

**Title: Using Groups for Ethics Education in Engineering**  
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**Summary:** An electrical and computer engineering professor at Kansas State University uses group learning to embed ethical analysis into an undergraduate senior seminar.

**Background:**

The EECE 590—Senior Seminar is a weekly one-credit course designed to give all seniors in the K-State electrical and computer engineering programs a capstone experience to prepare them for future professional experiences as engineers. Its objectives are to develop writing and speaking skills, to expose the students to ethical issues that may arise in their particular disciplines, and to help them prepare for the job search process.

While I had taught the class many times before completing the Ethics Education in Science and Engineering project in Fall 2007, I had never formalized the ethics content. Without introducing formal ethics theory, I had asked students to discuss in their final papers a problem from the perspective of what would be the “best” solution.

In Fall 2007, I wanted to devote about half the course to exploring ethical issues in the field of engineering, both in technical design and in the workplace. To do this, I participated in the EESE workshop series to develop class content and assignments for students to demonstrate their understanding of ethical thinking.

Learning Goals

- Students should know how to use ethical theories for systematic analysis of ethical problems.
- Students should know how to decide when it may be important to get involved in an ethical situation.

- Students should recognize that ethical problems are very likely to come up, in life and in engineering.
- Students should recognize that ethical thinking is an integral part of design.

### **Implementation:**

To incorporate basic ethical issues into the course, I presented students with a Power Point that covered the theoretical foundations of ethics and touched specifically on issues of intellectual property. We looked at three ways of considering ethics: rights and responsibilities (deontological), consequences (utilitarian), and virtue. Though we covered the first two perspectives, there was limited discussion of virtue-based ethics and no time to develop conclusions about the usefulness and interrelatedness of the three approaches.

I did not present a specific case study at this point, but instead asked students to choose their own issue of electronic intellectual property rights to analyze along a range of different ethical considerations. Each student completed a short (3-4 page) step-through analysis, looking at the facts of the case, specific questions to ask, affected parties, consequences, obligations or duties according to the IEEE Code of Ethics and the law, virtuous behavior, creative solutions, their gut reactions, and a response to possible objections others might make.

To grade this assignment, I created a simple rubric that evaluated students based on a complete and thorough discussion of the facts of the case, affected parties, consequences, rights and duties, character and virtue, a creative solution, and quality of writing. I left room for individualized feedback with my criteria but also tried to direct students' work by laying out what components I expected to appear in their final papers.

After they wrote their papers, we discussed the subject again in class to review the intellectual property issues students had chosen to emphasize and the challenges they had

analyzing these situations. We then moved on to analyze an intellectual property-related ethical case study as a class, again considering the theoretical approaches I had presented in the first section.

In the second assignment, I asked students to bring together all of their ethical knowledge to complete a group project. I wanted students to cover all of the three major ethics theories, but since it was a one-credit course I felt it was best to have them work in teams. Also, teamwork is highly encouraged within the engineering curriculum, since students will go on to careers where collaboration is essential, and I hoped fewer presentations would give more time for class discussion. Students worked in groups of three, with each individual in the group analyzing a particular case from a different ethical point of view. The first student focused on utilitarian, or consequence-based ethical thinking; the second on deontological, rights and duties-based thinking; and the third on virtuous thinking.

Students completed both a longer paper and a 20-25 minute presentation on their topics. Since the content of both the paper and presentation was so similar, I graded only students' ethical thinking in the paper and used the presentation as a way to evaluate the communication skills they will use as professional engineers.

### **Student Performance:**

Overall, the majority of the students in the seminar performed above average on both assignments, although they demonstrated a major improvement in understanding from the first assignment to the second assignment. It seemed that the first intellectual property assignment was challenging because we had not completed a case study in class, and they could not always successfully apply the theoretical background we had discussed. It was difficult for some students to move past right-or-wrong ethical decisions to more complex analyses.

The distribution of scores on the intellectual property rights assignment included three As, one B, two Cs, and two Ds. Excellent papers (see Paper 1 and Paper 2) chose a specific, thought-provoking issue or case study involving intellectual property rights and succeeded in clearly stating the facts of the case, affected parties, ethical perspectives (consequences, rights and duties, and virtue), and creative solutions with appropriate citations. Acceptable papers often showed students demonstrating good thinking overall, but with less developed ethical analysis or an incomplete assessment of the facts or affected parties. The least successful papers were poorly written and failed to thoroughly consider all three ethical perspectives, or gave unclear, obvious solutions to the topics discussed. (See Threshold Intellectual Property Paper as an example.)

Though students worked in groups to complete the second assignment, they each received an individual grade based on their portion of the longer paper. Nine students earned As for their contribution, while three students earned Bs. I think their success can be attributed to the in-class analysis of a case study, which provoked strong discussion and made students think about ethical situations more ambiguously. (See High Group Paper and Average Group Paper as examples.)

The presentations that accompanied the papers were also successful, since they mirrored the strong work completed for the papers. I set aside time for discussion after each presentation, but I was disappointed by the small amount of discussion that resulted.

### **Reflections:**

The most challenging aspect of the EESE project was incorporating a large amount of material on ethics into just a couple of class periods. Judging by students' lower performance on the first assignment, I think they were initially overwhelmed by theoretical material that didn't

all seem to have immediate relevance to the assignment or to other issues they had discussed in the class.

Since the ethical content seemed much clearer and easier for students to apply after the in-class case study example, in the future I will do the case study earlier. This seems to be the best approach, since it integrates all of the three major ethical perspectives and provides students with a problem and an understandable procedure to go about solving that problem.

Ideally, from now on I will start with an early, brief lecture, but present a case study in students' recitation sections before assigning the shorter or longer assignments. Doing away with a longer explanation of ethical theory will prevent unnecessary confusion about how to separate ethical approaches, since students will have to use all of them to develop a satisfactory, thorough analysis. I will still have them look at the approaches separately in the longer assignment.

Also, I would like to continue revising how I evaluate students' work and how I communicate my expectations for specific assignments and the course to them. This may include taking greater advantage of my course web site to post assignments and examples of strong work from previous semesters. Because it was difficult to construct grading rubrics without first seeing the general level at which students performed, I did not give students this semester specific grading criteria before they completed their assignments. Now that I have seen some of students' challenges and successes, I may be able to develop rubrics that students could use to help develop their work.

### **Follow-Up**

After teaching the course again in Fall 2008, it seemed students "got" virtue theory, which I focused on, and did not "get" the other two ethics approaches. It seems necessary to go through all three theories fully, from case study to conclusion, for them to understand what I'm

asking of them. In Fall 2008, there was a lot of confusion about how to think about consequences: consequences of the decision vs. consequences laid out in the actual case study. For instance, in one case the antagonists went to jail, but it was very difficult for students to imagine the antagonists before they made their decision in the first place. I want students to be able to step back and decide what should have been done originally.