engineering students. It is offered each quarter and approximately 250 students total enroll. Enrollment is limited to 90 each quarter. It is designed to introduce engineering and computer science principles through hands-on experience, establish a sense of community, develop an understanding of how to be successful in studying engineering, and to foster collaboration among students through cooperative teaming. This

course has a lecture section, a computer lab section, an instrumentation lab section and a writing across the curriculum section. The computer labs are designed for students to work independently and the instrumentation labs are designed for students to work in teams. The original course outline is provided in Table 1. Additional information on the course has been previously published. [6, 7, 8]

Table 1: Original Outline of the FECS Course.

Week	Focus
1	Bridge Building Competition
2	Engineering Art, Email and Web – Plane Building Starts
3	3D Art and Fundamentals of Flight – Plane Building Done
4	3D Art and Web Design-I – Plane Flying Starts
5	Exam I and Web Design-II
6	Instrumentation and Web Design-III – Final Project Assigned
7	Circuits and Engineering Math
8	Timers, Flip Flops and other ICS, Exam-II
9	Temperature Satellite and How Things Work
10	Launching Temperature Satellite, Recording, Analyzing Data, and Presentation of Final Project – Plane Flying Ends

This course structure was changed to incorporate the common book “An Inconvenient Truth” DVD, provide two new lectures and two new labs on global warming issues. In addition, the writing intensive portion was changed to a focus on issues on global warming of interest to engineers. The revised course is presented in Table 2.

Table 2: Revised Outline of the FECS Course.

Week	Focus
1	Bridge Building Competition
2	Engineering Art, Email, Web – Plane Building Starts
3	3D Art and Fundamentals of Flight – Plane Building Finishes
4	3D Art, Web Design-I, and Moments – Plane Flying Starts
5	Exam I and Web Design-II – start showing video
6	Instrumentation and Web Design-III – finish showing video – Final Project Assigned
7	Circuits and Engineering Math
8	Timers, Flip Flops and other ICS, Exam-II – Plane Flying Ends
9	Global warming, alternative energy generation, and start the writing intensive portion
10	Alternative fuels, finish the writing intensive portion Presentation of Final Project on last Saturday of Quarter
11	Final Exam

During the 2007 winter quarter we experimented incorporating the video into the lectures. We found it doable provided it was shown in parts over several lecture periods without much discussion. The response from the students was very positive with many exchanges of opinions and thought provoking comments. So, the lecture periods were extended 30 minutes to provide time to show the DVD and include the updated portion on the DVD and more discussion time.

Each week's lecture and two labs have web pages designed to convey the week's information and lab assignments (www.cs.wright.edu/egr190/start). Hence, a revised syllabus was needed, development of two new lectures, two new labs, two new sets of web pages and updating of the writing intensive lecture and web page. The Gantt chart below outlines the eight week development cycle, Figure 1. The development took place over the 2007 summer in order to have the revised course ready to teach starting fall 2007. The time line shows eight consecutive weeks of effort. There were two distinct sections: one for developing the labs and one for developing the lectures. The labs require ordering, assembling and testing of the components. Then the components require integration into two teach/learning labs. This involved setting up the experiments, the data collection methodology, student instructions, and student deliverables.

Task	Wk1	Wk2	Wk3	Wk4	Wk5	Wk6	Wk7	Wk8
Order lab materials	---->							
Assemble labs			---->					
Design labs				-----	-----	---->		
Test labs						-----	---->	
Design lab web pgs					-----	---->		
Research lectures	-----	---->						
Write up lectures		----- -	---->					
Design lecture web pages			-----	--->				
Update WI web pg					---->			
Integrate web pgs into course web site					-----	-----	-----	----->

Figure 1: Gantt Chart for Revising the EGR 190 Course

One of the lectures involved teaching about the various alternatives to oil and coal for energy production and reduction of CO₂, i.e. wind, wave, solar, biological, and nuclear. The other lecture looked at alternative fuels with a focus on ethanol and hydrogen as they have been receiving significant development efforts by industry. One of the new labs provided experiment using solar and wind power. The other lab provided experiments using a fuel cell.

Evaluation

At the beginning of each quarter the students were given a pre-course questionnaire that asks about their prior knowledge of the subject matter that is taught in the course. At the end of the quarter the students are given a post course questionnaire that also asks how they perceive their knowledge about the subject matter that was taught. A comparison of the pre and post questionnaires is then done. A pre and post questionnaire to test their perception of global warming was also given. A five point Likert scale was used. In addition, on the final exam, questions were added that focused on the two new labs. The evaluation results are presented in another paper.

Results

The lecture on alternative energy included presentation and discussion on:

1. The sun
2. Passive solar energy
3. Conversion of solar energy to electrical energy
4. Coal
5. Oil
6. Natural Gas
7. Nuclear Energy
8. Water
9. Wind
10. Geothermal
11. Wood
12. Biomass

The lecture on alternative fuels included presentation and discussion on:

1. Hybrids
2. Battery Power
3. Hydrogen

The instrument lab on wind and solar power used materials from the Fisher Technik Eco Power kit. [9] For the wind energy experiment a wind velocity meter was included along with a hair dryer and voltmeter. The hair dryer had several choices of fan speed and was modified to only blow room temperature air. The setup for the wind energy experiment is shown in Figure 2. The energy produced by the windmill at various wind velocities was measured.



Figure 2: Equipment for the Wind Experiment

The solar power portion involved solar cells, a light meter, a light source, and a voltmeter. The setup for the solar energy experiment is shown in Figure 3. The energy produced from the solar cells at different levels of light intensity was measured.

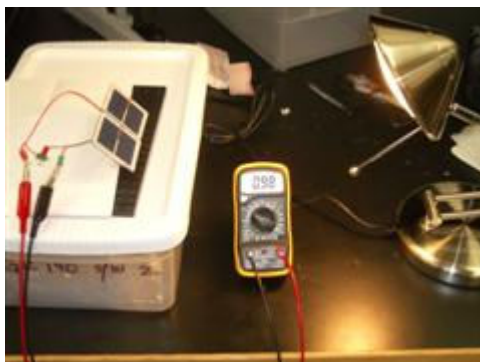


Figure 3: Setup for the solar energy Experiment

The fuel cell lab utilized the fuel cell from the intelligent fuel cell car. [10] The equipment for this lab is shown in Figure 4. It includes the fuel cell, gas capture chambers, a battery for electrolysis, and a voltmeter. The fuel cell was used for both electrolysis of water and the generation of electricity from hydrogen and oxygen. Energy measurements were taken and an energy comparison of the two uses was done.



Figure 4: Equipment for the Fuel Cell Experiments

Conclusion

Over a seven week summer period our freshman engineering course was successfully modified to provide a focus on global energy. The length of the lecture sessions were increased to allow time to show the DVD “An Inconvenient Truth” and provide discussion time. Two new lectures on energy and methods of powering a car were successfully developed. Two new labs were developed involving wind, solar, and fuel cell. The course web site was modified to include the new information and a new pre and post perception instrument was created for evaluation the course. The evaluation is the subject of another paper. The revised course was taught for the first time fall 2007.

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