New Orleans JAZZED about Engineering Education

Paper ID #15856

Using the Engineering and Science Issues Test (ESIT) for Ethics Instruction

Ms. Alison J. Kerr, The University of Tulsa

Alison Kerr is a graduate student at The University of Tulsa. She is pursuing a doctoral degree in Industrial-Organizational Psychology. Her research interests include training development and evaluation as explored across a variety of academic disciplines and organizational settings. She is currently assisting on a number of training projects aimed at developing engineering students on relevant non-technical professional skills including ethical practice and presentation.

Prof. Bradley J. Brummel, The University of Tulsa

Dr. Brummel is an Associate Professor of Industrial/Organizational Psychology at The University of Tulsa. He received his PhD from the University of Illinois at Urbana-Champaign.He conducts research on training and development and individual differences in the workplace. He also investigates the use of role play simulations for teaching ethics.

Dr. Jeremy S. Daily P.E., The University of Tulsa

Associate Professor of Mechanical Engineering

Using the Engineering and Science Issues Test (ESIT) for Ethics Instruction

The purpose of this paper is to describe an innovative approach of ethics instruction for engineers. This approach used student responses to measure ethical perceptions and moral reasoning in order to guide an undergraduate course lecture and discussion on professional ethics in engineering. The paper begins with an overview of approaches to ethics education and the reasons for this new approach. Then the paper describes the measure and how the resulting data was used to facilitate discussion in a single class lecture on professional ethics. The lecture is presented as a case study to demonstrate how requiring students to complete a survey measure prior to instruction promotes added depth of awareness and salience to follow-up case study and lecture pedagogy. The resulting data was a quantifiable and visual representation of the complexity of ethical decision making and moral reasoning. The paper concludes with thoughts on the potential benefits of this approach and future directions for investigation.

Ethical Reasoning in Engineering

The need to respond to ethical dilemmas is important in many career fields. The presence of ethical decision making in medical or psychological professions may be more obvious to the general public than in engineering. Although the existence of ethical decisions may not be immediately recognizable in engineering, these dilemmas do exist. For example, a civil engineer may face environmental ethics decisions when designing a road that would cut through a mountain; or a mechanical engineer may be required to serve as an expert witness on a court case investigating the responsible party in a vehicular accident.[1,2] Thus, just as it is important to train engineers to perform the more obvious functions of their jobs, it is equally important to train engineers in responding to ethical dilemmas that they may face in their careers. Responding to ethical dilemmas involves ethical reasoning. LeClair & Ferrell state that this decision making in the ethics area should be the most important design goal in ethics training.[3] Making decisions in response to ethics based dilemmas involves cognitively processing through a variety of different options in order to determine the most appropriate course of action. Determining methods of ethics instruction that can actual enhance the decision making process presents certain challenges including actually presenting enough distinct processing options as well as providing enough opportunity to actual practice making decisions. Current options for ethics training are noticeably limited in these areas.

Approaches to Ethics Instruction

There are multiple methods of ethics training currently in use. When determining what should be included in ethics training, there are aspects of both the delivery and the content to consider. Delivery methods are often separated based on whether instruction is disseminated as part of stand-alone ethics course focused on either general or more field specific ethics or if it is delivered in an ethics-across-the-curriculum method which is essentially an integration of ethics content in otherwise technical skills courses. [4] Content options for either stand-alone courses or integrated instruction may include professional engineering ethical codes, theoretical reasoning and moral theories, humanist readings, case studies, ethical heuristics, or service learning[4].

LeClair and Ferrell propose that although lectures are the most common methods of ethics training, they represent a passive learning experience which may not be the best method for ethical training transfer[3]. A more effective method is to provide students with ethical situations and then require them to think about their feelings on the issue.[5] A meta-analysis of 26 ethics programs in the sciences found that the most successful ethics training programs were case-based and interactive. These programs allowed participants to learn and practice real-world ethical decision making skills.[6] The combined conclusion from these researchers indicates that a mode of teaching that has the potential to best achieve objectives is one where students actually examine ethical dilemmas and choices that go into making a sound ethical judgment in the field but are also required to make decisions and experience the feelings associated with their choice.

One of the most commonly used methods used to present students with an opportunity to examine ethical situations in detail is case-study training.[7] Case studies can be described as a method of training that involves trainees receiving written descriptions of real or fabricated field related dilemmas that they read and analyze to develop their ideas on solutions.[8] This method allows for participants to learn by developing their own solutions as well as an understanding of possible other suggestions when it is accompanied by discussions of solutions with others.[8] Including content that focuses on different options for addressing ethical problems and working through decisions may improve ethics instruction effectiveness.[6] A review of best practices in ethics trainings utilized in eight organizations in the Silicon Valley showed that the use of case studies in on the job training is one of the most prominent methods of ethics training.[9] Case study training allows participants to consider and discuss possible decisions, reasoning, and anticipated outcomes of the prescribed situations presented; and this enhanced interaction may allow for greater benefits of the training.[6]

Although, case studies present students with an opportunity to consider a real scenario, they are potentially limited in developing more applicable moral reasoning by the fact that a student only imagines how they would act but does not have to actually commit to a decision. Although there are a variety of instructional methods that can be used for engineering ethics teaching, the instructional strategies that are chosen need to support the learning objectives.[10] In ethics education, where the learning objective is for students to actually make ethical decisions in their career, the instruction must also must also include the student actually making decisions.

