

Memorandum

To: Dr. Michael Davis
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Subject: Report Summarizing Integration of Ethics Education in ENGR 103 – Introduction to Engineering and ME, EE, IE 439 – Professional Awareness

Summary

Several ethics lectures were integrated into two diverse courses during the Fall 2001 semester in the School of Engineering at Western New England College. This included a single one-hour lecture given to 39 seniors from mechanical, electrical and industrial engineering disciplines preparing for their senior projects (ME 439, EE 439 and IE 439) and two one-hour lectures given to 88 freshmen in five sections of ENGR 103, an Introduction to Engineering class. Based on student comments and on data collected from Impact Surveys given to all students at the end of the semester, it seems that this first formal integration of ethics into these courses has been very successful. A summary of the survey data shows that 122 of 127 (96%) students surveyed felt that the lectures increased their awareness of ethics, 103 of 127 (81%) students indicated that the lectures changed their understanding of ethics, 102 of 127 (80%) students said that the lectures increased their ability to deal with ethical issues, 97 of 117 (83%) students said that the correct amount of time was spent on ethics during the semester and that they would not have done anything differently relatively to the ethics material covered and its delivery, and 97 of 112 (87%) students admitted never having been taught professional or business ethics in a class before. However, quiz and final exam results show that while student retention of the ethics material given appeared good immediately following the lectures, their ability to apply what they learned in a simulated real-life situation was weak. Overall, the data suggest that the material was well received, assisted the students in their professional development, but that more intensive integration is needed in the future.

Background

To my knowledge, the Fall 2001 semester is the first time the topic of “ethics” has formally been integrated into engineering courses at Western New England College. Previously, ethics had been implied through statements on “Integrity of Scholarship” made in the college catalogue, through course policies handouts, or most recently, through our Summer Orientation and Registration Program (SOAR) for incoming freshmen, who were given an explicit ethics homework problem to work on over the summer and turn in when they arrived at school in the fall. This integration came as a direct result of my participation this past June in the “Ethics Across the Curriculum” workshop you gave at the Illinois Institute of Technology. This report summarizes the results of my first attempt, working together with my colleagues at Western New England College (WNEC), to explore this difficult yet important topic for engineers.

At the workshop in June, I originally anticipated integrating one or several ethical case studies into an engineering class of juniors who would be taking my Mechanical Vibrations course, ME 320, during the Spring 2002 semester. I had presented a first draft of such a case study to my colleagues at the workshop on its final day in June. However, as planning for fall courses continued over the summer, it became apparent that we needed to formulate lectures on ethics for our class of approximately 105 incoming freshmen (which subsequently shrunk to about 90 students by the end of the semester). In recent years through our SOAR program, we had been introducing freshmen enrolled in our Introduction to Engineering course (ENGR 103) to the topic of ethics by discussing the “Hyatt Regency Skywalk Collapse” in some detail, including a technical demonstration, and then giving them related homework to complete over the summer. The introduction of several lectures during the semester along these same lines was thought to be a good follow-up to the SOAR assignments, and an appropriate point in the careers of potential engineers to introduce them to the topic of ethics.

Although formally integrating ethical topics into the curriculum for our engineering students farther along in their education was thought to be more problematic, I was asked by my department head to start by preparing a one-hour lecture on ethics for an interdisciplinary class of seniors preparing their senior project proposals in a Professional Awareness class, ME 439, EE 439 and IE 439. This class included approximately 40 engineers from the mechanical, electrical and industrial engineering disciplines.

