

Modifications to a Freshman Engineering Foundations Course

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This work describes modifications made to a first-year Engineering Foundations course which has been offered for 4 years to all Engineering and Applied Science students at the University of Cincinnati. The course provides an introduction to ethics, teamwork, problem solving, report writing, and presenting skills. The course also introduces students to the major fields of engineering and teaches basic laboratory skills through a series of four hands-on modules. Each module is two weeks and covers a variety of topics related to Electrical Energy, Solar Energy, Fuel Cells, Thermodynamics, and Structures. Last year, faculty came together and restructured the course with the goal of improving the students' problem solving skills, understanding of the link between engineering fields, and technical writing skills.

The problem solving skills were addressed by introducing a one week problem solving exercise during week 2 of the course. The problem they were given was to design a 52 inch tower using trusses and connecting pieces from the Bridge Building Hands-On Module, which then had to be able to cantilever a mass from the top. The tower was constrained by a cost function to help the students limit their material, base area, and maximize the weight they cantilevered. The cost function was also seen as a profit or loss with the goal of getting a number greater than 0. The students were required to provide an initial design on paper, after which they built their first tower and calculated the cost function. Using the cost function results, they were then allowed to do a redesign to try and optimize their cost function. This exercise did a good job at getting the students involved early in the course and based on their feedback it showed that they started seeing engineering as a field which was often guided by design and constraints.

For a freshmen engineering student, it is very difficult to see the link between the different fields of engineering, and the 4 modules related to Electrical Energy, Renewable Energy, Thermodynamics, and Structures would appear at first glance to only be applied to specific fields. To add unity between the fields of engineering, we began to emphasize the concept of series and parallel in the first 3 modules. The first module on electricity focused on series and parallel resistive circuits. This theme was then continued into the Solar Energy Lab where students were asked to put the solar panels in series and parallel to understand how the optimum power changes. The week after, they used fuel cells to power an electrical motor on a small car. The students were allowed to use 2 fuel cells, but they needed to decide if the fuel cells should be in parallel or series. They quickly learned how the power was impacted (series went faster and parallel lasted longer). Ultimately, the students were beginning to understand how fundamental engineering principles could assist them in the design of any product.

Another major change to the class was the shortening of the lab reports associated with each of the hands-on modules. During the first 3 years, students were asked to write a complete lab report which included an introduction, procedure, results, discussion, and conclusion. Although

the reports were good, it was noticed at the end of the semester that they were still not be able to do the basic task of writing a good paragraph about a figure (graph or table). Thus, the new lab report format required students to only write about their results (tables and plots) which included a 1-paragraph discussion for key figures. Each lab module was 2 weeks so ultimately they wrote 2 to 3 paragraphs to summarize the results. This method enabled us to focus the grading around the technical writing where they needed the most improvement.

In conclusion, a few modifications to an Engineering Foundations class provided significant improvements in the students' perceptions and understanding of engineering. The evaluations support this conclusion, and next year we plan to further improve these modifications to provide a very streamlined class which provides a valuable learning experience for our students.