Another limitation to typical case study instruction is that students may not be provided enough exposure to the range of response options that may actually apply to the situation. Even when participating in discussions about cases, students may only be aware of a few possible response options. Responses may also be limited to the few that are most outwardly supported by the group discussion. If this happens, then students may not truly be able to learn how their own decision might compare to the true range of their peers' approaches or whether their own approach would alternatively be successful or considered ethical. This limitation allows for an opportunity to enhance the case-study based training approach and related lecture teaching methods. Students need to experience the reality that responses to ethical dilemmas are not always straightforward. To do so they require exposure to a broader array of issues that make a dilemma a true problem and how different emphasis given to these related issues will influence the resulting choice of response. This paper discusses an approach to enhancing the ethics lecture

and case-study approach to ethics instruction by using preliminary measurement to present resulting data aimed at enriching the student learning experience.

Preliminary Measurement Approach

During the 2015 spring semester at a small Midwestern university, the authors explored how the Engineering and Science Issues Test (ESIT) could be presented to facilitate a professional ethics discussion for students participating in an undergraduate engineering course. The ESIT was created by researchers at Georgia Tech as a science and engineering specific adaptation of a widely used assessment of moral reasoning, the Defining Issues Test (DIT-2).[11,12] Students were asked to complete a survey including the ESIT prior to a course integrated lecture. Then, data was used from the survey in effort to expose students to a more personalized and germane case-study based ethics lecture. The survey-informed ethics lecture was integrated into a broader upper-level mechanical engineering course which had 70 students.

In addition to the ESIT, the survey included several extra questions to help establish the extent of the students' ethical education and comprehension. A series of questions asked students about the degree of their awareness of field related ethical dilemmas as well as their confidence in being able to respond to such dilemmas. Also included were two open-ended questions which asked students to define the resources they would use in making ethical decisions and to provide a definition of ethics in their own words. These additional questions were asked prior to the ESIT portion of the survey.

Students completed the survey two weeks before the scheduled ethics lecture. All students were given a link to the survey to be completed online in their own time that week. Students were given participation points for completing the survey but were not graded on their responses. The survey took approximately 40-60 minutes to complete. The survey yielded 61 usable sets of responses.

As mentioned above, the survey consisted of three components used in the lecture: a series of ethics awareness and efficacy questions, two open response questions, and the ESIT moral reasoning measure.

Ethics awareness and efficacy questions were on a 5-point scale asking students to respond with the extent to which they agreed with each of the following five statements:

1. *I am aware of what the ethical guidelines for the field of science and engineering encompass.*
2. *I am confident in my ability to act ethically in my field of science and engineering.*
3. *I think at times it will be challenging for me to make ethical decisions in science and engineering.*
4. *I think ethical dilemmas in science and engineering can be unclear at times.*
5. *I think ethical decisions in science and engineering are usually easy to make.*

Open-ended questions were as follows:

- *What are some resources you would consider in determining what constitutes ethical practice in science and engineering?*
- *In your own words describe what it means to practice ethical behavior in the field of science and engineering.*

The ESIT consists of descriptions of six science and engineering related case-based moral dilemmas and 12 corresponding questions that present judgments representing three levels of moral reasoning schema. For each of the six dilemmas, students rate the 12 associated questions on how important they are towards making a general decision about how to respond the ethical dilemma. Next, students rank the four questions that they deem most relevant to making the decision. The ESIT may be scored similarly to the DIT-2 with two main scores that reveal the presence of postconventional reasoning in relation to preconventional reasoning. Neither of these optional scores was calculated for use in the instructional lecture, instead, the general response decisions for the individual cases as well as the associated 12 issue average ratings of moral schemas were used to make the data more directly meaningful to the students.

As an example of the general case scenario that the students are presented the following is Scenario 1 from the ESIT:[11]

> *Engineer Jameson owns stock in RJ Industries, which is a vendor for Jameson's employer, Modernity, Inc., a large manufacturing company. Jameson's division has been requested by management to cut one vendor: either RJ Industries or Pandora Products, Inc. Pandora Products makes a component that is slightly higher in quality and slightly more expensive than that made by RJ Industries. Management and the other engineers in her division do not know that Jameson has a financial interest in one of the two vendors.*
>
> *Should Engineer Jameson participate in the vendor decision?*
>
> - *Should participate in the decision*
> - *Can't decide*
> - *Should not participate in the decision*

The Educational Ethics Lecture and Discussion

The data obtained from these measures was analyzed and used to create an ethics lecture one week after the students completed the survey. For the lecture, after the instructor introduced himself, the students were presented with the results of each survey component as well as basic field related ethics instruction. The elements of the survey results and how they were used in the lecture are detailed as follows.