Methodology

The manner of delivery for the seniors was relatively simple. About two-thirds of the way through the semester, I prepared and gave a one-hour lecture to a group of about 40 seniors, and several faculty from the ME and EE departments, covering ethical topics and issues very similar to those discussed in our June workshop. A copy of the PowerPoint presentation I gave is included with this report. As you can see from this handout, I first started my lecture by introducing the students to some of the ethical and philosophical definitions I thought they needed to know to appreciate the complexity of this subject. These were taken from the definitions you provided at the workshop¹, which I referred to during the lecture. I then showed them the various codes of ethics² in existence, using the ASME Code of Ethics as a specific example. Using this code I discussed its major principles and canons and their importance. I reinforced the importance of some of these principles and canons with my own personal anecdotes based on previous industrial experiences I had had in the field. For example, the importance of filling out expense reports in an honest manner, despite what others might tell you to do, even those in authority. Next, I discussed things they should consider when analyzing an ethical dilemma, focusing on the seven-step analysis we used in the workshop. To illustrate this method of analysis, I used the case study of M. Pritchard, “Catalyst A versus Catalyst B.” We worked through this problem together, with me leading them strongly at first, but then with some good class interaction thereafter. The lecture finished with my making several summarizing points: First, that ethics in engineering is very important; second, it affects them directly; third, that the appropriate thing for them to do as engineers from a professional point of view is to use the applicable Engineering Code of Ethics in their discipline (it was pointed out here that the various codes are very similar) and their own moral standards as a guide in assessing and acting to resolve ethical dilemmas; and fourth, that there may be times when no easy answers can be found to solve an ethical dilemma. Following the lecture, the students were given a homework assignment to watch two video tape case studies: one concerning the Space Shuttle Challenger accident and the other involving the dilemma of water quality monitoring in a river when the measuring device cannot resolve the variation of toxin levels slightly above or below specification. As part of the assignment, the students were asked to write a brief report analyzing these two case studies based on

class discussion. Each student was also given a copy of the NSPE, AIChE, IEEE, ASCE, ASME, and ABET Codes of Ethics for their reference.

The manner of delivery for the freshmen was a bit more complicated, given the fact that the course was taught in five sections by five different instructors, including myself. It was my job within this course to prepare the ethics lectures for the course instructors to be given to all sections. It was decided among the five instructors that two one-hour ethics lectures would be given, with a homework assignment linked to the course textbook by Holtzapple and Reece³ sandwiched between the lectures. I suggested we use a presentation nearly identical to the presentation given to the seniors, given that the freshmen had already had some exposure to an ethical case study through SOAR (more than the seniors had had up to that point aside from practical class or work experience), but that we should deliver it more deliberately over two class sessions. We also decided to add slides explaining topics from the Engineering Ethics chapter in the course textbook and a homework assignment covering the case study from the lecture and material from the textbook. The PowerPoint handout included with this report contains these added slides, and a copy of the homework assignment given from the textbook. The first one-hour lecture, given by each instructor to their own class section, covered the ethical and philosophical definitions, the Engineering Codes of Ethics, an explanation of how to analyze an ethical problem using the seven-step analysis procedure, and a reading of the “Catalyst A versus Catalyst B” case study. Each section was then instructed to attempt to analyze the case study using the seven-step analysis procedure for homework, as well as to do an assigned problem on ethics from the textbook after reading the chapter relating to this problem. Handouts of the various Engineering Codes of Ethics were not passed out since the course textbook already contained a copy of these codes, which was pointed out to the students. The second one-hour lecture involved reviewing the homework, including carefully going through the seven-step analysis to analyze the case study presented the previous class. A third class (last week of classes) included a fifteen-minute ethics quiz, which was given to all the sections. In addition, the final exam for the course, which was common to all sections, included a design question requiring the students to use their understanding of ethics in order to recommend appropriate action as an engineer. The ethics portion of this exam was assigned as 10% of the overall exam grade. Both the quiz and the final exam (question #3) are included with this report in Appendix A.

Results and Discussion

At the end of the semester I asked the instructors for both the senior and freshmen courses to have their students complete the Impact Survey that you provided at the workshop. This was done by all instructors, after which time I collected and summarized the results of this survey. These results are shown in Appendix A of this report. The original surveys from all students are also included in this mailing.

As stated previously, these data show that 122 of 127 (96%) students surveyed felt that the lectures increased their awareness of ethics, 103 of 127 (81%) students indicated that the lectures changed their understanding of ethics, 102 of 127 (80%) students said that the lectures increased their ability to deal with ethical issues, 97 of 117 (83%) students said that the correct amount of time was spent on ethics during the semester and that they would not have done anything differently relatively to the ethics material covered and its delivery, and 97 of 112 (87%) students admitted never having been taught professional or business ethics in a class before. A sample of student comments and explanations related to the survey questions asked is also included with the summaries in Appendix A. For each question, the comments received range from very positive “course gave good examples,” “I learned a lot,” “it opened my eyes,” “just the right amount,” etc. to very negative “I already knew ethics was important,” “a worthless pursuit that contradicts itself.” However, a reading of all the comments shows that most were positive or constructive. For example, several students

wanted to have more discussion in class, more examples of real-life case studies, and begin the topic earlier in the semester. These are all considered very helpful and will be used to plan future ethics lectures and teaching modules.

