# Using Small Groups to Promote Active Learning and Student Satisfaction in a Required Engineering Ethics Course

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## Introduction

A learning experience in professional ethics has become increasingly important for engineering majors for several reasons. Chief among them are (1) ABET EC-2000's learning outcome which states that engineering programs "must demonstrate that their graduates have an understanding of professional and ethical responsibilities," (2) the trend of campuses to include some variation of ethics as a campus general education principle, and (3) the increasingly complexity of the working world which necessitates the inclusion of professional ethics in the curriculum. It is not surprising, then, that the call for engineering schools to offer ethics related courses has been sounded by Stephen H. Unger[1]. He goes so far as to say, "Every engineering student should be required to take such a course in the freshman year. Engineering faculty should teach the courses so that students ill get the message that ethics are important." Heinz C. Luegenbiehl[2], Professor of Philosophy at Rose-Hulman Institute of Technology, says, "In the future it can be expected that ethics education will become even more central to engineering education, due in large part to the new standards being developed by ABET," followed with "A further sign of the future emphasis on ethics is that the initial requirement for obtaining a professional engineering license, the Fundamentals of Engineering examination, will include a series of questions on ethics for the first time in 1997."

In our course, learning is accomplished through classroom discussion, out-of-class discussion, library research, case studies, written assignments, oral presentations, an essay final examination, and a minimum of traditional lectures. Students meet once a week for sixty minutes in a sixteen-week semester, including a week for final exams. Students earn one credit hour, which is counted toward their general education requirements in the pre-ABET 2000 accreditation scheme. Under ABET 2000, the course will be used to assess outcomes in the areas of knowledge of contemporary issues, understanding the impact of engineering solutions in a global societal context, understanding of professional and ethical responsibility, and communicating effectively. The course outline is displayed in Appendix 1.

## Course Goals

Based on faculty experiences with student apprehension for nontechnical courses, particularly those of the more esoteric variety such as philosophy, course goals were developed to facilitate student acceptance of a required course in applied engineering ethics and to counter commonly heard student opinions that "ethics and the determination of right from wrong are common sense issues and that students do not need to take an ethics." In order to develop an effective course, the following course design goals were developed and used as guidelines.

1. The course should be built on in-class and out-of-class group discussion rather than lectures and individual homework assignments to promote active learning.
2. Individual accountability should be included by requiring several individually graded written and oral presentations and an individually written final exam.
3. There should be several assignments that help students develop their skills in recognizing and processing dilemmas.
4. There should be reading assignments that would provide students with a cross section of topics that cut across a wide path from basic principles to case studies. This consists of readings on definitions ethics and applied ethics, models of right actions, whistle blowing, conflict of interest, confidentiality, cases, and codes of ethics.
5. Students should rate each member of his or her group for individual accountability.

Using these goals as a guide, we developed a course that consists of seven lectures of 30 minutes or less, seven in-class and out-of-class group assignments requiring written and oral presentations, and a written final exam.

## Course Learning Objectives

The classroom assignments and exercises for the course were established before the selection of the current textbook, *Engineering Ethics,* by Martin and Schinzinger[3]. It was quite by coincidence that this book listed a set of practical skills which were commensurate with our course goals. In this section, we present a list of the skills that they recommend and the ways that we provide students with experiences that lead to the development of the skills. Each of the underscored objectives below is taken directly from *Engineering Ethics.*

- Proficiency in recognizing moral problems and issues: This proficiency is promoted by asking students to collect newspaper articles that describe moral and ethical issues, not only in engineering, but in all professions.
- Skill in comprehending, clarifying, and critically assessing arguments on opposing sides of moral issues: Each student group must make an oral and written presentation of a resolution of an ethical issue. The group presentation must include a description of the issue (clarification) and a defense of each side of the issue (critical assessment).
- The ability to form consistent and comprehensive viewpoints based on consideration of relevant facts: The group presentation of an ethical issue previously described promotes this ability. As part of their presentation, the team must resolve the issue to the best of their ability and present a concise, cohesive summary of the arguments on both sides of the issue.
- Imaginative awareness of alternative responses to issues and creative solutions for practical difficulties: This is promoted by an assignment that requires each group to resolve a case in which an engineer faces a dilemma in the workplace.
- Sensitivity to genuine difficulties and subtleties, including a willingness to undergo and tolerate some uncertainty in making troublesome moral judgments or decisions: This skill is practiced through group resolutions of real dilemmas and theoretical cases.
- Increased precision in the use of common ethical language, which is necessary in order to be able to express and defend one's moral views adequately to others: A common language is developed in several ways. It begins with making group presentations on the

meaning of ethics and on the definition of engineering ethics. It is also promoted by a reading assignment and lecture on theories of right actions.