For an introduction to ethical dilemmas in the field of science and engineering the responses to awareness and efficacy questions were presented. The five questions and the mean responses are presented in Table 1. The response averages to all five questions were presented as a bar graph.

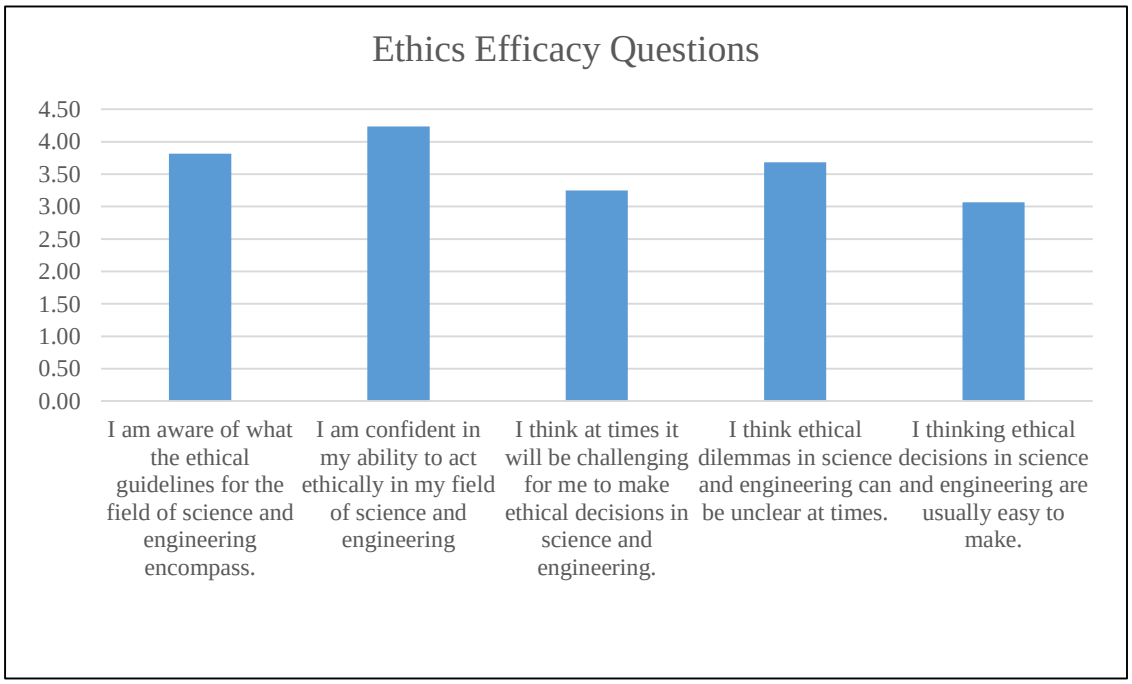
All averages were above a 3 indicating that there was general support for each. Interestingly, questions 3 and 5 asked about ethical decisions being either challenging or easy to make and both question response averages were close to the middle "Neutral" response. These items also had higher standard deviations than the other questions which may be an indication that students were not sure how to answer the question or that opinions varied widely. This lack of agreement as to whether ethical decisions are expected to be challenging or easy was the first indication that professional ethics in science and engineering may not be as exact as one might believe.

Table 1. Awareness and Efficacy Questions

Item no.	Statement	*M*	*SD*
1	I am aware of what the ethical guidelines for the field of science and engineering encompass.	3.82	.68
2	I am confident in my ability to act ethically in my field of science and engineering.	4.23	.67
3	I think at times it will be challenging for me to make ethical decisions in science and engineering.	3.25	1.26
4	I think ethical dilemmas in science and engineering can be unclear at times.	3.68	.95
5	I think ethical decisions in science and engineering are usually easy to make.	3.07	1.07

Note. Ratings on a 5-point agreement scale: 1 = "Disagree", 2 = "Somewhat Disagree", 3 = "Neutral", 4 = "Somewhat Agree", 5 = "Agree Completely".

Figure 1: Awareness and efficacy questions as displayed in lecture



As mentioned, students also responded to the two initial open-ended questions which asked them to frame their own understanding of ethical practice in their field. The first question asked students about what resources they would use to determine ethical practice. For this question, 49 students submitted a response. To present these answers during the lecture, all responses were compiled on a single PowerPoint slide. A selection of responses were colored so that they would stand out and so that they could be highlighted during the discussion. The intention was to highlight the variability in responses and to provide a good representation of the responses that were given most frequently. Table 2 presents the highlighted response examples.

