AC 2010-1428: INTEGRATING ETHICS CURRICULUM WITHIN A SERVICE-LEARNING DESIGN CONTEXT

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Designing Ethics Curriculum:
Teaching and Assessing Moral Decision Making in a Service-Learning Design Course

The doer alone learneth.
Friedrich Nietzsche

Introduction

Though much has been said about what might constitute "engineering ethics"—or even what might constitute "ethics," for that matter—and perhaps more has been said about how best to teach ethics across the curriculum, much of therelevant literatureis still markedly academic and gives inadequate treatment toapplied or service-learning engineering contexts.Since service learning programs are by definition centered on direct interaction with the community—meaning the point at which students have direct contact with stakeholdersin the community comes sooner than it would otherwise—we believe the development of useable, practical ethical skills must come sooner, too. The disconnection in the literature on engineering ethics from the particular situation of service learning experiences, then, is problematic. Traditional classroom courses remain separated from the world outside the university, and sooftenplace less emphasis, and certainly less urgency, on teaching ethics.But service learning programs carry a greater responsibility to teach their students how to act "right". They have a necessary urgency to their instruction in ethics and a unique gravity about the effectiveness of this instruction. Taking this proposition as our starting point, we see our positions as administrators of EPICS, a large, multi-disciplinary, service-learning design course at Purdue University,as an opportunity to infuse within our regular curriculum a practical course of instruction in ethics. Our goal in this regard is to help students learn viable skills that will enable them to work through a moral decision-making process on their own as they encounter ethical issues in the course of their profession and beyond.

Service learning programs, by virtue of their non-traditional classroom structure and their experiential learning models, present valuable opportunities for educators to add value to the student experience. In their book *Where's the Learning in Service Learning*,Eyler and Giles (1999)[3] illustrate this unique situation by drawing quotes from students actively involved with service learning programs:

> I suppose I've learned about real life. That's the only way I can put it. I've encountered people that I never would have met . . . situations that I would never have been confronted with . . . [and] I've been able to forge friendships with people that I never would have met. (23)

Another student writes: “the community service brings [the experience] to life and makes sense of why you are even there” (57). Eyler and Giles open their first chapter with a powerful student sentiment. “I can honestly say that I’ve learned more in this last year in [service learning] than I probably have learned in all four years of college” (1). And this student is not alone. The authors show that 80 percent of students surveyed reported having a “good or excellent experience” with service learning (59). And this seems to translate into increased motivation to participate and ahigher degree of learning. The study shows 55 percent “felt motivated to work harder in service-learning classes,” while a slightly higher percentage, 58 percent, “felt they had learned more” than in a traditional classroom setting (60). Andwhile the opportunity is greater for students to work hard and to learn, so too, is the need for proper and practical instruction in ethics.

Lima and Oakes (2006)[5] suggest that “the idea that engineers behave in socially responsible ways is take for granted, . . . History provides us with numerous examples of engineering practiced in ways that created more problems” (40). The authors cite several examples that show the complexity of finding the “right” way to act. In a general example, they say, “something that was designed according to all laws and recommendations twenty years ago may be considered an irresponsible design using today’s laws and recommendations” (40). More specifically, the authors cite the example of New York City planner Robert Moses, who intentionally built overpasses on the Long Island Expressway low enough that buses could not pass underneath, eliminating the possibility that people who require public transportationcould reach the beaches on Long Island (40-1). These clearly are cases of questionable moral value, and they begin to give us a good idea of the types of difficulties practicing engineers—whether students or otherwise—will have to consider in the course of their work.But they stop short of developing a systematic method for deciding “what is right.” And the larger body of literature is similar. Some writers, such as Lima and Oakes, offer insight into the difficulties of ethical situations in service-learning environments, while others, such as Caroline Whitbeck in*Ethics in Engineering Practice and Research*(1998)[7]focus mostly on advanced topics in ethics as they might apply to the graduate student, professional engineer, or scientist.