- Enriched appreciation of both the possibilities of using rational dialogue in resolving moral conflicts and of the need for tolerance of differences in perspective among morally reasonable people: This is promoted by an extensive use of group assignments where students must resolve ethical dilemmas and the extensive use of the discussion mode instead of lectures.
- An awakened sense of the importance of integrating one's professional life and personal convictions--that is, the importance of maintaining one's moral integrity: This is accomplished by discussing real cases that are presented in the textbook. It is through these cases that students begin to see that they may be faced with an ethical situation, must choose between carrying out an assignment and refusing to do so, or decide whether or not to blow the whistle on a superior.

## Evaluation of Student Performance

Students are graded in groups and on an individual basis. Since the course has been designed with a considerable amount of group activities where students share equally in the group's grade, individual accountability is accomplished by requiring an individually written, essay final exam and by creating a few assignments where the group's report includes individual contributions. Attendance is taken each class period since the course depends upon group work and classroom discussion, and this contributes to approximately 12 percent of a student's grade. Since a large segment of our students miss class because of work or family responsibilities, a process for making up missed classes was developed, where students may make up a missed class by writing a research paper on a topic of interest to the class. An individually written essay exam is given as a final exam **that contributes to approximately 20% of the course grade.** Prior to the final exam, each student's grade is normally in the "B" to "A-" range because of the dependence on team grades and a liberal grading policy. Thus the final exam, with its 20% weight, can increase this spread from "C" to "A".

## Assessment of Student Satisfaction and Opinions

Student satisfaction with course over its two most recent offerings has been assessed, and the results are presented here. Three areas have been assessed: (1) satisfaction with the course, (2) rating the reading assignments, and (3) rating the activities. The items in each table are presented in the order of best to worst.

### Satisfaction With the Course (n = 27)

Results of the assessment of student satisfaction with the general nature of the course are shown in Table 1. Students were asked to rate each item on the basis of 5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree.

The first item in Table 1 tells us that we need to include more case studies. This should not be too surprising since engineering students are more applied than theoretical, coupled with an understanding that cases present more than just a real ethical situation; they describe a

person's involvement in an ethical dilemma, including his or her actions and their real consequences. This was the only item that received score of "agreed" or better.

Two satisfaction items nearly scored at the "agree" level. Students reported that they nearly agreed (3.93) that the course will help them resolve ethical dilemmas on the job and that working in groups was favorable (3.89). A score of 3.0 reflected a neutral attitude, and a score of 2.0 reflected a disagreement with the item.

Table 1: Student Satisfaction

| Item | Average |
|---|---|
| 1. The course should include more case studies | 4.11 |
| 2. This course will help me resolve ethical issues on the job | 3.93 |
| 3. Working in groups was a favorable experience | 3.89 |
| 4. This course was more interesting than I expected | 3.48 |
| 5. This course would be improved if a two-credit or three-credit course | 3.37 |
| 6. This course was as I expected (contents and structure) | 3.26 |
| 7. There should be more readings on applied ethics | 2.93 |
| 8. There should be more individual work and less group work | 2.59 |
| 9. There should be more readings on theories of ethics | 2.52 |

We were pleased with the fourth item, which asked students if the course was more interesting than they expected. While an average score of 3.48 out of a possible 5.0 does not reflect agreement (4.0), it is still above a neutral response. Coupled with an average score of 3.26 on the sixth item that asked if the course contents and format were as they expected, we conclude that we have been successful with the course.

Item 5 tell us that students were slightly more than neutral ( 3.37) on whether or not the course should be expanded to a two or a three-credit course. Also, students were slightly less than neutral about the addition of more readings on applied ethics, (item 7, 2.93), more readings on theories of ethics (item 9, 2.52), and more individual work (item 8, 2.59).

Student Satisfaction With Reading Assignments

Results of the assessment of student satisfaction with the reading assignments are shown in Table 2. Students were asked to rank order the items from one to seven. As you might expect of engineering students, items ranked one through four are more applied, and items ranked five through seven are more theory based.

