

Combining Engineering Design with Professional Ethics Using an Integrated Learning Block

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Abstract

This paper deals with the development of a new sophomore level engineering design course at the University of Hartford. The new course is part of a NSF grant, “Integrating Engineering Design with the Humanities, Social Sciences, Sciences and Mathematics”, which impacts all four years of the undergraduate curriculum. The new engineering design course shares a one credit integrated learning block (ILB) with a sociology course, “Ethics in the Professions”. The ILB mechanism allows for the study of specific ethical issues associated with the design projects being undertaken by the engineering students. In the sociology course, engineering students benefit from wide ranging discussions of ethical issues, and non-engineering students and faculty are brought to understand the nature of engineering work and its broad social context. Several workshops were held to engage the faculty teaching “Ethics in the Professions”, and to define outcomes for the ILB.

In order to formulate realistic design projects with identifiable ethics components, an Outreach Committee, comprised of local professional engineers, was formed and met as a group to discuss the types of projects that would be appropriate for sophomore level students. Professionals, whose projects were selected, would serve as technical mentors to the student teams, while faculty members would serve as technical support, provide project management, and guide discussion on ethical issues. This paper documents the planning activities that have taken place to define the ILB planned for the new course, which will be taught for the first time in the Spring 2001 semester as a pilot section.

1. Introduction

The focus of the NSF grant¹, “Integrating Engineering Design with the Humanities, Social Sciences, Sciences and Mathematics”, involves the reshaping of the engineering curriculum through: 1) the integration of contextualized, interdisciplinary design projects throughout the four years of the program; 2) experimental and collaborative learning; 3) partnerships with industry in the creation of “real life” engineering projects for students at all levels; 4) cross-collegiate and cross-disciplinary teams of faculty and practitioners working together to develop the integration of curricular materials and coordination of assignments. The goal of the grant is to incorporate these objectives into all four years of the undergraduate curriculum, in a coordinated effort to expose students to the design process including all ancillary functions. As part of this

curriculum revision, a new sophomore level design course was proposed which will have a structured link to professional ethics as it relates to the design procedure. A sociology course “Ethics and the Professions”, has been offered for several years and is quite popular with engineering students who choose it as part of their humanities/social science elective package. It was decided to formally link the design course with the sociology course through the use of an integrated learning block (ILB), making the “Ethics in the Professions” course a required course instead of elective. An ILB is constructed as a shared space/time among the courses, (meeting jointly, in groups and/or meeting electronically) in which students are engaged in collaborative projects with defined learning outcomes that have been developed by faculty from the identified disciplinary areas. In essence, two courses sharing an ILB will cover the same topics, but approach the material from different perspectives. In our case, the students will be assessing ethical considerations in the context of their specific design project, while studying closely related topics in the “Ethics and the Professions” course. The ILB concept was recently introduced at the University of Hartford, at the freshman level².

One of the major problems with implementing a design course is selecting a set of design projects that match the student’s ability and training, are stimulating enough to pique interest, and contain an identifiable ethics component. A particularly difficult aspect of project generation is that it must be replicated on a continuous basis, providing a daunting challenge. To help in this regard, an outreach committee (OC) was formed as part of the grant’s activities. The local professional members of the outreach committee were enlisted from firms associated with the College of Engineering’s Application Center (EAC). Formed in 1985, the EAC has cemented strong bonds with the surrounding corporate/industrial community, and lists such corporations as Pratt & Whitney Aircraft, Otis Elevator, LEGO Systems, General Electric, and others, as associates. University faculty and staff supporting the EAC, provide research, development and design services. Strong student involvement is evident in most projects. The EAC is thus a logical source for a continuous supply of possible design projects. Also added to the OC were engineers from the Connecticut Departments of Transportation and Environmental Protection, and local town and consulting engineers. Faculty assigned to the OC are charged with ensuring that projects selected meet both the course level ability of the students and curricular requirements, and that the project experience corresponds as closely as possible to that encountered in practice.

2. Discussion

The first meeting of the OC was held in December of 1999. The role of the OC as discussed with emphasis placed on the submission of suitable design projects (to include a major ethics component), and the role of the professional mentor in the academic process. Professional mentors were asked to: 1) submit a design project proposal; 2) serve as technical consultants during the semester; 3) be part of the student evaluation process; 4) share their individual assessments of the entire experience. The importance of the professional mentor in ethics discussions is underscored (somewhat tongue in cheek) by an anonymous quote that recently appeared on the Web – “As someone who has worked both in private industry and in academia, whenever I hear about academics wanting to teach ethics to people in business, I want to puke”.

A format for submitting a proposal was developed that included half page description of the project to include a projected ethics component, followed by a bulleted list of expected outcomes. By the middle of the Spring 2000 semester, twelve potential projects were received – and the faculty chose six as candidate projects. Details of these projects can be obtained at the course web site³.

Faculty teaching the multiple sections of “Ethics in the Professions” come from Arts and Sciences, Business, and Engineering. Defining the ILB required three workshops - convened over a one-year period. Discussion in the workshops ranged from trying to define “ethics” to details such as how the different sections were to be set up. It was decided that having engineering students all assigned to one section would not meet the spirit of the grant. Therefore every instructor teaching “Ethics in the Professions” would need to be involved with the ILB (which was now defined to be 1 credit of a three-credit course). In this way, students from other disciplines would actually outnumber the engineers – producing a wide-ranging discourse of ethical issues. Discussions also centered on how the ethics component of the design course would be handled in the ILB. Since an average of five projects a year would be undertaken by the students, it quickly became evident that the inclusion of specific ethics issues associated with each project would easily exceed the one credit allotted for the ILB. At the last ILB workshop held in November 2000, each of the six candidate projects was reviewed in detail to fix the specific ethical issues particular to that project. We agreed that the ILB would concentrate on “macro ethics” issues such as the effect on the environment, etc, vs. “micro ethics” issues like accepting gifts from contractors. Once the candidate projects were reviewed, it became apparent that there were several overarching “macro ethics” themes that were common to all projects, and it was some or all of these broad themes that would become part of the ILB. These themes included: cost/quality conflicts; loopholes in design criteria – letter vs. spirit of the law; cost vs. safety; how is “safety” defined; government intervention/support of emerging technology; long-term effect of technology. It would be the responsibility of the engineering students to apply these themes to their individual projects, using the professional mentors as a source, and the Internet for background material³. As part of the evaluation process, students entering the “Ethics of the Professions” course will take an ethics acuity test, followed by a similar exit test. The purpose of the tests is to assess whether the students have developed an aptitude for identifying and solving potential ethical problems.

3. Summary

The tendency in undergraduate engineering design projects is to concentrate on the technical process of design and presentation techniques. There is little time left to examine ethical issues in depth, although ethics problems may be as daunting as the technical questions. To create space and time for entertaining such ethics questions, a one credit ILB is created within an existing ethics course. Within the ILB, topics pertaining to the design project students are working on in the co-requisite engineering design course are covered on a “macro” ethics basis. Secondary benefits of this arrangement accrue from the fact that non-engineering students in the classes bring a more universal vision of ethics problems, and they, in turn, are introduced to the kind of atmosphere in which engineers toil.

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