Within EPICS, and with the assistance of a Course, Curriculum, and Laboratory Improvement (CCLI) phase two grant from the National Science Foundation—which we share with three other universities—and a seed grant from the College of Engineeringto support the characteristics of the NAE’s Engineer of 2020, we have created curriculum components to fill the gaps in “engineering ethics” instruction. We have sought to address the service-learning environment specifically by recognizing the unique and valuable learning experience it offers students. Our curriculum includes instruction in the foundations of ethics, its language and methods, and in a practical moral decision-making process that studentscan adapt and implement in their own projects. We have also created methods of assessment to determine how much progress students make in their moral decision-making abilities and in their ability to identify, characterize, and reflect on the specific ethical issues they encounter in their project work. To this end we have created reflection questions, lectures, workshops, and an assessment instrument. As with all curriculum development, these tools are continually updated as we learn more about

them, but our data so far suggest these tools have enabled us to be effective in our task of teaching engineering ethics in a service learning design course.

Where We Began

Our goals from the beginning were to satisfy the Accreditation Board for Engineering and Technology(ABET)'s requirement that students havean "understanding" of ethical issues. But this is only a start, and since our program works so closely with the community, we must also go well beyond ABET, helping our studentsusetheir understandingof ethical issues to then apply a process of practical moral reasoning, a process through which they can arrive at a justifiable and feasible response to ethical dilemmas in their project work. Our goals are not simply academic. Nor do we want to teach only ethics. Rather, we have aimed our efforts at teaching engineering ethics to students who must be able to apply these lessons to their own ongoing projects and be able to work through a reliable decision making process that produces consistently justifiable results.

When we began, we took a measure of our starting point by analyzing a sample of student reflections given in the previous academic year—fall 2008 and spring 2009. On this sample we overlaid a table of questions asking whether students were able to recognize the ethical situations in their project work, whether they could identify the possible solutions, which solution(s) they chose (if any), and what they think might have happened had they not addressed the issues in question. Our initial findings were disappointing. Many students were unable to identify ethical situations—or even potential situations—in their projects,even when we as administrators knew them to exist.Of those students who did identify and describe an ethical situation, many either erroneously attributed ethical content to a non-ethical situation, or attributed correctly, but did so in only a vague or general sense. The most commonly detected weakness in the student reflections was incorrect or incomplete identification of ethical issues. The next most common was a narrow focus on the general need for safety, often without a specific connection to their own projects. Whetherfrom an inability to identify properly, or from a real paucity of ethical language to articulate their thoughts fully, our students' reflections told us that we were not where we wanted to be. And they told us where we needed to begin.

Where We Want To Go

Since EPICS is at its core a service-learning course—one focused on engineering-centric design—our focus as educators while designing ethics curriculum in this context must be on actual student behavior and not only theoretical knowledge. To that end, we began our infusion of ethics by identifying four overarching needs that we must address if we are to be successful. First, we need a set of clearly-articulated learning objectives. Ethics is a large and complex field

with much of its work being only tangential to our program. We must know what areas we want our students to focus on and we must leave out what is extraneous. Second, we need an established model of moral development by which we can locate students' reasoning skills both before and after their experience in EPICS. After much searching and consideration of many good models, we chose to use Kohlberg's model of moral development, although our use of it remains at a high level[2]. Third, and perhaps most obviously, we need the tools of instruction. We need to create the instructional materials that will become a part of the regular EPICS curriculum. Fourth, we need a valid and reliableassessment instrument in order to measure the progress we make with our changes to the curriculum.

Our Process

To address our first need, we developed learning objectives based on the issues we identified in our student reflections. Given the apparent difficulty students had in properly identifying situations with ethical content encountered in their project work, it seems clear that any efforts made to improve the instruction of ethics must begin with this. EPICS currently consists of roughly 30 lab divisions, many of which are made up of 3-5 project teams, and all of which work with partners in the community and have as their end users real people who intend to use the product(s) delivered.This feature sets EPICS apart from other design courses that focus only on the iterative technical process of design. Our students interact directly with their local community—and sometimes their not-so-local community—and their designs are ultimately judged in a sense by whether they are implemented by their community partners or whether they sit unused. This also sets EPICS apart from traditional courses in ethics. Teaching our students why Plato intended philosophers to rule the Republic—or why poetry should be banned—has little direct relevance to how they should act withintheir project teams. Instead, EPICS has as one of its central theses the belief that design should always be centered on the user and that, therefore, all instruction in ethics should be as authentic to the students' experiences as possible and be directly relevant to a real-world, user-centered design experience.

