

Design in the Freshman Engineering Curriculum

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Design is an important element in the education of the impressionable freshman. If required courses in mathematics, chemistry, and physics do not take into consideration the vital connections between theory and the world of engineering; there is a good chance that a sizeable number of prospective engineers may never graduate in their originally chosen major. It is critical that classes begin immediately in the freshman year to acquaint students with all the facets of engineering. Along with the connecting links to the university, the college of engineering, and to all the elements of life as an engineer, students should be given a design experience. This should include design in classes, design in extracurriculars, and design as part of out of class assignments. A unified course of action will be described which involves all of the above connective elements in the education of the engineer. These elements are combined with the activities and sections of the Residential Option for Science and Engineering Students (ROSES) program. The ROSES program meets once a week during the semester and is a one credit course. This one credit does not reflect the actual activities of the participants in the ROSES program. Students are housed together, take classes together, act in teams, network, and process elements necessary in the design activities of the graduated engineer in the real world.

The importance of looking at freshmen as excited but sometimes poorly guided individuals will be addressed. As Parker Palmer states "Everyone must be educated into a capacity for connectedness." This connection of reality, academics, impressions, and misconceptions must be addressed in order for the student to truly learn the material for a career in whatever branch of engineering that they choose. A model for incorporating design into the total education of the student will be described. The presently offered course for residential option students will be described in regard to the design component and a projected incorporation of senior design aspects into the freshmen program.

The Residential Option for Science and Engineering Students (ROSES)

The ROSES program was created to provide students with not only close proximity to fellow engineers through centralized housing but to classes that group these students together in math, physics, and chemistry. The students are required to enroll in a customized engineering course housed in the College of Engineering. This course addresses issues that are commonly experienced by most freshmen, but it also focuses on highly specialized topics involving engineering in particular. Topics range from introductory material on their chosen majors to ethics. It is also an important time in which to make clear the necessities of studying, time management, networking, and coping with the normally difficult engineering freshman's course load. This beginning effort shows great promise in bringing freshmen into the departments of engineering much sooner than in the past.

One aspect of the program involves the increased concern voiced by engineering faculty, ABET, and employers that students need to be experiencing much more design based orientation than they are now receiving. With that focus the following items will be presented: in-class design, out of class assignments in design, and extracurricular activity that focusses on design.

Since the retention of students in any engineering program may revolve around their abilities to see relevance in the courses they are taking, it is imperative that courses clearly show the relationship between what is being taught and future application. Freshmen, especially, are searching for paths to follow and answers to a myriad of questions that are posed in the first days of their college or university careers. The introduction of design in some form in every course provides a means to draw correlation between technical knowledge and the real world.

Simple Definition

One of the things that we can focus on first is the definition of design. In its simplest forms a dictionary definition will suffice: "to make preliminary sketches of, sketch a pattern or outline for, plan to plan and carry out in a skillful way; to form in the mind, contrive, to develop according to a plan." With these ideas in mind it is a relatively easy step to begin formulating one's own plans to involve students in the world of design, a world where the participants understand that design is the heart of engineering.

Design in ROSES

ROSES students are given opportunities to design class presentations on topics that relate to engineering. Students become the teachers in order to speak to their fellow classmates. They investigate the real world in order to find out how they will be perceived when they, too, carry the mantle of engineer.

Flexibility in course topics allows students **to initiate the planning and execution of videotaping exercises** where they actually go out into the community to find out first hand what the world believes both about engineers and what they do in the workplace.

Team building exercises bring the world of actual engineering design into class when students form groups **to work with a variety of materials to create bridges, towers, and exotic devices.** The building activities do not end with the final whistle that signals the end of the competition. This is the time for the discussion to begin on what techniques did each team use to produce its end product.

Are there any methods that were learned in other classes that came to bear in the final design. Here students do not simply frantically build some device, they talk about the thought processes that went into the design, what went well, and what failed to be achieved. A wide variety of activities are incorporated into assignments. Activities that do not require a great deal of time but do initiate thought in future engineering issues. Design techniques are discussed. Problem definitions are created in relation to the projects, whether they be large or small. The importance of time lines can be expressed. And lastly written documents in the form of Gantt charts, progress reports, preliminary reports, and final documents are discussed and produced. These

reports, created around real world activities (large or small) will be remembered by the students.

It is important to state at this point that programs that only allow students to enter their programs in their junior year must be mindful of design in the early days of the students' lives. If colleges and universities expect to retain students, there is a distinct need to give them a correlation between the real world and the required courses that they are taking in their early years before they are fully immersed in engineering. Design can easily perform this task.

Directing students within the classroom setting with activities such as tower building allows for immediate explanation of why a particular course of study is being required. Issues that will never be raised in a mathematics course can be tied to the study of particular angles that may or may not produce a workable structure. Designing reports can also make the student aware that design does not simply revolve around mechanical devices. Students can be drawn into the world of communication and how the particular design of a report can make or break the acceptance of a proposed project.

Design out of class allows the student to formulate ideas over the dinner table, in the dorm room, or out under a favorite tree. Working into the late hours of the night trying to come up with a design that can be demonstrated in class will have a much greater effect upon the student than the commonplace lecture. The act of planning, researching, and building keeps the minds of the students active and interested. There is reality in design. Reality that is sometimes in very short supply in many courses. These freshmen, then, are constantly made aware of the relationship of the courses in which they are enrolled and the world in which they will eventually work.

Extracurricular design is the third area in which students should be directed to participate. Direct mailings, phone calls, e-mail, personal contact, flyers, and class visits are used to encourage freshmen and sophomores to participate in activities that have in the past been the domain of the upper classmen. Designing, building, and racing the Formula SAE cars; doing the same activities with the Baja vehicles, and researching the true needs of hybrid energy efficient vehicles all are promoted with these younger students. The very contact with upper classmen will gain a transfer of knowledge along with a tangible reason for taking many of the courses in the curriculum.

There is one last area that may not have received much discussion but can produce interesting results. Most colleges and universities have final projects, courses, or capstone design courses that culminate the entire body of courses taken by the student. A future project hopes to introduce freshmen to members of the senior design class and allows these freshmen to sit in on some of the proceedings of meetings, work sessions, and company visits the connection between what they are going to face in their classes and the final real world projects may clarify much of what they will find in their courses.

Conclusions

Design can be an integral part of every course in the curriculum. Using it to show correlations between what is taught and what will be encountered in the real world gives the student the tools to continue to accept the educational system as a valuable activity. Allowing students to quickly formulate plans and even more quickly build the designs in in-class activities gives them the chance to see design at work and keeps alive the connection with other courses.

Out-of-class design activities allow students to create within environments of their own selection. Working together in teams the natural enjoyment of design can make otherwise seemingly worthless courses valuable. If these teams contain upper level students, the added value of previous experience and the passing on of valuable lessons will only strengthen the bond between technical knowledge and how it is used in the real world. Design and all its components must be made an integral part of the everyday activity of students in engineering departments because design is truly the heart of engineering.

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He was educated at Michigan State University and he returned to the university in 1986 after teaching in the public school system for thirteen years.