Table 2. Open-ended Resource Highlighted Responses

Question: What are some resources you would consider in determining what constitutes ethical practice in science and engineering?
ASME ethical practice standards
Probably what my church teaches on it. The internet? What the government says about research ethics.
Google
I would go check ASME standards
Professors
Accountability, Potential Conflicts of Interest
I don't know
Personal conscience, as well as any regulations that you are required to follow, since not following regulations is unethical
Common sense

Following the presentation of resource responses, the lecture shifted to ethics instruction focusing on ethical code content. Content of the lecture focused on an overview of The American Society of Mechanical Engineers (ASME) Code of Ethics of Engineers including the Fundamental Principles and Fundamental Cannons. The intent of this portion of the lecture was to emphasize the somewhat blurred distinction between the personal and subjective values that drive moral decision making and the field specific guidelines which form the basis of ethical practice[13].

Following the ethics instruction and overview of the ethical codes of engineers, the second open-blank question responses were presented. A total of 59 students wrote a response to this question. Again, all responses were compiled onto PowerPoint slides and different quotes were colored to draw attention to the variety and range of response that were represented in the class. All highlighted example responses are presented in Table 3. Discussion centered on the variety of answers and how these answers aligned with the ethical codes just presented.

Table 3. Open-ended Ethical Practice Highlighted Responses

Question: In your own words describe what it means to practice ethical behavior in the field of science and engineering.
Keeping not only the customer's personal interests in mind but also being able to back up your own claims and practices that may affect an outcome of a moral or ethical decision.
Put your product before your wallet. Science and engineering are usually higher paid positions, and it could be easy to find the cheap, simple solution without considering much of long-term effects associated with your decisions.
To put forth all commonly accepted ethical standards before any other motives.
Practicing ethical behavior in science and engineering is using your best judgement in everyday actions. These actions should not conflict with the university code of conduct. Basically, do not cheat, take credit for someone else's work or findings, or use sources in any way that would be considered cheating the system.
To not falsify any data, approve designs that could be potentially harmful, or only accept projects/designs they are qualified for
To be a good person, try to deal all the people kindly and equally and do not differ anyone.
It means doing unto others that which you would have done unto your self. It means putting the safety of other human beings before the deadlines, budgets, and bosses of your project.
To be honest to yourself, co-workers, and other members in the field. Practicing ethical behavior is being responsible with your ideas and the ideas of your company and not violating any contracts undertaken.
To act in a way that provides clients and fellow engineers with explained and examined work that functions correctly or supersedes expectations. One must be compliant with both legal code and moral code when acting in the field of science and engineering.
Practicing ethical behavior in science and engineering means always telling the truth, even if it makes things more difficult for you or your company. Also, it means acting in the interest of safety for the general population, as well as following governmental or other regulations, even though this probably costs more money.

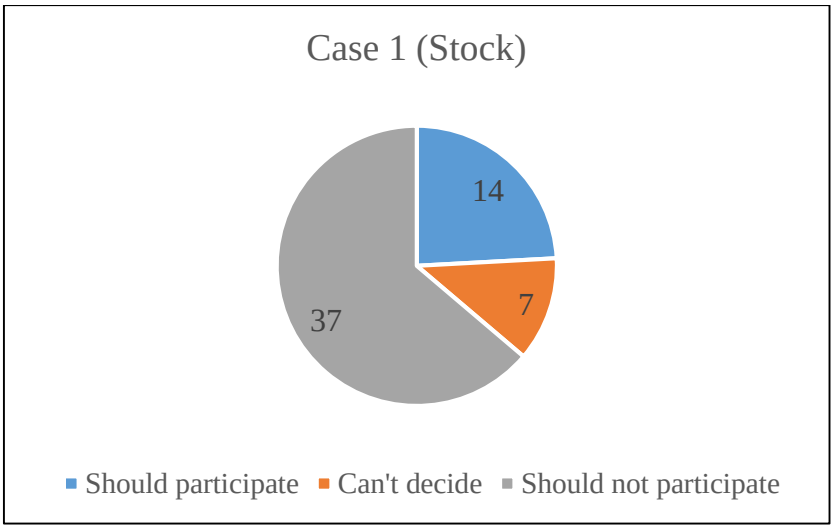
After priming students with the results of the general approach to ethical decision making and open-ended questions, the instructor then presented select results from the ESIT measure and facilitated commentary and discussion on each individual case. For each case the description of the scenario was first reviewed. Then, the results of the class breakdown of the general response decisions were displayed. Last, the average importance rating for each of the 12 corresponding moral reasoning issues were presented with focus on the different moral reasoning approaches.