First, and most importantly, students must be able to demonstrate awareness of ethical situations.This wording has an intentional double entendre: students must both be able to recognize ethical situations insofar as they manifest—or potentially manifest—themselves in their projects, and in addition they must be able to demonstrate this awareness. Our requirement of demonstration is critical. We believe that the process of articulation, written or oral, helps to clarify and solidify the students' understanding of the issue in question. Second, the process of articulation also requires a working knowledge of ethical language. Students must have the proper disciplinary language in order to describe what they see. We also think that having a command of ethical language will, in turn, increase students' abilities to recognize ethical situations. We think these two learning objectives—awareness of ethical situations and awareness of ethical language—are inextricably linked. While people often have an instinctive ability to detect when situations are somehow not right, this is not equivalent to the ability to articulate the precise components of an ethical dilemma. As their ability to recognize ethical

situations increases, so must their relevant language. And as their language increases in precision, so will their focus.Third, students must demonstrate awareness of the three levels of Kohlberg's moral development model. We think there is value to students understanding what different levels of moral reasoning might look like or sound like. Similarly, and fourth, students must be able to demonstrate their awareness of multiple ethical frameworks. Not all ethical problems are solved in the same way. Not all people are motivated by the same ends, nor do they value actions in the same way. Some situations, and some people, call for an "ends can justify the means" approach (utilitarianism), some recognize a duty to certain actions or certain ends (deontological ethics), some focus only on intentions rather than outcomes (virtue ethics), while others are concerned with not violating human rights as their primary motivation (rights ethics).

Having multiple frameworks by which a person might reason through an ethical dilemma is a fundamental part of proper and informed reasoning. Our goal is not to favor any one of these approaches, but rather to present them as common frameworks that can be used to arrive at justifiable ways of acting. On the other hand, we do not expect students to memorize the subtle and comparative details of each framework. Ideally, students will be able to demonstrate they understand that multiple frameworks exist and are available to them. This understanding seems to imply students also know some of the key distinguishing features of each framework. Fifth, students must be able to demonstrate they understand the distinction between what it means to be a professional versus a non-professional and what theattributes of a profession are. As part of our attempt to situate our instruction of ethics in an authentic and useful context, we position ourselves explicitly and specifically within the bounds of professional culture. Personal cultures play a role, of course, in ethics broadly construed, but keeping in mind that EPICS is a service-learning design course, personal cultures necessarily fall outside of what we explicitly address. Instead, the role of culture we are interested in manifests its influence as the limitations placed on professionals by their profession. That is to say, we recognize professional cultures as limiting agents in professional activities.We use the formulation found in Martin and Schinzinger's book *An Introduction toEngineering Ethics*that describes a profession as work that involves"advanced expertise" and"self-regulation,"where"public good"is the result (Martin&Schinzinger 2000)[6]. Sixth, students must be able to describe the purpose of professional codes of conduct. Understanding the particular professional culture in which they are operating and making ethical decisions is key to making good decisions, and understanding the content of a professions (or a company's) code of conduct says much about that professional culture.

To address our second need, we have adopted Lawrence Kohlberg's well-known model of moral development which recognizes three general levels of moral reasoning where each is additive and proceeds from the last (Colby and Kohlberg 1987)[2].Kohlberg's model functions as the theoretical framework of moral development for us, against which we can compare the results of our assessment instrument, first to determine where our students' moral reasoning skills are at the beginning of the semester, and second,to determine whether those skills have improved after being exposed to our instructional materials.Kohlberg calls level one "pre-conventional" and characterizes it with two sub-levels: "Obedience and punishment orientation" and "self-interest orientation." A person reasoning at level one, in Kohlberg's terms, would be motivated exclusively by self-interest. Negatively, the level one reasoner tries to act in such a

way as to avoid punishment. Such actions might take the form of a strict adherence to whatever rules apply in the situation, or actions might be judged to be bad insofar asand to the degree to which they produce punishment. Positively, the level one reasoner considers the personal gaininvolved with an action. One might judge an action to be good insofar as it produces beneficial personal gain to the one who performs it. Level two, or "conventional" reasoning, is characterized by a focus on law and order and on maintaining established social norms. A level two reasoner is concerned with "being good," especially in the eyes of others. What constitutes being good can be different in different contexts, but the level two reasoner is adaptive to the context. The "golden rule," or a modernization of Kant's categorical imperative, becomes the driving force behind right actions. Level two reasoners often consider questions such as "what if everyone did this?" or "would I want everyone to act this way?" Kohlberg's highest, and third, level, "post-conventional," is characterized by a focus on plurality and diversity of opinion. Post-conventional reasoners are "aware that people hold a variety of values and opinions [and] that most values and rules are relative to your group" (Kohlberg 1987). While certain core values always remain nonrelative, such as rights to "life and liberty," other values can be weighed against a number of other options depending on the circumstances and opinions that seemed like certainties at lower levels of reasoning, such as rules and laws, now appear to be flexible, if needed. The highest point of level three involves "following self-chosen ethical principles" and having ultimate faith in these as guiding principles, even when laws come into conflict.

