

2006-256: THE ETHICS BLOG: STUDENTS MAKING CONNECTIONS AMONG ETHICS, THERMODYNAMICS, AND LIFE

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The Ethics Blog: Students making connections among ethics, thermodynamics, and life

Abstract

The question of whether engineering ethics should be taught in a stand-alone course or be integrated throughout the curriculum has been a subject of debate in engineering education, with each approach having its own advantages and drawbacks. Integrating ethics across the curriculum ensures that students engage ethics and personal moral development throughout their undergraduate career, models the notion that all engineering students and professionals ought to be concerned with ethics, and highlights its importance and relevance in core classes. Shortcomings include: a sense of disjointedness when ethics is added rather than fully integrated into a course; the perceived challenge of connecting certain ethics topics with certain engineering subjects; and a lack of deep reflection or critical thinking on the part of students when not sufficiently supported.

In seeking to address the drawbacks of the ethics across the curriculum approach at our institution, we implemented an ethics weblog (blog) in the core engineering thermodynamics course. Previously, ethics had been taught in this course through the use of case analyses that dealt nominally with thermodynamics topics. In order to encourage deeper reflection and a better integration of ethics with both course material and everyday life, the blog was introduced with weekly read-response items. The blog was used not only for ethics but also for student reflection on technical material – in both parts of the blog students were asked to relate technical content, ethics, and their everyday life. The blog was designed to allow instructors to assess and encourage student learning and the development of critical thinking and reflective skills.

This paper analyzes the textual content of the blog and compares the results to previous approaches to learning ethics using case analyses. While the blog does away with some analytical formalisms and the systematic approach to ethical problem solving found in case studies as implemented previously in this class, it allows students to find meaning by relating the ethics topic to their everyday life and to the technical course content. This internalization of ethics and the ability to make connections between the personal and professional is an important creative skill that will support ethical decision-making and lifelong learning.

Good feedback is essential in helping students develop critical and reflective skills for the ethics blog. A rubric was used to aid students in understanding what was meant by terms such as critical thinking and quality of reflection, and to reinforce analytical approaches that were taught in a prerequisite course on mass and energy balances. The quality of the feedback is crucial, especially in helping students balance the analytical and reflective aspects. We assert that the blog holds potential for stimulating moral imagination and encouraging students to pursue new ideas that emerge from the integration of personal experience, technical content, and concepts in ethics.

Introduction

Educators in engineering ethics have long discussed the advantages and disadvantages of teaching ethics across the curriculum versus in stand-alone courses. The integrated approach has been shown to be effective in meeting key outcomes criteria.¹ It can also help students better understand the relevance of ethics to their professional lives by providing important technical context, and can enrich engineering courses as instructors creatively enhance core content to include ethical dimensions.² When engineering professors engage in ethics instruction, they create appropriate professional expectations for students to be similarly engaged. Ethics ought not to be seen as an inoculation -- one exposure and you're done; the integrated approach supports personal moral development over time.

Some drawbacks of this approach include: the problem of needing to train engineering faculty to teach ethics well;³ the greater potential for disjointedness or giving ethics minimal attention when ethics is added on or squeezed into core courses rather than properly and fully integrated; and the challenge of finding ethics topics that fit well with technical course content in certain subject areas. Perhaps the greatest drawback of the integrated approach is the potential to give less emphasis to critical thinking and deep reflection, when so much else is demanded of students in the same courses.

Engineering Ethics learning at Smith College has so far employed the integrated approach, weaving ethics across five required courses in the curriculum: a design-based introductory course, a first year course in mass and energy balances, continuum mechanics, thermodynamics, and the capstone design clinic.⁴ The two first-year courses motivate a well-rounded engineering education and social responsibility, encourage reflective thought and articulation of values, and introduce frameworks for ethical problem solving and case analysis. Core engineering courses build on this experience, employing additional cases that integrate relevant engineering content. In the capstone design course, students apply what they have learned preventively to identify potential pitfalls related to their particular projects. Additionally, advanced ethics topics are explored in two upper-level technical electives, examining key issues of environment and sustainability and considering critically the role of engineering in global development.