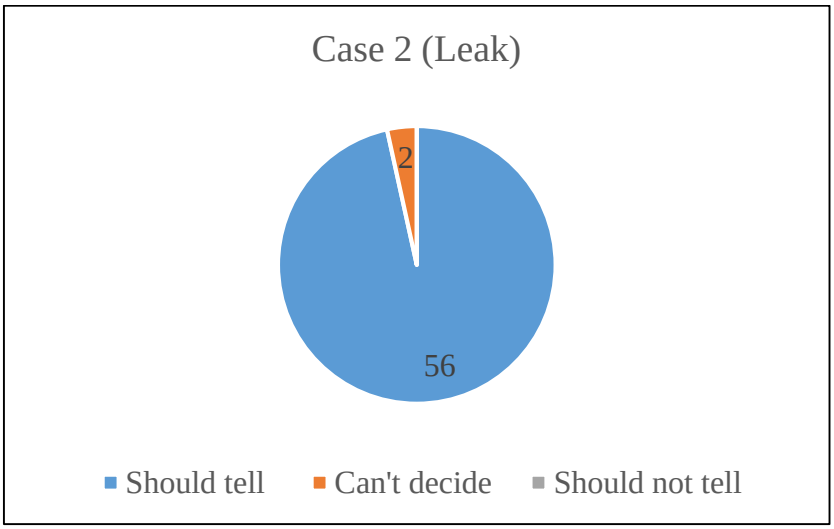
One of the purposes of presenting students with case-studies is to expose them to the potential for ambiguity in determining how to respond. Each of the six ESIT scenarios was created to present a dilemma that does not have a single option for response. After reading a scenario, the respondent is asked to check one of three options for what they think the response should be: two options are opposing response behaviors, the third is “can’t decide.” This general response

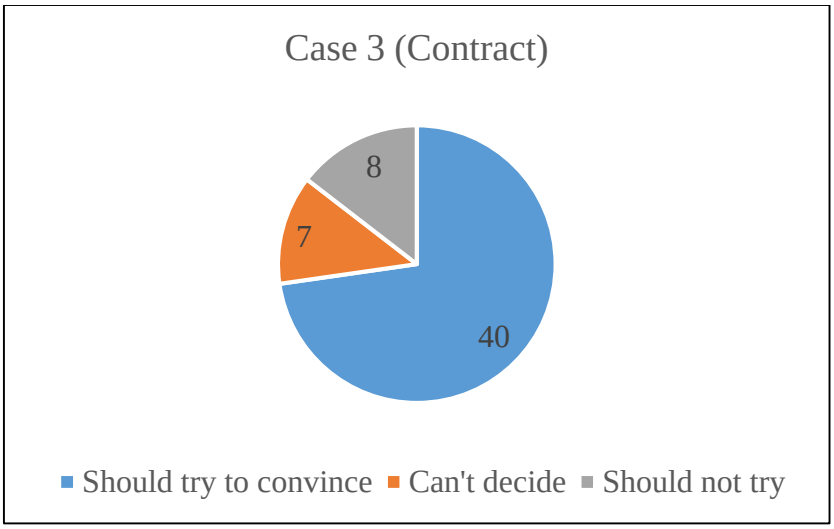
decision is not scored under the ESIT but is intended to provide the foundation for the subsequent 12 issues which are judged on how they are related to making that decision. For this case-study's use of the ESIT, students were actually asked to actually submit an answer to the general response options for each scenario. This allowed for the presentation of the results of the initial class reactions to the different case dilemmas.

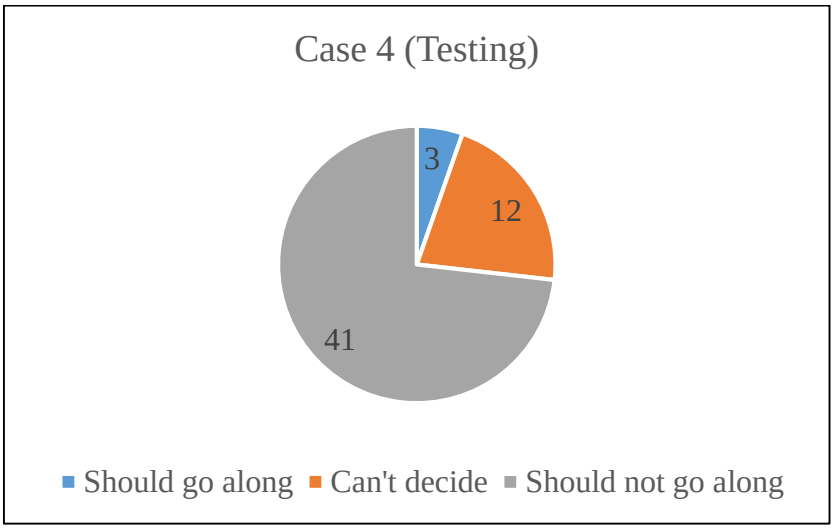
By totaling the survey responses to the three options for each scenario, we were able to present a quantified and visual representation of the ambiguity of the dilemmas. For the ethics lecture, we presented the general response data using pie charts. Figures 1-6 display the pie charts for all six scenarios.