With these goals in mind and a structural framework in place, we could move on to our third need, creating the instructional materials we would use to help students learn the objectives we set out for them. To this end we created an introductory ethics lecture and installed it as the fifth of a five lecture series required of all new students. It begins with the premise that engineers cannot have a complete design process without ethics. This lecture explicitly covers each of our learning objects, if only tangentially given the time constraints. The lecture opens with an example from a recent EPICS team: a fairly innocuous project that requires designing a device to improve the speed and efficiency of a currently manual process of attaching a cap to a small plastic medical vial, a vialwhich turns out to be used in medical tests on animals. The example is drawn out slowly with the presenter asking at several points throughout the development whether the students see any ethical issues. Students are told the workers have various mental and physical disabilities, which is true. They are told the workers are paid based on how many units they can produce, which is also true, although neither of these has any ethical bearing in this case. The intention is to give the students a feeling for what ethical issues might look like, how they might appear in their projects, and how they might recognize issues that are not at first apparent. All of this is kept as close as possible to the real EPICS experience so students will be able to translate what they learn in the lecture to skills they can implement in their own project work.

We have also integrated into our core lectures on design—lectures 2-4 of the required five lecture series—a strong emphasis on understanding the social context of everyone involved in the design process, from the student members of the project teamto the community partner or end user(s) and beyond. We have found from past experience that student design teams have a tendency to design for someone other than the actual end user, and often for themselves or some

hypothetical ideal user. What was once a separate lecture on the importance of social context is now integrated into the design lecture series as we ultimately decided that the social situation of the community partner—the user in this case—and the team involved in the design was impossible to disentangle from design itself. Understanding the user is a fundamental part of the design process and without fully engaging with the specifics of the social situations of everyone involved leads to an uninformed designer, one necessarily incapable of making informed ethical decisions if need be. In this sense, our human-centered design occurs fully within the boundaries of the user's social context, and this bigger picture is fully subsumed in the domain of the ethical. We further develop the importance of social context, along with ethics, in smaller, more intimate workshop settings, what we call skill sessions. Skill sessions typically consist of a smaller group of students—10-20 usually, down from over 100 in lecture—who participate in an interactive discussion of a particular ethical issue, often one pulled from a real EPICS experience in order to maintain authenticity and to increase the students' ability to identity with the situation. The intimacy allows students to freely experiment with different solutions and ethical decisions.

To further root the relevancy of our instruction, and to provide more "hands on experience," we are currently developing a detailed case, based on a past EPICS team project, which students can analyze from several angles. The original project we are basing this study on was fraught with design issues and with ethical ambiguity. The team suffered from leadership issues, which led to confusion for the other team members,which ultimately led to massive delays and an inability to deliver the project, among other problems. Students can return to this case, now anonymized, and sift through the details with a critical eye, analyzing what went wrong and what went right, if anything. To aid the students' analyses, and as another method of instruction, we are working on leveraging our pool of teaching assistants by providing training to help guide students through the issues in this case. Ideally, all our teaching assistants will at least be familiar with the types of issues we mean when we talk about ethicsand will be able to recognize for themselves the ethical issues on their teams and in turn help their students recognize them and work through them.

