

## **The Development and Evaluation of Expert Witness Role Play Instruction for Teaching Engineering Ethics**

**Ms. Alison J. Kerr, 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, 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 with a specific focus on professional development, ethics, and coaching.

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

Jeremy Daily is an Associate Professor of Mechanical Engineering at The University of Tulsa in Oklahoma where he is researching Traffic Crash Reconstruction, Vehicle Digital Forensics and Commercial Vehicle Cyber Security. He teaches Automotive Design, Machine Dynamics, and Finite Element Analysis. A couple years ago, Jeremy was able to transition some of the University research on heavy vehicle digital forensics to practice by starting a technology company, Synercon Technologies, LLC.

# **The Development and Evaluation of Expert Witness Role Play Instruction for Teaching Engineering Ethics**

It can be a daunting challenge to effectively evaluate ethics training programs<sup>1,2</sup>. There are numerous options for evaluation, outcomes, and approaches<sup>1,2,3</sup>. However, there are also limited resources that can be dedicated to evaluation<sup>2,4</sup>. In many cases, assessments are simply conducted by determining whether a school or organization has any ethics training program<sup>4</sup>. If a training program is being conducted, additional assessments may involve determining what type of instruction is used, how frequently it is conducted, or at what point the trainee must complete the program in their career. Evaluations beyond this may focus on how well the program actually works or if it is effective in eliciting behavior change<sup>2</sup>. A common evaluation of effectiveness is to determine how trainees react to the training experience, the content of the program, or the instructor delivery<sup>1,3,5</sup>. It is difficult and rare to evaluate how well ethics training actually develops a trainee's ethical reasoning or behavior change<sup>1</sup>. However, evaluating training programs can help provide useful information which can be used to help make decisions about the training program<sup>1,5</sup>. Decisions may be very broad such as whether or not to keep conducting the program or they may be more specific such as how to improve the program and what elements should be enhanced<sup>5</sup>.

This paper demonstrates how the authors evaluated a specific engineering ethics training program. The program utilizes expert witness role play instruction and various evaluations of the complete training program were conducted over the course of a number of years of implementing the instruction. This paper illustrates how the formative evaluations were used to make decisions about modifying the program and how summative evaluations provide conclusions about its overall effectiveness. The review of these methods and decisions may serve as a useful model for other educators as they develop and adapt professional ethics training programs to different students with varying resources and goals.

## **Expert Witness Role-Play Ethics Training**

For the past six years, the authors have incorporated an ethics component in an undergraduate mechanical engineering course at a small Midwestern university. The ethics instruction involves asking students to act as an expert witness in a legal action simulation where they perform engineering analyses, write a report, and defend their findings in an oral interview. The role-play experience is intended to emphasize ethical decision making while at the same time requiring technical competence, professionalism, and communication. This is a unique approach to ethics instruction which actually requires students to experience what it feels like to be expected to act like an expert in their field while at that same time being faced with an ethical dilemma, ambiguity, and pressure.

For the first four years, this program was conducted with only a small group of students. The total four-year sample was 48 mechanical engineering students. This averaged about 12-15 students per year. During these years, the ethics instruction was conducted as a collaboration with law students in which groups of 4 students (2 engineer, 2 law) performed in a mock deposition with each participant being assigned as either the prosecution or the defense in a simulated court case. Engineering students took the role as the expert witnesses on opposite sides of the court case. They were expected to create a report which analyzed a two car collision

scenario and provided conclusions on the cause of the accident (e.g., the speed of the vehicles). They then defended their conclusions under the pressure of the law students. During these years of using this method of providing ethics training, the program was evaluated in two ways. The first was by video-taping the interviews and coding the behaviors of the students to determine how they performed. The second was by having the students complete a reactions survey after their experience. Reactions to the experience were generally positive with students enjoying the experience and thinking it was worth doing. Some of these results have been described in more detail in other publications<sup>6,7,8</sup>.

In the planning for year five of the expert witness training, several changes were planned with respect to the simulation scenario, the method of the role-play, and the evaluation of the program. First, in effort to gain a larger archive of scenarios which could be used for this type of role-play, the instructors created a new lawsuit dilemma which involved a car lift collapse accident. A second program change was also implemented due to the size of the engineering course increasing dramatically when over 60 students enrolled. The instructors responded to the challenge by adjusting the method of the role play to no longer be a group interaction but simply focus one student interviewing at a time. Also, in attempt to systematize the experience, the plan was for the engineering students to no longer be interviewed at random by law students also participating in a role play simulation; but instead, all students would be interviewed by one of three possible interviewers who merely acted the part of lawyer and followed a semi-structured interview protocol. Finally, with the goal of determining if the changes in the role play simulation and procedure were still effective in training on ethics and if so, in what ways, the evaluation method was changed to include a pre-test, post-test assessment of the students' perceptions of ethics in addition to their reactions.

In year five, the planned lift collapse scenario was pulled due to concerns with the identifiability of the participants in the actual case. However, the pre-test survey was administered and the data proved information as a method of understanding the base level of students' comprehension and perceptions of ethics within their field. This data was used to enhance a single lecture on ethics to the class in lieu of the role play instruction<sup>8</sup>. This data was also used to inform the following year's instruction procedure and the evaluation plan.