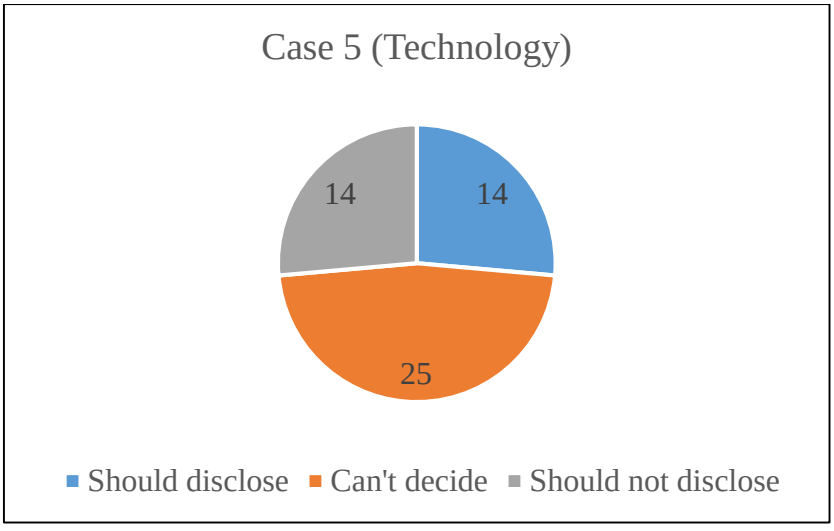
Figures 1-6. General response breakdowns for each of the six ESIT scenarios.

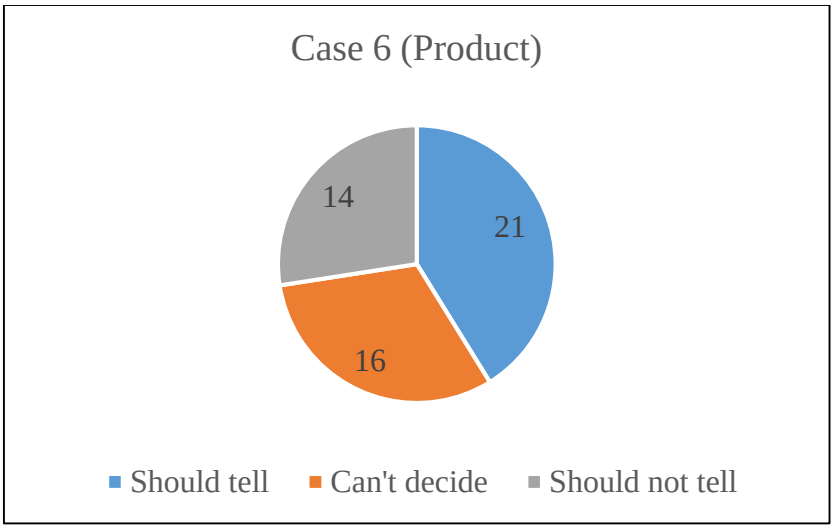





Case 3 (Contract)
8
7
40
Should try to convince
Can't decide
Should not try


Case 4 (Testing)
3
12
41
Should go along
Can't decide
Should not go along


Case 5 (Technology)
14
14
25
Should disclose
Can't decide
Should not disclose



By displaying the responses in this, way it was possible to lead a discussion on how the appropriate response is not always clear. As represented by the data, some dilemmas seemed to have a more clear resolution than others. This is shown by contrasting the almost unanimous decision in Case 2 with the more evenly distributed responses in Cases 5 and 6. It is also worth noting that the Case 5 had a comparably large percentage of "can't decide" responses. Obtaining these results of the pre-lecture survey made it possible to highlight how many students were uncertain about how to respond to the dilemma and how those that did responded were not always in agreement. This made it possible to display the actual ambiguity and challenges that may exist in ethical decisions and give greater saliency to the use of case-studies to highlight the haziness of what truly constitutes ethical practice.

After the general response proportions were presented, the 12 related situational issues for each case were displayed in the lecture. These issues are presented in the ESIT as questions that may be potentially relevant to determining what general response decision to make for the associated situation. Each set of 12 issues represented a mix of the three moral reasoning schema as well as six nonsensical issues which were dispersed throughout the six cases. The three representations of schemas are intended to assess three levels of moral reasoning based on an interpretation of Kohlberg's hierarchy of moral development. In ascending order, the schema levels are preconventional, conventional, and postconventional reasoning. Preconventional represents the lowest level of thinking which concerns only aspect which have a directly personal impact. This is essentially an "all about me" mentality. Conventional reasoning at the next level involves an adherence to societal norms and the laws and guidelines created to enforce them. Postconventional morality is the highest level under the neo-Kolberg standards and is presented as a consideration for the greater good of society. In Kolbergian theory the goal of moral development is to seek to achieve the highest level of postconventional reasoning.[11,12]

Students were asked to rate the issue questions in terms of importance to determining a general response. Ratings were on a 5 point scale with 1 = "Great importance", 2 = "Much importance", 3 = "Some importance," 4 = "Little importance", 5 = "No importance". Lower responses represented greater importance. For each case, all 12 issues were presented in the lecture on a

single slide along with the associated class average importance rating. The different reasoning schema were color coded so that each category was easily identifiable. Figure 7 provides an example of how the issues and associated class average ratings were presented in the lecture. Students were asked to comment on why they thought the class found different issues to be more or less important when making the decision. Students indicated that they wanted more information to make choices on some of the cases. This subsequently led to a discussion of specific rules and laws compared with what was the right thing to do morally in addition to ethically for some of the cases.