If we look at the data from the seniors and freshmen individually, there seems to be little change in the survey data and comments. This is really not surprising since, in the sense of a formal classroom setting, the seniors as well as the freshmen have an entry-level ethics background (see the Impact Survey results). Admittedly, it is likely true that the seniors can be considered more practically educated in ethical issues, especially academic ethics, based on their added classroom, laboratory and work experience, although this was not obvious from the survey results.

Regarding the ethics quiz given to the freshmen, which tested the students' ability to retain the material given in the handouts and lectures, the average grade achieved by students taking the quiz in my section (-05) was 84.6%. Grades for the other sections were similar. Although the questions were relatively simple True / False questions, we required students to explain their "False" answers. Thus, it is my opinion the positive quiz results suggest relatively good student retention of the ethics material presented in the lectures.

On the other hand, the results of the design (with ethics) question given to the freshmen on their final exam were not very encouraging in terms of students' ability to apply the ethical material they received in a simulated real-life situation. The results of 31 students of the freshmen class (about third) are shown in the table in Appendix A. These results are representative of results for the entire freshmen engineering class. As seen from this data, the average score on the ethics portion of the question was only about 36%. Only 7 of 31 students scored 70% or higher on this part of the question, and 10 of the 31 students did not discuss ethics at all in connection with the design question asked, therefore receiving no credit at all. Although this is somewhat disappointing, the results do indicate an encouraging sign in that 14 of the 31 students, or about half, received 50% or more of the possible credit on the ethics portion of the design question. This suggests that about half of the students are at least more aware of the importance of ethics and have some idea of how to apply what they learned in this area to a real-life situation. This is good progress, but we certainly need to do more.

Regarding my freshmen section (section 05), I had something very fascinating happen. In the process of giving the first ethics lecture, I passed out a copy of the presentation I was about to give, and mistakenly included a copy of my own seven-step analysis of the "Catalyst A versus Catalyst B" problem. In effect, I gave the class answers to half of the homework assignment without realizing it. The assignment was to be due a week later during the next class period. About halfway through that week, 3 of the 19 students in my class approached me on two different occasions (i.e. two came together and another came separately) to ask me whether or not I realized I had passed out solutions of a portion of the homework assignment to the class. Somewhat embarrassed, I told them, "No, but why did you come and tell me?" They replied they thought my passing out of the solutions and not saying anything about it to the class was a way of my testing their ethics. Although unintentional on my part, I found this incident very enlightening. On the one hand, I was glad to have students in the class honest enough to come forward, and on the other hand, I was disappointed that so few recognized the dilemma, or perhaps recognized it, but decided not to report it. Or perhaps the students that came forward did so out of concern that I was testing them and that they must come forward or risk failing this test. Regardless of the reason, it brought to light a possible method to be employed (intentionally) in future classes.

Conclusions

Based on my experience during the ethics lectures, class discussions, survey data, and test results the following conclusions are made from this initial integration of ethics in the engineering curriculum at Western New England College:

- (1) Students generally brought away an increased awareness, appreciation and understanding of ethics from the lectures and accompanying homework assignments given in these courses;
- (2) While the majority of students felt the material given and the manner it was given was appropriate, and that they now had an increased ability to analyze an ethical situation, a measurable number of students voiced doubt that the material given was adequate to carry out an effective ethical analysis.
- (3) The majority of WNEC engineering students have never had professional or business ethics in the classroom before and very much need to have this instruction.
- (4) While student retention of the ethics material given appeared good immediately following the lectures, their ability to apply what they learned in a simulated real-life situation was weak. This suggests more intensive integration is needed in the future.
- (5) Other engineering faculty I talked to or who were involved in this integration were very supportive of increasing the ethics content in our curriculum.