The approach to date has been grounded in problem solving and systematic analysis, teaching students to build and support arguments engaging with primary themes in ethics. This is grounded in the idea that emphasizing similarities between engineering problem solving approaches and ethics problem solving approaches will help students learn by analogy, approach problems with an appropriate analytical formalism, and build confidence by starting with what they know. A different approach based in social cognitive theory suggests that reflection and personal engagement, as well as interpersonal engagement, are critical for learning. Our assumption here is that true learning happens when students are engaged and knowledge is internalized, engaging both their intellect and emotions with the social and thus the ethical.

Vygotsky⁵ described a process he called *internalization* (similar to what Bandura⁶ refers to as acquisition) in which children learn to speak by internalizing the speech of those around them. For college students learning ethics, a similar process might be followed in which students take

in external modeling of moral decision making through engaging with topics and case studies, and ultimately internalize them through a process of self-reflection and interpersonal discussion.

Thus, we* pilot tested a new structure for the ethics component of the thermodynamics course, typically taken in the third year, after students have engaged with ethics in three courses. The approach to formal case analyses is taught in the first year and reinforced in the sophomore continuum mechanics course. We selected an approach that mixed some case analyses with some more general presentations of topics in engineering ethics, emphasizing the importance of connecting ethics to students' lives. Our primary goal was for students to engage in deeper reflection, and achieve a better integration of ethics with course material and everyday life.

Weblog Structure

The ethics assignments were read-response reflections, incorporated into a larger weekly journaling assignment via weblog (blog). The blogs were designed to integrate learning and assessment, to support intentional learning processes. The blog is an individual journal, one for each student, with each successive entry appending onto the earlier ones, so that progress can be easily reviewed and followed. Each week included reflection questions related to technical material as well as an ethics case or topic reflection. Guiding questions structured student reflections and responses, asking students to identify how the ethics case related to both the course material and their personal or professional lives. Students worked in groups of four, reading each other's blogs and commenting where appropriate. Ultimately, the goal was to find a common question that emerged from the technical portion of the blogs to pursue for a project, but we hoped that the engagement with each other's blogs would extend to the ethics assignments and promote lively exchange.

The blogs provided the instructor with evidence of progress for an individual student and also permitted comparison across students in the course. The entire blog (both ethics and technical components) was graded based on the quality of critical thinking and reflection, as well as completeness, with the combined components worth 20% of the total course grade. The technical aspects of the blogs were analyzed separately and are discussed elsewhere.⁷

The main objective of the ethics portion of the blog was to encourage students to relate ethical topics to their technical learning and daily lives. We hoped this would stimulate and solidify the students' understanding of ethical concepts and appreciation of social justice. To that end we picked a range of topics that grew in scope from the individual to organizations, then to the broader society and finally the global community. The first set of topics focused the students' attention on their personal values and actions, and encouraged them to reflect on the formation of their values and the repercussions of their actions. The second set of readings focused on the relationship between the individual and the organizations in which they work or live. These were meant to help the students begin to explore the boundaries and demands of those relationships.

* Although it is common practice in ASEE papers to use the third person, we have intentionally chosen to use the first person here. When we use the third person and the related passive voice, we remove agency and obscure information about who is acting; this is problematic whenever agency relates to responsibilities for ethical action. The third person also creates an aura of objectivity that is not appropriate to this work; rather we seek to be transparent about our subjectivities and our role in the work.