Figure 7. Display of the 12 moral reasoning questions associated with Case 1 of the ESIT with average responses as presented in lecture.

1. Would the process be more or less fair if she discloses her financial interest?	2.1
2. Is it required by law that she report that she owns the stock?	2.0
3. Is the transfer from vendor to customer inherently efficient?	*3.1*
4. If she participates in the decision, would Jameson be undermining the credibility of the engineering profession?	2.1
5. What does the code of ethics of the National Society of Practicing Engineers (NSPE) have to say?	1.9
6. Would disclosing her financial interest help Jameson's career?	**3.1**
7. Would Jameson's coworkers be angry if they learned of her financial interests in the decision?	**3.3**
8. Is now a good time to buy Pandora stock?	*3.9*
9. Does Jameson have a professional duty to participate in the decision, no matter what?	2.6
10. How much would the value of Jameson's stock decrease if RJ Industries is cut	**3.5**
11. If Jameson remains silent, will RJ Industries hire her in the future?	**3.6**
12. Will Jameson's decision potentially cause harm to the public?	2.1

Note: Schema coded as bold = preconventional, black = conventional, underlined = postconventional, and italics = nonsensical.

Theoretical Benefits of this Approach to Ethics Instruction

In all methods of training, determining a starting place and an objective is valuable. Without determining what the preliminary understanding of trainees is, it is difficult to determine what still needs to be learned and potentially impossible to show that any learning has occurred. By asking students to respond to the preliminary survey questions in their own words prior to introducing the ethics material, they were potentially better equipped to be aware of what their own base understanding of ethics resources and practices were in order to comprehend how the lecture information fit into or required an expansion of their individual schema.
Requiring students to complete a measure prior to the ethics lecture meant that students actually had to make decisions about cases instead of just declaring general intentions of doing the right

thing. The resulting data provided a quantitative portrayal of the real disagreement in responses and the inconsistency in decision approaches within the class population. Additional survey items which asked students to define ethics and to list the resources they would use to make decisions also helped demonstrate the obscurity of ethical dilemma approaches. The complete survey made it possible to convey the reality of how challenging ethical decisions truly are. As a result, this case-study illuminates an innovative and salient approach to ethics education.

Future Directions

There are a number of next steps which can be taken to further develop and understand how the ESIT measure can be used in this type of informed instruction. For this particular lecture, students were not given their individual responses on the day of the lecture. As a result, they could only relate what they could remember about their own responses and the impressions they formed while reviewing the scenarios to the overall data presented. In some ways, this negates the purpose of requiring them to make a decision. Even though they had made a decision on the survey, if they cannot remember the exact one they made then they may be at no more of an advantage than if they were just being exposed to a typical case-study based lecture. This also means they were less prepared to calibrate any shift in their reasoning triggered by learning about the ethical standards of their field. To further enhance the recognition of how the student's immediate responses to the scenarios compare with the members of their peerage as well as the trained ethical standards, students could be given their complete set of individual survey responses for use during the lecture.

Another possible advantage of using the ESIT as a developmental tool not explored on this occasion is for students to be provided their overall ESIT scores to gain a unique interpretation of their general moral response processes. The ESIT was created to be scored similarly to the DIT-2 with two main scores (the P-score and the N2) [11]. These scores were not used in the lecture as they do not include general response decisions nor do they include the conventional reasoning schema which is relevant to ethical codes and guideline. Additionally, these scores aggregate the scores of all six scenarios which excludes one of the benefits of the ESIT as it was used in this lecture which is that the individual cases provide a wealth of information when discussed as discrete scenarios with unique response outcomes. Also, both ESIT total scores are complex computations which may be overly confusing to students where the goal is to present more salient information that can be readily understood. Still, the scores might be used to enhance the student's awareness of their overall achievement of higher moral reasoning and how this influences their discrete decisions.