References

- [1] Notes taken from Workshop given by Michael Davis, "Ethics Across the Curriculum," Center for the Study of Ethics in the Professions, Illinois Institute of Technology, June 18-26, 2001.
- [2] Harris, C.E., Pritchard, M.S., Rabins, M.J., Engineering Ethics: Concepts and Cases, Wadsworth Publishing Company, New York, 1995, pp. 389-402.
- [3] Holtzapple, M.T., Reece, W.D., Foundations in Engineering, McGraw-Hill, New York, 2000.

APPENDIX A

WESTERN NEW ENGLAND COLLEGE
Springfield, Massachusetts
SUMMARY OF 18 STUDENT EVALUATIONS – ETHICS COURSE IMPACT SURVEY
ENGR 103-01 INTRODUCTION TO ENGINEERING - FALL 2001

<u>Question</u>	<u>Yes</u>	<u>No</u>	<u>Sample Comments</u>
1. Increased awareness of ethics?	18	0	Course gave good examples. Forced to think about specific situations. Showed us why rules are necessary. Saw what problems could arise. Didn't know engineers have ethics code. Taught how to solve moral issues.
3. Course changed understanding of ethics?	15	3	Learned a lot about real-life issues. I already knew they were important. I realize that there is little space to slack. It opened my eyes ... Showed how engineers are responsible. Ethical decisions unexpectedly difficult.
5. Increased ability to deal with ethical issues?	15	3	I had to think about issues. Taught to seek out help if problem arises. Should do things that question ethics. 7 step process for analyzing situations. More scenarios would help. Scenarios we went over were realistic.
7. Anything that should have been done differently?	3	15	Spent the right amount of time. I'm not experienced enough to know. It seems we should have spent more time. More information could have been given.
8. Professional ethics in a class before this one?	1	17	

WESTERN NEW ENGLAND COLLEGE
Springfield, Massachusetts
SUMMARY OF 18 STUDENT EVALUATIONS – ETHICS COURSE IMPACT SURVEY
ENGR 103-03 INTRODUCTION TO ENGINEERING - FALL 2001

<u>Question</u>	<u>Yes</u>	<u>No</u>	<u>Sample Comments</u>
1. Increased awareness of ethics?	17	1	Made me aware of real life issues. Made me aware of how ethics applied. Engineers liable for everything they do. Already aware of some ethical issues. Explained importance of ethics codes. Need to be specific / give better notes.
3. Course changed understanding of ethics?	18	0	Showed how professional world works. Learned communication w/ upper mgmt. Job loss if moral codes not followed. Better understanding ... in this field. Ethics are important to follow. Ethics helps maintain work quality.
5. Increased ability to deal with ethical issues?	15	3	Gave me a process to follow. It made me not cheat. Showed steps to look at issues/conseq. Now I know how to solve ethical prob. I don't think it could. Give more guidelines w/decision making.
7. Anything that should have been done differently?	1	15	Just the right amount. How do I know, didn't apply knowledge? Should have a bit more help with work. Raised awareness w/o focusing too much. Just enough, but kind of late.
8. Professional ethics in a class before this one?	3	15	

WESTERN NEW ENGLAND COLLEGE
Springfield, Massachusetts
SUMMARY OF 17 STUDENT EVALUATIONS – ETHICS COURSE IMPACT SURVEY
ENGR 103-05 INTRODUCTION TO ENGINEERING - FALL 2001

<u>Question</u>	<u>Yes</u>	<u>No</u>	<u>Sample Comments</u>
1. Increased awareness of ethics?	16	1	I realize application of other classes. Made me aware of various ethics codes. It prepared me for situations I may face. Gave me knowledge about my future. You are responsible for your own work. Complicated issues arise as an engineer.
3. Course changed understanding of ethics?	9	8	I had a good understanding already. Thought it depended on person not field. Job loss if moral codes not followed. Not aware of legal implications. Helps view everything in a different way. Like to think I already knew importance.
5. Increased ability to deal with ethical issues?	14	3	Made me look at all sides. Process to follow if something unethical. Showed steps to look at issues/conseq. Know categories and 7 steps to follow. Gave me a general idea. Would like to go over more examples.
7. Anything that should have been done differently?	3	12	Class did a good job. Anymore time would have been overkill. Should explain more business ethics. Explain more at beginning of school. A worthless pursuit that contradicts itself.
8. Professional ethics in a class before this one?	3	14	