The third set of readings focused on the broader community from the immediate neighborhood to the global village. These readings were meant to encourage the student to examine her place in and responsibility to the world both now and in the future. The number and scope of readings was necessarily limited by time but they were chosen with the hope that they would stimulate further thought on other topics. These readings were not typically discussed in class, although some topics came up in class discussion when raised by students or the instructor. All topics were selected from Harris, Pritchard and Rabins’s text, *Engineering Ethics: Concepts and Cases*, covering a range of issues within each of the three spheres outlined above.⁸

Personal Values and Actions:

- Self Interest and Fear (p. 36-38)
- Forms of Dishonesty (p. 127-128)
- Conflicts of Interest (p. 144-146)
- Loyalty (p. 197-200)

Individuals in Organizations:

- Responsible Organizational Disobedience (p. 200-206)
- How Clean is Clean? (p. 227-228)
- Are there “Normal” Accidents? (p. 159)

Global Concerns:

- Avoiding Exploitation (p. 250-251)
- Bribery and Local Practices (p. 252,262)
- Sustainable Development (p. 218)

Analysis

We evaluated the textual content of ethics blogs using a detailed rubric that parallels our learning objectives for the ethics component of the course. This analysis was more detailed than the rubric used to evaluate students for the purpose of grading. Due to time and resource constraints, grades in the course were assigned based on a more general evaluation of ethics and weekly reflections on technical material. These grades were based on three criteria: the completeness of the work, the quality of reflection, and critical thinking, which encompass the items we isolated for more detailed analysis here. Our rubric for this more detailed analysis is shown in Table 1.

Table 1: Ethics Blog Evaluation Rubric	0	1	2
A. Reflection is clear, concise and logical			
B. Connections between everyday life and ethics were made			
C. Connections between technical engineering concepts and ethics were made			
D. Moral imagination is displayed			
E. Factors that may influence ethical problems are recognized and considered			
F. Consequences of possible courses of action are weighed			
G. Student reflects on personal development			

A clear, concise and logical reflection would be written with excellent grammar, reflect clarity of argument, and include no extraneous information. It was of primary importance that students

find and make connections between ethics and their life on or off campus, so that they could internalize the issues as personally relevant. Similarly, we wanted students to find or make connections between the ethics topics and the technical material in the course or engineering practice. We assessed moral imagination as student articulation of values that underlie the problem presented, an ability to employ preventive thinking and generate “third way” resolutions that went beyond the problem description. The students’ ability to approach an ethical problem analytically was assessed in their ability to identify the influence of values and facts on ethical decision making, and separately their ability to anticipate consequences of different ethical choices. Finally, we assessed the ability of students to recognize and express their own changing, ambivalent or static beliefs on an ethics problem, as well as to track their growth and moral development over time.

In addition to the textual analysis, we conducted focus groups with 14 students in the thermodynamics course (47% of the total enrolled). We compared these data with prior focus groups with other engineering students as reported by Riley, Ellis and Howe (2004). We also were able to compare course survey data from the previous year with the current year in order to ascertain student reaction to the two approaches.

Results

Textual Analysis. The results of our textual analysis are presented in Table 2. Mean scores for the class are reported for each rubric element, for each week of the class. Standard deviations are reported for the semester averages (in parentheses). The factors with the lowest overall averages were F (anticipating consequences) and G (reflecting on personal development). The highest was A (clarity, concision, and logic), followed by B (connections to everyday life) and D (moral imagination). The standard deviations show high variability in student performance for each factor. Across the semester, there were no statistically significant changes in student performance. Averages decreased slightly (not significant) over time for factors B and G, and the others increased (also not significantly).