Table 2: Ranking the Reading Assignments

| Topic | Rank |
|---|---|
| 1. Conflict of Interest | 1 |
| 2. Whistle Blowing | 2 |
| 3. Confidentiality | 3 |
| 4. Codes of Ethics | 4 |
| 5. Defining Ethics and Engineering Ethics | 5 |
| 6. Theories of Morality | 6 |
| 7. Kohlberg's and Gilligan's Models of Moral Development | 7 |

Student Satisfaction With Course Activities

Students were asked to rank order the different kinds of course activities on the basis of their satisfaction. The results are shown in Table 3.

Table 3: Satisfaction With Course Activities

| Activity | Rank |
|---|---|
| 1. In-class small group discussion | 1 |
| 2. Discussing issues as a class | 2 |
| 3. Out-of-class discussions | 3 |
| 4. Listening to group presentations of an ethical dilemma | 4 |
| 5. Group presentation of an ethical dilemma | 5 |
| 6. Listening to lectures | 6 |
| 7. Reading daily newspapers to collect articles that reflect ethical issues | 7 |

The three most satisfactory activities are group-centered activities. The first three involve group discussion, the fourth involves listening to student group presentations, and the fifth involves presenting as a group. The two lowest ranked activities involved listening to lectures and reading daily newspapers to collect articles reflecting ethical issues. We failed to include an item on reading the textbook, but this failure was somewhat covered by the presence of items eight and nine in Table 1, where students reported that they disagreed with the addition of more readings.

## Concluding Remarks

In this paper, we describe our one-credit, required course in professionalism and engineering ethics and how a heavy use of small group exercises can facilitate student acceptance of such a course. Our evidence of student acceptance is based on several assessment items. Item 4 in Table 1 demonstrates that students found the course more interesting than they expected. Item 3 in Table 1 demonstrated that the students were nearly satisfied and more than neutral in their enjoyment of the group experiences. Since the course used group experiences heavily in the course, we can conclude by inference that a similar conclusion can be drawn about the course.

The way that the course was designed allows considerable opportunities for discussion. Students often comment that this is the first time that an instructor has asked for their opinions and that they were given a chance to argue a position. It is also not uncommon to hear a student say that he or she thought that the course was going to be boring and find it quite interesting.

Finally, we envision that the course will play a role in the assessment of learning outcomes under ABET 2000. Furthermore, the lessons learned in teaching this course will help us modify the more traditional courses and develop new courses to satisfy the assessment needs under the new accreditation principles.

**References**


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Biographies

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Appendix 1: Course Outline

| Period | Weekly Activities |
|---|---|
| 1 | Overview of the course: What you should gain from the course<br>Assignment 1: Group research on "What is Ethics?", due period 3<br>Assignment 2: Collecting newspaper articles, due period 6<br>Homework: Read Chapter 1 on ethics, applied ethics, and types of inquiries |
| 2 | Discussion of reading assignment<br>In-class: Begin group work on "What is Ethics?"<br>Group homework: Continue working "What is Ethics?" |
| 3 | Presentations of Assignment 1 by group spokespersons<br>Assignment 3: Group prepares a report on the textbook's definition of engineering ethics<br>Assignment 7: Group creation of scenarios that contain dilemmas |
| 4 | Presentation of Assignment 3<br>Homework: Read rest of Chapter 1 through "Theories of Kohlberg and Gilligan" |
| 5 | Discussion of the reading assignment on Kohlberg's Theory and Gilligan's Theory<br>Presentations of Assignment 7<br>Homework: Read about Whistle Blowing, pp 246-256 |
| 6 | Discussion of reading assignment on whistle blowing<br>In-class activity: Processing an engineer's ethical dilemma |
| 7 | Presentations of resolution of engineer's ethical dilemma<br>Homework: Read "Theories About Right Actions,"pp. 51-60, and "Virtue," p. 40-42 |
| 8 | Discussion of the reading assignment on right actions and virtue<br>Homework: Read Chapter 3, "Codes of Ethics," pp. 105-111 |
| 9 | Group quiz: Brainstorming a dilemma<br>Discuss reading assignment on codes of ethics<br>Homework: Read pp. 216-223 on Conflict of Interest for period 10 |
| 10 | In-class activity: Group Process of news articles for presentation |
| 11 | Discuss reading assignment on conflict of interest |
| 12 | Begin group presentations of dilemmas found in news articles |
| 13 | Complete remaining group presentations<br>Read: NSPE Code of Ethics in the textbook's appendix |
| 14 | In-class activity: Evaluating the NSPE Code of Ethics on the bases of duty based ethics, goal based ethics, rights ethics, and virtue based ethics. |
| 15 | Discussion of the Evaluation activity<br>Peer evaluation of team members' contributions |
| 16 | Essay final exam |