Introducing a Service-Learning Component to a Freshman Engineering Graphics Course

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Abstract

ENGR 1120 serves as an introductory course in engineering graphics for freshmen in Biological and Agricultural Engineering at The University of Georgia. The prevailing emphasis in the course has traditionally been to develop 2-D and 3-D graphics communication skills, heavily weighted in the enhancement of visual skills and the ability to generate sets of working drawings through an intense final group project. For the past three years, the approach to this final project has been for the instructor to give a fairly well defined description of a problem and leave the development of an early-stage solution to the creativity of the students. This approach has yielded positive results with respect to preparing them for their sophomore and senior level engineering design courses. However, in order to incorporate the ethical and societal responsibility of the engineering profession, while maintaining the traditional emphasis necessary in graphics science, a service-learning element has been included in the final project beginning Fall 2001 wherein the students define their own problem using instructor criteria that gears the student toward identifying a community need for disadvantaged individuals. This paper reports on the framework for this effort and the results for Fall 2001 and Spring 2002.

Introduction

Identifying needs and improving the quality of life for society are paramount in the ethical responsibilities of an engineer. Freshman students entering an engineering curriculum are typically drawn to the program based on the lucrative and professional aspects of the field itself. However, as society becomes increasingly dependent on technology and as the hard sciences of engineering become more integrated with the soft science aspects of politics, economics and cultures, there is a increasing need for students to understand the link between technology and society. In a paper on a new paradigm for ecology and engineering, Wiedenhoft [1] comments, "The path to new paradigms lies in raising such questions [as what, why] and earnestly grappling with possible answers. Not a new dogma is thereby defined, but a new intensity and breadth of searching, a new open-mindedness, new awareness. Concerning impacts on society, the

Association of American Colleges[2] says it for us all: 'So many technical problems are now also social problems – or ethical, or political, or international problems – that some ability to deal with them as such is just part of the essential professional equipment of engineers.'"

One approach to impressing students with this ethical responsibility is through service-learning, which is a method by which students learn and develop through thoughtfully-organized service that is conducted in and meets the needs of a community and is coordinated with an institution of higher education, and with the community, helps foster civic responsibility; is integrated into and enhances the academic curriclum of the students enrolled; and includes structured time for students to reflect on the service experience[3]. This paper presents the steps currently being taken at The University of Georgia's Biological and Agricultural Engineering Department to incorporate the ethical responsibility of engineering in a freshman engineering graphics course using a service-learning environment without sacrificing the emphasis on technical graphics communication. Past Approach to Graphics

ENGR 1120 is a 2-semester hour (3-quarter hour) course and is the only engineering graphics course taken by students in the Biological and Agricultural Engineering Degree programs at the University of Georgia. For many years the emphasis has been on the technical aspects of developing visualization skills in 2-D drawings and isometric pictorials. Traditional subject matter is given as:

Technical Graphics	The Design Process	ANSI Standards & Conventions
Linetypes	Scales	Workplanes
Projections	Isometric Pictorials	Multiviews
Projection Theory	Orthographic Projection	View Selection
Edges & Planes	Principal Views	Auxiliary Views
Line of Sight	Section Views	Hatching
Geometrics	Locations of Features	Dimensioning

A capstone final project is the primary means of melding together the technical aspects of the course. The goal has been to provide the students with the opportunity to conceive an idea and generate a set of working drawings as a preliminary design concept that would be subject to further review. A problem statement was given with constraints specified and the instructor served as a mentor and consultant for each project. Typically, one requirement is that the device be mobile and incorporate the use of a gear, sprocket or pulley. 3-D solid modeling is emphasized as the database format for all drawings. Students in the class have typically displayed a mixed understanding of basic mechanical concepts such as redirection of movement, fasteners, bearings, etc. which usually motivates the instructor to stress these concepts. This has proven to be a valuable learning experience as the students have been forced to delve into and research subjects with which they had always taken for granted and had no previous experience. Class projects are divided into groups of 2 or 3 and students are required to maintain a design notebook. At the end of the semester all projects are presented to the class along with a written report. The instructional goals and objectives of the class and the final project are

1. To develop 2-D and 3-D visualization skills
2. Introduce the students to idea conceptualization and provide them with an in-depth experience
3. Develop the skills to convey technical information from the idea phase to a graphics format
4. Develop skills of inquisitiveness regarding previously unknown concepts.