Week	A	B	C	D	E	F	G	TOTAL
1	1.71	1.42	0.71	1.03	0.77	0.52	1.13	7.29
2	1.48	1.32	0.84	1.06	0.81	0.71	0.87	7.10
3	1.55	1.26	0.77	0.81	0.90	0.45	0.90	6.65
4	1.48	1.29	0.77	1.13	0.84	0.77	0.84	7.13
6	1.42	1.06	0.74	1.13	0.81	0.71	0.90	6.77
7	1.48	1.03	0.94	1.13	0.77	0.81	0.61	6.77
8	1.65	1.03	1.19	1.29	1.52	0.84	0.48	8.00
9	1.48	1.26	0.58	1.23	0.84	0.74	0.58	6.71
10	1.61	0.97	0.81	1.29	0.81	0.65	0.65	6.77
11	1.61	1.13	0.74	1.52	1.06	0.90	0.77	7.74
13	1.58	1.16	1.35	1.23	1.23	0.77	0.61	7.94
Semester Average (standard deviation)	1.55 (0.65)	1.18 (0.75)	0.86 (0.80)	1.17 (0.75)	0.94 (0.78)	0.71 (0.78)	0.77 (0.83)	7.17 (0.51)

We present examples of our textual data to provide depth to the evaluation described above and to illustrate how the different factors are typically demonstrated. This more qualitative examination of the blog text reveals the centrality of moral imagination in creating opportunities for demonstrating the other factors. In order to understand how a situation arises, or the consequences of certain approaches or actions, one must be able to think beyond the problem statement and be creative. The ability to translate a given situation into one's everyday life or into professional or technical contexts also depends to some degree on this skill. In the following passage, a student demonstrates her moral imagination by pointing out some of the deficiencies in the passage's treatment of sustainable development:

The other thing that bothers me about this particular code of ethics is it does not take into account the environment or future generations. Such an absolutist approach does not allow for the weighing of different criteria for a happy medium. What if the right of ownership of property in a community requires the loss of habitat for an endangered tiger species? What about... installing power in 3rd world countries at the cost of oil for future generations?

In the following passage, another student is able to use her moral imagination to think critically about the text's discussion of exploitation, considering the application of principles in professional practice, and reflecting an understanding of the factors that contribute to ethical problems and the potential consequences of certain lines of thinking about those problems.

I guess whether I become an engineer or not, my responsibility at my workplace would be to ensure that in doing my work, I do not exploit anyone by taking away anything from people without their permission. This definition of exploitation is also problematic because it presupposes that once you ask permission from people and they agree, you can take away anything from them. This would mean that if poor people in a community agree to let a polluting company be built in their community in exchange for much-needed money, it would not be exploitation since they have agreed. I suppose it would then be the responsibility of engineers and other professionals to realize when people give them permission against their will and because of their circumstances.

A third student demonstrates moral imagination as she anticipates consequences of different ethical approaches to cross-cultural work:

As a western engineer if I travel to other countries, as I hope to one day do, I will be contribut[ing] to the spread of western ideals. Personally that bothers me because I feel it is wrong of me to impose my beliefs on others, yet if I travel to another country that has laws that restrict women or people of color I would still want western morals to apply. It makes me wonder what the best procedure is in this case. When is it okay to interfere? I don't want to be treated the way some women are treated in other countries nor do I feel the women there should have to be treated that way either. However who am I to tell them that their ways are wrong? If I were to go to another country and try to change their policies I would be interfering in an unwanted way but I still feel that the rules there should be changed.

Students struggled with relating ethics issues to technical content in the course. The following passage reveals this struggle as the student applies the laws of thermodynamics (which she is still coming to understand) to the question of “how clean is clean?”

Cleanliness in terms of technology and development is quite idealistic because we can never put back something that we take away from the environment completely. This is the first law of Thermodynamics. We cannot create what we take away. Energy is lost in all transformations and processes and this lost energy cannot all be restored and reused as useful energy. So we try to be clean when using resources and taking things from the environment. But how clean is a realistic goal?

Students may not be comfortable revealing their partial understandings of concepts as they learn them, but the process of taking this risk and receiving well-designed feedback is an important way for a student to solidify her understanding of the technical material. Another discussion relating technical concepts to ethics emerged from the reflection on accidents, in which a student advocates a higher standard for safeguards in more complex systems:

And it should be expected that more complex systems will have more ways of failing, some of which may be unforeseen or foreseen but not expected to occur. However, it should also therefore be expected that complex systems have more detailed ways to prevent against accidents and failure.