WESTERN NEW ENGLAND COLLEGE
Springfield, Massachusetts
SUMMARY OF 18 STUDENT EVALUATIONS – ETHICS COURSE IMPACT SURVEY
ENGR 103-07 INTRODUCTION TO ENGINEERING - FALL 2001

<u>Question</u>	<u>Yes</u>	<u>No</u>	<u>Sample Comments</u>
1. Increased awareness of ethics?	17	1	I know more stuff about it. More aware of ethical issues. I realized responsibilities as an engineer. Helped teach me standards and codes. I already knew the ethics we discussed. Always put things in a report.
3. Course changed understanding of ethics?	17	1	I had no understanding. Showed acceptable behavior. Did not know about codes and canons. Realized ... trouble you can get into. I now know what is ethical. We don't have to agree with the boss.
5. Increased ability to deal with ethical issues?	16	2	More class discussion would help. Always do what is "morally" right. Helped me understand choices to issues. Now I know how to deal with problems. My ability was increased. Helped explain more.
7. Anything that should have been done differently?	3	14	More time needed for discussion. We covered everything important. Should cover in beginning of semester. Wasn't emphasized or overlooked. Too much, it was annoying.
8. Professional ethics in a class before this one?	2	16	

WESTERN NEW ENGLAND COLLEGE
Springfield, Massachusetts
SUMMARY OF 17 STUDENT EVALUATIONS – ETHICS COURSE IMPACT SURVEY
ENGR 103-09 INTRODUCTION TO ENGINEERING - FALL 2001

<u>Question</u>	<u>Yes</u>	<u>No</u>	<u>Sample Comments</u>
1. Increased awareness of ethics?	16	1	Other classes did not focus on this. Yes, through readings of studies. I was introduced to code of ethics. Learned ... the right course of action. I realized what is actually a bribe. I saw how we are accountable for actions.
3. Course changed understanding of ethics?	11	6	My understanding was already there. I now believe in the importance of ethics. Didn't know importance of ethics. Didn't change, but solidified knowledge. Study more how engineers affect world. No, ... I have no clue.
5. Increased ability to deal with ethical issues?	12	5	You have to assess the situation. Must talk about and think through issues. No, must spend more than a day on it. Yes, through homework and case studies. More discussion on how to handle issues. Gave a logical process to follow.
7. Anything that should have been done differently?	5	12	Just the right amount. Should have been done earlier. Not enough time. More time because ethics is a big part. Too much ... ethics always mentioned in lectures.
8. Professional ethics in a class before this one?	5	12	

WESTERN NEW ENGLAND COLLEGE
Springfield, Massachusetts
SUMMARY OF 39 STUDENT EVALUATIONS – ETHICS COURSE IMPACT SURVEY
ME,EE,IE 439-01 PROFESSIONAL AWARENESS / SENIOR PROJECT PREP - FALL 2001

<u>Question</u>	<u>Yes</u>	<u>No</u>	<u>Sample Comments</u>
1. Increased awareness of ethics?	38	1	Stand up for your convictions. Showed new light of how to view things. Broke the ice. Helped confirm experience as intern. Good to see/read IEEE code of ethics. Brought forth complications in choices.
3. Course changed understanding of ethics?	33	6	Did not realize importance of issues. I already had a good foundation of ethics. It's hard to make a right choice. Provided eight cannons in engineering. Made me think about circumstances. Never knew there was a code.
5. Increased ability to deal with ethical issues?	30	9	It's not OK to just look the other way. Role playing of a situation. No, more examples. Evil wins when good people do nothing. Showed there is rarely a clear answer. Made me question decisions of others.
7. Anything that should have been done differently?	5	29	I feel prepared to handle ethical issues. More personal experience would be nice. Too little. Enough to open our eyes. Too much ... most people know quite a bit about ethics.
8. Professional ethics in a class before this one?	1	35	