Grading criteria is:

Functionality and Completeness	35%
Attention to Details	25%
Overall Appearance	15%
Creativity	15%
Notebook and Presentation	10%
Bonus for Top Project	3 point curve on final average

The projects have been generally prescribed for the most part and have included such topics as:

Go-carts
Trailers
Lifts
Hoists
Conveyor systems
Underwater samplers

While some preliminary designs differed to some degree, the overall concepts were in general very similar. The instructors are confident that the goals and objectives as previously stated were met.

New Direction

At the 2001 ASEE conference in Albuquerque, New Mexico, Lima, et al[4] presented work being done at Louisiana State University to introduce service learning in the Biological Engineering program. That presentation inspired the authors of this paper to explore the possibility of introducing similar concepts in the freshman engineering graphics course. It was the position of the authors that the instructional procedures needed to maintain an emphasis on the technical graphics aspect, but be inclusive of the social aspects of the engineering profession and ethical responsibility.

Beginning in Fall 2001, a brief questionnaire was given to students to determine a basic level of their understanding of the engineering profession. They were given the following:

1. Define “Engineering”.
2. Describe what you believe an engineer does.

3. Explain what you perceive to be an engineer's role and responsibility in society?
4. What do you believe motivates an engineer?
5. Why did you choose engineering as your major?
6. How would you characterize a good and/or successful engineer?
7. List up to ten skills, qualities or characteristics that you believe are most needed for someone to be deemed as a good and/or successful engineer.

After the questionnaire, class time was dedicated to a presentation on the societal, ethical and technical responsibilities of the engineering profession. Material was presented on the engineering design process, ethics, societal needs, engineering integrity, quality of life, engineering and economics, engineered systems, problem identification and the application of basic scientific knowledge. The purpose of the questionnaire and presentation is to impress upon the students a big picture view of the engineering profession and its responsibility to society.

While technical course content remained focused on graphics science and technical graphics communication, a backdrop of service-learning was put in place. The final project was reformatted to be much more open-ended with explicit instructions that the preliminary design must benefit individuals who are physically challenged. These were first steps and it was fully expected that much effort would be needed to establish a true service-learning environment. It was also understood that there would be a need for instructional help from experts in the field of service-learning.

Results

The strategy taken for the Fall 2001 section was to leave the format very open-ended. Students were given the one constraint of developing an idea that would benefit individuals who are physically challenged. No instructions were given that required students to meet one-on-one with physically challenged individuals. Of the 13 projects submitted, 10 were based on a basic wheelchair design and only 1 group actually met with individuals who are physically challenged. This indicated to the instructors that the "service concept" had not been impressed upon the students since the majority of the ideas were conceived in the minds of the students.

As for course evaluations, evaluations of instructor performance did not expressly ask for feedback on the service-learning aspects of the course. This was intentional and served to provide feedback on how well-impressed the students were with the project and its focus. Evaluation results showed mixed results with some mention of the service-learning aspects of the course but not enough to convince the instructors that the concept was well-conveyed.

Initial results show that students remain focused on the technical aspects of the course with little regard to the social responsibilities. This was not altogether unexpected since only a minimal amount of class time was spent on conveying the ethical responsibilities of the engineering profession. Again, this was a first attempt and future efforts will aim at weaving lecture material on this into future classes. Lessons from the first attempt at introducing service-learning helped guide the instructors to enhancing the efforts for the Spring 2002 semester where final projects will require that students contact the targeted group and include the results of their discussions in

their reports. Moreover, a professional relationship has been developed with service-learning experts whose expertise will be integrated into future efforts.

References

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