Our fourth need is an assessment measure that allows us to determine students' moral reasoning abilities before they begin the semester and then again after they have some experience with our curriculum. Ideally we would like to see students improve in the areas of our learning objectives from pre-semester to post-semester. While surveying the literature for existing assessment instruments we found several examples of high quality work, instruments that look very promising, but ultimately none that fit our vision. Since our integration of ethics into the EPICS curriculum is a narrow and specific application, we have made a great effort to keep our instructional tools as authentic as possible. Throughout our development process we have learned that students must be able to recognize our examples as something relevant to their own work. Hypothetical examples like the trolley problem, or well-known and analyzed events such as the Challenger explosion make the connection too difficult. This was our conclusion even as we considered some of the more popular instruments, such as the DIT-2 from the University of Minnesota or the Test for Ethical Sensitivity in Science and Engineering (TESSE) or Engineering and Science Issues Test (ESIT), both from Georgia Institute of Technology. We intend to continue using student reflections as a means of assessing students' abilities and

progress, in addition to both short writing assignments given during the ethics skill sessions and general observation of the students during lab. But our primary focus in this area is in creating a valid and reliable instrument that we can use to assess students' starting points and their progress each semester—or over several semesters, in the case of multi-semester students.

Results

Our end-of-semester reflection questions produce a consistent type of information about our student's ability to demonstrate their awareness of the ethical situations in their projects. We have found this consistency encouraging because it suggests, at the very least, that our questions are being read, interpreted, and answered in the way we intended. But these questions do not seem to produce enough of the information we need in order tosay with confidence what Kohlbergian levels or what philosophical frameworks students are using in their decision making.Our assessment instrument has also produced encouraging results. Most significantly, we have seen data from two pilots of the instrument that suggest it is a reliable method for measuring student's moral decision making abilities within the context of their EPICS project work. This is to say we have seen positive feedback that the information we are getting back is the information we want. But these types of assessment methods are difficult to use with certainty, and we continue to learn more about them and to improve as we use them with our students. Since context-specific decision making is difficult to quantify in any way, and perhaps more difficult to assess based on self-reports from students, we have not found it useful to report data along a lickert scale or something similar. Our results are best understood, until we have a much larger data set, in a more qualitative narrative style.

Our instrument reflects much of the theoretical grounding we have insisted on for all our curricular components.While we include questions addressing each of our learning objectives, our primary focus—and the bulk of our questions—is on moral decision making,which centers on three areas: 1) Ability to identify ethical issues, 2) Awareness of multiple ethical frameworks, 3) Levels of moral reasoning. Our questions asking students to identify the ethical issues are intended to present an authentic, EPICS-like situation where the "right" way to act is not clear, but where some decision about how to act must be made. Since we have found that students often have difficulty identifying the parts of a situation that have ethical content, our questions include several different types of information including types with no ethical content. While our intention is not to mislead students intentionally with irrelevant information, we do think it is necessary that students demonstrate their ability to identify which pieces of information are relevant to their moral reasoning and which are not. These types of questions are well represented by the following example:

> Your student design team has recently delivered a much needed project for a local center for children who have physical disabilities. At the delivery you learn from the therapists that due to budget problems the clinic will be closing permanently soon and the kids will

be transferred elsewhere. The therapists suggest that they can use the project as a selling point for their board of directors. If the board sees the clinic is using innovative and effective (and cheap) new technologies, it might be more inclined to keep the clinic open. You also discover, once you are there in person, that the clinic now serves younger students than before and now the height of the project from the ground is too high for the younger children to use effectively. The original agreement was that it should be usable by all students. The project seems to have a severely limited use and needs to be slightly redesigned and rebuilt in order to maximize its use, a project which will take two months.

Which are the ethical dilemmas in this situation? Choose all that apply.

1. There are no ethical issues, only common sense decisions to make.
2. Rebuilding the project to meet the original specifications will require it to be gone for two months, eliminating it as a selling point to keep the school open.
3. Leaving the project at the school to be used by the children might present dangers to the younger children who are not yet tall enough to use it properly.
4. The board of directors has decided to close down a much-needed school without providing a replacement.
5. Your team, as designers, delivered a project that did not meet the project partner's needs.

This question is adapted from an actual EPICS experience and modified only slightly so that the ethical issues are included along with other morally-neutralinformation. We think the best answers in this case are (2) and (3).The answers, as they are, give students a range of options: students have the opportunity to claim the scenario presents no ethical issues; they could select the wrong issue (5. Your team, as designers, delivered a project that did not meet the project partner's need); they could acknowledge that there are multiple parts to this ethical issue, but choose some or all wrong parts, etc.