Another option that could also be explored with more complex data analysis is to determine class correlations between general response decisions and the associated moral reasoning schema. The correlations might be used to show how "tougher" decisions are associated with different reasoning and concerns. One of the interesting discoveries coming out of the review of the ESIT as a set of case-study based decisions and moral reasoning is that there was not agreement on the general response decisions and this lack of agreement varied by degree for each case. This implies that while we can display that students have varying approaches to ethical dilemmas we might also consider how the dilemmas alone may also present variation in degree of difficulty and clarity. It would be interesting to compare the level of agreement (or lack of) to the averages

of the scores on the different types of moral reasoning. For an example with Case 2, there was almost complete agreement with the general response decision. Looking at this closer it may be that the scenario provided a more apparent issues of concern or incited a more prominent reasoning response (e.g., postconventional schema).

Another question that could be asked in regard to the scenarios which lacked agreement are if this related to more ambiguity in field specific codes and rules as opposed to higher order moral interpretations. Of the three moral reasoning schema assessed in the ESIT, science and engineering standards might best be interpreted as conventional reasoning where assessments of "the greater good of humanity" are represented in postconventional schema. Correlating something like prior ethics education with moral reasoning response decisions and ratings might provide information about how moral reasoning might be adjusted with exposure to field specific ethical standards and expectations. Presenting such correlation analyses could add to the understanding of what makes ethical dilemmas more or less challenging and how knowledge of professional ethical standards might influence response decisions.

Finally, the impact of this pre-loaded survey approach to ethics education should be compared to other educational approaches to assess the learning outcomes and the relative ease of use in order to help educators make informed decisions about their own approaches to engineering ethics pedagogy. This paper is presented as an exploration of how a preliminary survey and the ESIT might be used to provide additional support for traditional ethics pedagogy. To further explore the impact of this approach, student reactions and learning should be evaluated. The efficacy and open-ended questions which were asked along with ESIT could be useful in understanding the educational impact if they are also used in a post-lecture measure. It would be necessary to consider whether providing information about the complexity of science and engineering related ethical dilemmas would be expected to increase the student's confidence in their ability to navigate such problems, or if this knowledge would enhance their awareness of the true challenges they might encounter and reduce their belief in the simplicity of making such decisions. Ultimately, the goal of comparing this augmented method of case-study based lecture to more traditional methods would be to determine if a preliminary survey enhances the student learning experience so that they are better prepared to recognize the issues related ethical dilemmas, make informed decisions, and respond appropriately when faced with problems during their careers. This case-study explores a potentially useful and innovative approach to ethics education in science and engineering and further use and investigation of this method might offer an important contribution to the understanding of ethics pedagogy.

Acknowledgements

This material is based upon work supported by the National Science Foundation under Grant Number (1338638).

Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Bibliography

1. Brummel, B. J., & Daily, J. S. (2014). Developing engineering ethics through expert witness role plays. *Proceedings of the American Society of Engineering Education Conference 2014*.

2. Brummel, B. J., Daily, J. S., Stauth, J. T. (2015). Guidelines for constructing expert witness role plays for engineering ethics. *Proceedings of the American Society of Engineering Education Conference 2015*.

3. LeClair, D. T., & Ferrell, L. (2000). Innovation in experiential business ethics training. *Journal of Business Ethics*, *23*(3), 313-322.

4. Newberry, B. (2004). The dilemma of ethics in engineering education. *Science and Engineering Ethics*, *10*(2), 343-351.

5. Fly, B. J., van Bark, W. P., Weinman, L., Kitchener, K. S., & Lang, P. R. (1997). Ethical transgressions of psychology graduate students: Critical incidents with implications for training. *Professional Psychology: Research and Practice*, *28*(5), 492-495.

6. Antes, A. L., Murphy, S. T., Waples, E. P., Mumford, M. D., Brown, R. P., Connelly, S., & Devenport, L. D. (2009). A meta-analysis of ethics instruction effectiveness in the sciences. *Ethics & Behavior*, *19*(5), 379-402.

7. Herkert, J. R. (2000). Engineering ethics education in the USA: Content, pedagogy and curriculum. *European Journal of Engineering Education*, *25*(4), 303-313.

8. Goldstein, I. L., & Ford, J. K (2002). *Training in organizations* (4th ed.). Belmont, CA: Wordsworth.

9. Sekerka, L. E. (2009). Organizational ethics education and training: A review of best practices and their application. *International Journal of Training and Development*, *13*(2), 77-95.

10. Li, J., & Fu, S. (2012). A systematic approach to engineering ethics education. *Science and Engineering Ethics*, *18*(2), 339-349.

11. Borenstein, J., Drake, M. J., Kirkman, R., & Swann, J. L. (2010). The engineering and science issues test (ESIT): A discipline-specific approach to assessing moral judgment. *Science and Engineering Ethics*, *16*(2), 387-407.

12. Rest, J. R., Narvaez, D., Thoma, S. J., & Bebeau, M. J. (1999). DIT2: Devising and testing a revised instrument of moral judgment. *Journal of Educational Psychology*, *91*(4), 644-659.

13. Davis, M., & Feinerman, A. (2012). Assessing graduate student progress in engineering ethics. *Science and Engineering Ethics*, *18*(2), 351-367.