Applications to everyday life were very common and ranged from the personal to the global. In her reflection on dissent from organizations, one student wrote the following about her decision-making around personal religious observance:

The reason I think about restrictions is because I keep the Sabbath (on Saturday). If I were to go for a job in which I had to work on Sabbath, I wouldn't be able to take it. Here at school, I don't do work on Sabbath. It is sometimes hard when meeting in groups because Saturday is almost always an easy day to meet, no class the next day. My group, like a company, needs me to work with them, but my personal moral obligations do not allow me to work on that day.

Campus life reflections were the most common. The following passage, a response to the reading on self-interest and fear, additionally contains a clear enumeration of factors that contribute to the creation of an ethical problem. The passage suggests an internalization of and deep engagement with the issues that are also a nice example of the personal moral development we sought students to demonstrate:

On campus we are constantly faced with moral and ethical dilemmas in our everyday life relating to the honor code, our interactions with others, etc. All of the reasons for moral failure mentioned in the passage are always present here at Smith: The need to advance oneself, and moreover the ever present fear of failure. Either of these things could drive me or anyone to commit a moral infraction, but knowledge of my own integrity the ability to recognize unethical temptations in my life now, will strengthen my conviction to be a strong and ethical engineer in my life in the future.

There were only a few passages that included evidence of personal moral development; in this piece on dissent and the organization, one student provides a moment of honest introspection that suggests an increased consciousness about her ethical decision-making:

I would like to think that if I were under that much pressure from so many important and powerful sources that I would still be able to stand up and voice my concerns. But I honestly can't say that I would have the backbone to take a stand against that kind of strain. It's the kind of real life situation that makes me begin to question the ferocity of my own moral and ethical beliefs in the face of such an opponent.

Focus Groups. The focus groups had mixed reviews of the ethics blog assignment. Some students felt it worked as designed, and described the benefits of ethics for their learning and personal development:

- *I thought it [ethics blog] was very beneficial. I felt that you would do the problems and then do the writing and while this is a very different situation, it was definitely applicable because you are applying what you know about thermo and not just doing the math – you see how it connects to your daily life too.*
- *The end of the ethics part where you're supposed to relate the case to you, as a student, at Smith, and energy, that little part I really liked because it made me think of so many cases and yes what's involved in most of them, it affected me and I think critically about those things that I would not have thought about if I had not done these assignments.*
- *What I have noticed throughout this class is that my critical thinking has been changing, and I believe that's good. Now I am more critical; critical about the problems we solve, about the issues we cover in class and the discussions we have there also. There has been so many deep thoughts that have come to me that I don't think I would have had or would have seen things that deeply if I had not taken this thermodynamics class. It was not just the sciences, the technology, and all the math behind it, it was also this other side that helped me develop these critical thinking skills.*
- *I don't think it helped me learn thermo. At the same time it did help me to connect things more and to see how things relate to real life and real issues. It has also helped me to become clearer about who I am becoming as an engineer.*

Some focus group participants offered helpful suggestions for improving the ethics element of the course, primarily asking for a return to case analyses:

- *We should have talked about the ethics in class. I did not really like reading other people's blogs because I felt it was too personal. Case studies would have been better than just the ethical topics.*
- *I felt that some of the ethics questions we'd study were not always relevant and I wish we'd done case studies instead.*
- *Sometimes the ethics was hard to relate to thermo directly.*

- *The ethics topics tended to be too commonsensical and case studies could be better to motivate us to learn more too.*

Some participants expressed concern about the workload in the course, and the balance between ethics and technical material:

- *I worry that we have not done enough thermodynamics and have focused too much on things like ethics.*
- *I have been cutting the problem sets off by two or three problems because I just, I don't have time because of everything else, and I don't understand what's going on.... But the most frustrating part of the blog is that there was no thermo in it. I am told there are connections between ethics and thermo but I am sorry I do not see those connections. There was too much, so that by the end of the week I would not have taken anything in, and not really therefore internalize all these things. In order to make it more effective they should just pick fewer things to focus on.*
- *Ethics could be instead a once every other week thing, and I agree it should be in there. Everything in this course was very important. I think you just need to pick and choose more where the focus lies...*
- *Ethics does not belong in Thermo because there are plenty of other opportunities for it in our curriculum like Engineering 100 and Senior Design Clinic, and if you want to put ethics in the middle, Thermo is not even really in the middle.*
- *I really did like some of the ethics, some of the questions were so interesting but I did find it far too much work and really no time for reading each other's blogs. It's just too long.*

Course Surveys. Course evaluation data taken on the last day of the terms in 2004 and 2005 were compared and are shown in Table 3. Scores were lower in every category for the second course offering, though not significantly different. The increase in class size may have had a significant impact on overall course satisfaction, as this was an unusually large class for our institution. It appears that the formal case analysis assignment may be more popular than the blog assignment, though both get lower ratings compared with the other ethics-related items on the course survey (though not different from other assignments). The high standard deviations suggest that some students really like this aspect of the course, while others find it to be their least favorite.

Item	2004 (N=17)			2005 (N=28)		
	mean	Median	stdev	mean	median	stdev
Ability to think critically about thermodynamics and engineering ethics	4.24	4	0.53	3.84	4	1.23
Instructor fostered critical thinking	4.12	4	0.70	3.93	4	1.15
Instructor helped me relate concepts to everyday life	4.06	4	0.56	3.72	4	1.13
Instructor linked the technical subject of the class to real world and ethical issues				3.84	4	0.99
Quality of ethics assignments	3.65	4	0.79	3.14	3	1.27

Discussion

Employing the blog format meant that students relaxed some formalism in their thinking and writing; the systematic approach taught in the first year and practiced in the sophomore year was retained less than we had anticipated. Many students spent less time on the assignment, and some took it less seriously.

However, it is evident from our analysis that students did connect material to everyday life readily and frequently, something that was not part of case analyses in the past. Similarly, connections to technical and professional practice issues were also more abundant and more organic. While students in the focus groups mentioned that this was difficult, they accomplished this objective to a greater degree than previous students.

The blogs did not create as much internalization and reflection on personal moral development as we had hoped, but there was much more room for this in the blogs than in previous assignments. Providing examples from the first set of blogs that does a good job with this element of the assignment could help students do a better job with this in the future. Encouraging more interpersonal work by formalizing the reading of other blogs in one's collaborative learning group would also support these efforts.

Creativity was supported well in the blog format, again in a way that seemed more organic than in formal case studies, where creativity was required and sometimes seemed regimented, with students artificially enumerating creative alternatives. With the blogs, creativity came in a self-motivated way, perhaps evidence of a certain kind of internalization of creativity into students' thinking and decision-making around ethics.

More feedback would be helpful in the future to better support student performance. There were logistical problems with the way feedback was delivered (electronically, but students often did not check their digital drop box on Blackboard where the feedback was located). It is apparently worth the extra time and expense to deliver feedback on paper. A more detailed rubric for evaluation may also help students better isolate and work on aspects of their performance.

Subsequent offerings of this course will incorporate feedback from students and combine elements of formal analytical case studies and retain some of the more reflective elements of the blogs. Choosing a small number of case studies and incorporating a more complete process that includes formal writing, blog reflections, and classroom discussion will hopefully create a better process for student engagement with ethics. Blog questions would promote the moral development and connections to everyday life and course material, while formal analyses would address the other factors. This represents a merging of learning goals between previous semesters and the current offering.

Conclusion

The blog holds potential for stimulating moral imagination and encouraging students to pursue new ideas that emerge from the integration of personal experience, technical content, and concepts in ethics.

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