The ethical frameworks we have in mind, and which other of our questions address, are grounded in century's old philosophy. We have not tried to reinvent ways of thinking about ethics, nor have we imposed our own thoughts on what might constitute right and wrong. Our introductory lecture introduces, if too briefly, five philosophical frameworks: Utilitarianism, Duty ethics, Rights ethics, Virtue ethics, and Social contract theory. At the risk of losing the authenticity of our examples, we currently present a classic trolley problem question to see whether students will make decisions differently, based on different frameworks, as details of the situation change, or whether they stay with one method of reasoning, no matter the details. This question begins with the following:

A passenger train is out of control and is speeding down a track. Tied to the track, and in imminent danger, are 5 people. Luckily you have the ability to throw a switch and divert the train onto another track. However, on that track there is another person tied down.

Would you throw the switch? Circle the answer you would choose to do.

Then, put an "X" next to ALL the answers that are ethically justifiable actions.

1. Yes, because saving five lives is more important than saving one.
2. Yes, because you have a duty to act as you would want others to act and saving five lives is the choice you would want others to make.
3. No, because you do not have the right to control anyone's lives or decide who lives and dies. By pulling the switch you are deciding who dies and who lives and you cannot make that decision.
4. No, because you have no responsibility or duty to do anything for anyone else. You keep yourself out of harm's way and avoid having any responsibility in this incident.
5. Yes, because you have a responsibility to do what's best for the community, and preserving a larger portion of its members is the best course of action.

The question has two sub-questions (below) which alter the dilemma slightly, allowing the students an opportunity to choose a different answer (out of the same answer options), which would indicate to us, if they do so, the use of a different ethical framework. These alterationsplay on common perceptions of moral worth in different types of people.

The single person on the alternate track is a close family member of yours. Do you pull the switch?

The single person on the alternate track is a convicted criminal of the worst kind. Do you pull the switch?

The final part of the question asks the students to indicate*all* answers that are ethical actions. This gives the student a chance to demonstrate an awareness of moral rightness through different frameworks (though the subtly of the changing frameworks will remain hidden to the student).

Perhaps the most important questions in this instrument, and certainly the most challenging to create, are those that measure the levels of moral reasoning of the students. To assess this we created questions that present an authentic EPICS-like example and ask the students what they would do. Each of the five answers is designed to map directly onto one of Kohlberg's levels of moral reasoning. In several of these questions, the student is faced with the same action listed as multiple possible answers, but that action is followed by a different rationale. To give two examples:

First,

At a recent university mixer, your design team listened to another team discuss its plans for building a pedestrian bridge over the Wabash river. As they talked, you notice a component of the design that is specific to your discipline that you think could be designed better, possibly saving money while increasing safety. But this is not your team and you do not know any of the team members personally. How do you handle the situation?

1. You do nothing. This is not your team and it is wrong to interfere.
2. You offer to help, thinking you can get credit for working on this project in addition to your own.
3. You tell a mutual friend to make the suggestion. You know you should say something, but you don't want to insult the other team.
4. You tell the other team that they need to make the fix you have in mind. They currently have it wrong and do not know it.
5. You alert them to what you think is wrong and you ask if there is a good reason for this, acknowledging that the team might have an important reason for designing in this way.

Second,

Your student team is partnered with a local school district which wants you to build a database solution. They want to match volunteers from the community open positions within the schools.

The school's principal tells you all about what the project should do and you quickly get to work on the design. Halfway through the semester you have a meeting with the school superintendent who outlines for you a very different vision of what the database should look. Some of his information contradicts the information given by the principal. At the end of the project, on the day of delivery, the school district's network technician says he cannot install the database in its current form because it is created in the wrong technology. The technician explains how you must change your design in order to make it compatible, but these changes will mean that it is functionally different from the visions of the superintendent and the principal.

Whose information do you go by?

1. The Principal's, because he has been the regular point of contact and he might be upset with you if you choose someone else's design variations.
2. The Principal's, because you have developed the best relationship with him and he will be able to explain the situation to the Superintendent and the technician for you, saving you the risk of dealing with a touchy situation.

3. The network technician's, because he knows the only way to get anything installed and without doing what he says, you will get nothing done. Doing what he says will make everyone look good.
4. The Superintendent's, because he is the highest level of authority.
5. No one's. You have conflicting information from three people who clearly do not communicate with each other. You decide not to deliver the project since the terms of the arrangement have changed.
6. Everyone's. Since they are all stakeholders, and since you are the designer, you must all work together to arrange a compromise.

