# Introducing Design Process in Engineering, Engineering Technology

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## Introduction

An innovative set of projects introduced in a regional campus of a state university (with which the author was affiliated prior to his current position) forms the basis of this paper. Indiana University – Purdue University Fort Wayne (IPFW) is the sixth largest public university in Indiana with an enrollment of 12,000 students. Typically a commuter campus (although residence halls have opened since the fall of 2004) the students are a mix of part and full time students, as well as one of traditional and non-traditional types (who have been out of school for several years). The School of Engineering, Technology and Computer Science (ETCS) has an enrollment of about 1500 students and comprises of five departments, that of Engineering and Computer Science and three Technology departments. The introductory freshman course ETCS 101 is a required course for all ETCS majors, which provides them with an introduction to the various departments within the School of ETCS, counseling and career information along with some team projects. A new project introduced during the fall of 2003 and continued through the spring of 2004 forms the basis of this paper. This project involved the design of posters to convey the solution of an open-ended problem devised by student design teams. The teams were asked to identify a problem area or opportunities for improvement in the campus that could be solved or executed with in an assumed budget of $1000.00. The goal of the project was to reinforce the concept of the engineering design process in the very beginning of their academic careers. This activity effectively demonstrated the importance of graphical, oral and written communication skills as well as teambuilding skills essential in engineering design.

## The Poster as a Communication Medium

The poster is a convenient way to present technical information. It is a static visual medium that can be used to communicate ideas and messages. An effective poster helps one engage people in conversation and is instrumental to get the author's main points across to as many people as possible. It all starts with an idea and the challenge is to turn that idea into a succinct image and support that image with a combination of pictures and short blocks of text. In short the objectives of the posters were to provide the engineering, technology and computer science freshmen with the following:

(a) Practice their visual, written and oral communication skills in a conference-type environment.
(b) Share their work with other students, faculty, administration and the community at large.
(c) Improve the visibility of student efforts by recognizing the excellence of student projects.

In effect the poster is supposed to do the most of "talking."  Although in our case the posters mostly did all of the talking, because a lot of teams could not be physically present because of their prior commitments to their jobs.  As a result the majority of the teams that designed the posters did not get instant feedback because they were unable to stand by their posters and defend their designs.  If they were able to stand by their posters they could have answered questions and could have provided further details and convinced the judges that the designs that they came up with were indeed excellent and worthwhile.  Nonetheless it was a good learning experience for the students as they worked it teams to produce the posters.  Moreover it was an activity that produced a lot of interest in the campus and the community.

**Poster Project Details**

The students were asked to work in 2, 3 or 4 member teams on projects (3 was the preferred number, although there were a few 1-member teams).  There were four sections of the course with about 30 students in each section.  The team members need not had to be all from the same section although this was the preferred option.  The teams were asked to go around the university campus and identify either problem areas or opportunities for improvement.  These could be in one of the following categories:
(a) Technology dealing with the university facilities
(b) Safety issues at the university
(c) Cultural/Social issues affecting the university

Once the teams identified the topics they were asked to develop the solutions with an assumed budget of $1000.00.  The identified problems and the proposed solution within the specified budget were to be presented in posters for display and critique by the university community.  The Office of the Dean of the School of ETCS provided the posters and other materials.  A panel of experts was to evaluate the posters and top three projects were to be implemented by the Dean's office.

**Poster Design Philosophy**

Specific strategies of the posters were to research the primary literature and topical reviews; evaluate methodologies, technologies, and experiments on the project, and determination of the pertinent data and analysis leading to the conclusions reached by the

experts in the field. Then the data needed to be presented in a logical and concise fashion in a poster format. The philosophy of the poster project was the application and appreciation of the engineering design process and required to have the following steps, which are detailed below:

The student teams were asked to examine, identify and establish the needs and to answer the following questions:
"Why the problem you have chosen to solve is indeed a problem?"
"Is there a legitimate need for you to solve the problem?"
"Would the university campus benefit if such a project were to be implemented?"

The teams were asked to further examine the current situation in more detail before you embark on a specific solution. The next step for the teams was to brainstorm possible solutions using their knowledge of science, mathematics, engineering and technology. In the lecture sessions such brainstorming strategies were constantly encouraged and reinforced. Many student teams decided to keep their problems and associated solutions a complete secret till the day of the poster presentation. Some of the groups came forward with their problems and solutions. No formal advising on the solutions was provided to the design teams.

The next step was to select the best solution out of the set of solutions the team members came up with in terms of time and budget constraints. The projects were assigned 4 weeks after the beginning of the course and the presentations were scheduled after 8 weeks after they were assigned. The cost of executing and /or implementing the solution would not exceed $1000.00.

The final and of course the deciding step of the process was to present the solution and discussions as to how the solution fits the needs of the problem originally formulated.

A cost analysis was required of each team in which they would outline the costs to implement their specific solutions in terms of material labor and administrative costs. The purpose was to reinforce the concept that the cost is the most important consideration in any design effort.

In short, this project seemed to have enhanced a heightened awareness of engineering design as an important element of engineering education and practice. A general view of the posters appears in Figure 1.

**Figure 1: Poster Project Display**



**Figure 2: Details of a Winning Poster**

**Poster Evaluation**

The initial evaluation of the posters involved assessment by the experts and also by the public at large using a ballot box. Later the public ballots were discarded because of the lack of fairness and only the judging by the experts was employed. The judges were asked to grade the posters in terms of criteria listed in Table 1.

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**Criteria for Judging Posters**

1. Problem Definition:                                    (20 points)
   (a) Understanding the situation
   (b) Establish the Needs
   (c) Identify the Constraints of the problem

2. Problem Synthesis                                      (15 points)
   (a) Identify Alternatives
   (b) Techniques used? (Brainstorming, etc.)
   (c) Thinking "outside the box?"

3. Evaluate Alternatives                                  (15 points)
   (a) Methods used?
   (b) Criteria used for Evaluation?

4. Concept Selection                                      (20 points)
   (a) Why did you choose this option?
   (b) Is it the most satisfactory one?

5. Cost Evaluation                                        (20 points)
   (a) Material
   (b) Labor
   (c) Overhead

6. Recommendation for Further Work? (Bonus Points: Maximum 10)

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**Table 1 Criteria for Judging Posters**

Along with these criteria, additional elements were introduced in the judging process. These were (a) impact, (b) practicality and (c) creativity. The top three winners were picked based on these criteria. Figure 2 shows one of the winning projects.

Assessment of Student Learning
As a result of the poster project activities, the students were exposed to a host of problems that existed in the campus, to which they had no awareness.  A number of projects dealt with pressing problems that the students faced during their stay in the campus, while some others dealt with issues of beautification of the campus.  Some of the projects were worthy of being implemented by the administration.  Coincidentally some of the problems that the students identified were already in the process of being implemented by the administration.  But more importantly the poster projects provided the students an impetus to solve the problems with a demanding constraint of the budget cap of $1000.00.  This was a learning experience in that (a) they were doing something worthwhile, (b) presented them with a reality what could be accomplished with a limited budget, and (c) how alternative solutions could be worked out within constraints posed by the design.  The presentation of the solutions in a limited space of a poster board, while conveying the relevant aspects of the students' designs was quite a challenging task.

Although initially viewed as rudimentary and non-traditional, the student response was quite favorable and the annual (and later on bi-annual) poster competition was acclaimed as a major event in the campus through its widespread popularity. The ideas and concepts embodied in the top-ranked posters were implemented for improvement or beautification of the campus by the university administration.

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