In both examples, the answers students choose will tell us much more about *why* they would choose a particular action than about *what* action they would choose. Using a key, we are able to map each of these answers on to a specific level of moral development in Kohlberg's model. For example, in the previous question, if a student chooses the first answer, this tells us the student has used Kohlberg's level-one reasoning, or "obedience and punishment orientation". Choosing the sixth answer tells us the student has used Kohlberg's level-six reasoning, his highest, or "universal ethical principles". What we would like to see from this type of question is a general upward trend in the indicated level of reasoning based on measurements pre- and post-instruction.

Conclusion, Current Status and Future Work

Our students seem to understand the unique situation of our service learning program in the greater university curriculum. The differences between EPICS and traditional classrooms are obvious, and are always present, and this in itself seems to highlight the need for students to make the right decisions in their professional behavior as in their designs. So far, our curriculum has integrated well with our existing materials. The students do not report seeing the ethics instruction as "extra" or as "additional" to their usual EPICS curriculum. Previous to this deliberate effort to address the need for ethics instruction, the students often saw the ethics materials and lectures as irrelevant and separate from their technicaldesign work.

Though no one component of our ethics curriculum is sufficient in itself, the combination of several has produced much valuable information that we did not have access to before. Initial feedback from students indicates that the lecture is effective in getting across the important information and in making clear what the students should focus on and apply in their own work. They have responded well to the relation of the moral decision making process to the design process. Students report having an easy time internalizing the moral decision making process when it is presented as a series of calculations made possible by a structured procedural model.We have implemented skill sessions—based closely on the ethics lecture—which develop in greater detail the main points of the lecture while adding an often intimate and open-minded discussion where students are free to explore and question multiple alternative choices. These sessions allow students to talk freely about their own thoughts about the examples given or even

to raise their own examples. The more intimate setting encourages students to engage in the discussion and ask questions. Perhaps most importantly, we have completed the assessment instrument and have determined it functions in the way we intended. We continue to implement this instrument with increasing numbers of students with the intention of showing validity and consistency over time. We have learned this is an ongoing process of continual improvement, and a process that requires extensive interaction with the students. As we continue to make improvements in our curriculum components it will be in close coordination with our students.

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Appendix

Learning Objectives

First Semester Students will:

1) Demonstrate awareness of ethical situations:

    a) As they relate to professional responsibility in general, such as Bribery, Fraud, Environmental Protection, etc.

    b) As they relate to design specifically, such as Inclusiveness, Fairness, Honesty in Research & Testing, Conflicts of Interest (Fledderman)[4].

2) Demonstrate awareness of ethical language, and be able to define certain terms:

    a) Value dichotomies: Good and Bad, Right and Wrong, Fact and Value, Ethics and Morals.

b) Social Context: Social Responsibility, Professional Responsibility, Moral norms.

3) Demonstrate awareness of multiple ethical frameworks, such as the following:
    a) Utilitarianism
    b) Duty Ethics
    c) Rights Ethics
    d) Virtue Ethics
4) Demonstrate awareness of the attributes of a profession (Martin & Schinzinger)[6]. A profession:
    a) Involves work that requires advanced expertise
    b) Allows for self-governing societies to set standards of conduct, usually with codes of ethics, and to enforce those standards.
    c) Involves activity that produces significant public good.
5) Describe the purpose of professional codes of ethics and their common components.
    a) Engineering majors will read their own discipline's code as well as the NSPE code.
    b) Other majors will read their discipline's code.

<u>Second and Additional Semester Students and Senior Design Students will also:</u>

1) Demonstrate ability to identify ethical issues related to a case or to the design of their EPICS project.
2) Demonstrate ability to identify the stakeholders involved in ethical issues related to a case or to the design of their EPICS project.
3) Demonstrate ability to identify at least two or more ethical frameworks and their value in the resolution of ethical issues related to a case or to the design of their EPICS project.
4) Demonstrate ability to identify a potential or actual ethical issue related to a case or to the design of their EPICS project.
5) Demonstrate ability to identify the value of their discipline's professional code of ethics (engineering students will read their engineering discipline's code as well as the NSPE code of ethics, other majors will read their discipline's code) as it relates to a case or to the design of their EPICS project.
6) Demonstrate ability to argue for a particular course of action in response to an identified potential or actual ethical issue related to a case or to the design of their EPICS project. Students will take into account the value of at least two or more ethical frameworks in addition to their professional code of ethics.