In the most recent sixth year, the authors conducted the most intensive and full scale training yet. Because again there was a challenge of scale with over 70 students enrolled in the engineering course, the decision was again to focus solely on engineering students rather than to collaborate with law students. Additionally, in attempt to make the experience more consistent and representative of a real simulation the interviews were structured as though the students were being questioned as if the "lawyers" were trying to determine if they wanted to hire them as their expert witness and to potentially put them on the stand at a later date. To further the fidelity of the interview, students were asked to submit a resume and to indicate what their fees would be if they were hired. Students asked for things such as an A in the course, 12 dozen home-made cookies, and an all-expenses paid trip to Scotland. The part of the "lawyer" for this year was played by one of three individuals prepared and experience with interviewing and the method of role-play instruction. The roles of "lawyer" were played by the course instructor, a research assistant, and an engineering professional. Interviews were run with one student and a panel of two or three of those designated "lawyers."

For evaluations in year six, the goal was again to attempt to conduct a pre-test, post-test assessment. However, as an additional step to the instructional procedure, after all of the students were interviewed, several small group debrief sessions of 12-15 students were also planned in order for students to have assistance in making sense of their experience and applying it to their future career. With the new addition of a group debrief, assessments were split into three separate surveys. First a pre-test was administered which contained a series of questions intended to assess what students might know about ethics in their field and the degree to which they felt prepared to respond to ethical dilemmas they may face. Then, after the students participated in the expert-witness interview, they were asked to complete a reactions survey similar to the reactions survey from previous years. Finally, after the group debrief, a final post-test survey was administered in which students responded to the same questions as in the pre-test and also provided responses to a series of reaction questions which targeted either the group debrief or the overall ethics instruction method and procedure.

Essentially, the evaluations for the sixth year were intended to be both formative and summative. The formative evaluations were intended to gather information about the program which could be used to make decisions about whether the process was effective and worth continuing and how it might be further improved. The summative evaluations were focused on determining if the method of instruction actually yielded change in the students' understanding and awareness of ethics in their field.

### **Formative Evaluations for Program Enhancement**

In the sixth year, with so many changes, one of the driving purposes behind evaluation efforts was to determine the answer to the following question:

- If the role play simulation was altered to an expert witness interview instead of a mock deposition could it be just as good?

More specifically, the hope was to determine if it could compare to the previous years in the following ways:

- Would it be as liked?
- Would it be viewed as useful?
- Might it be better?
- Might it be seen as more applicable?

In order to determine if this new interview only method of role-play was as effective as the previous procedure, the authors first wanted to examine the results of the student reactions to the experience and when possible to compare these results to the previous student sample reactions. Because the year six process included an expert witness interview role play but was also followed by a group debrief, the evaluations included two rounds of reaction surveying: The first was focused on reactions to the interview experience and the second was to gain information about the added group debrief component and the overall semester experience. In comparing reactions to previous years it was necessary to consider how the reactions from prior years were limited to only the role-play whereas the sixth year had several additional components.

## Student Reactions to the Role Play Experience

To begin, the need was to understand how students reacted simply to the expert witness role play. The belief was that changing the simulation from a mock deposition with law students to a selection interview with a panel of consistent “lawyers” would enhance the student’s experience. The reactions obtained on the first survey were intended to target the same portion of the experience as in prior years. The first reactions survey included questions asking students to provide ratings on various aspects of their interview experiences in addition to questions which were open-ended and allowed for students to provide their own unique information about their experience. Some of the questions used in this survey were the exact same as in previous years. Other questions were similar but had minor changes in wording or asked for ratings on a different scale. These adjustments we made to allow for more precise interpretation of the ratings by target. Several additional questions were also added.

Perhaps the most informative reactions questions are the ones which address whether or not participants enjoyed it and if they found it helpful. These questions are generally viewed broadly as simply a form of reaction but some researchers find it valuable to consider satisfaction and utility questions as two separate assessment<sup>9</sup>. Two questions were asked which directly addressed the satisfaction with the experience and perceived utility aspects. The questions are as follows:

- *Did you enjoy participating in the expert witness interview?*
- *How useful was participating in the expert witness interview?*

For the first satisfaction question, participants responded on a 4-point scale from “no, not at all” to “yes, definitely”. Results showed that students tended to enjoy the exercise with a mean rating of 3.43 ( $SD = .68$ ).

Utility reactions were obtained from students responding to the question on usefulness. Usefulness was also rated on a 4-point scale with ratings from “not at all useful” to “extremely useful”. Results showed a mean rating of 3.19 ( $SD = .67$ ).

As an additional measure of utility reactions, two questions were asked regarding the degree to which students felt the experience helped them develop the skills they needed to recognize and respond to ethical dilemmas. The two questions are as follows:

- *Through this exercise, I was able to develop skills I might need to recognize an ethical dilemma during my career.*
- *Through this exercise, I was able to develop skills I might need to in order to respond to an ethical dilemma during my career.*

These questions were also rated on a 4-point scale with the extent to which they felt the experience developed the skills they need to both recognize and respond to ethical dilemmas in their career. The mean rating of skills needed to recognize an ethical dilemma was 3.55 ( $SD = .61$ ). The mean rating of skills needed to respond to an ethical dilemma was 3.49 ( $SD = .68$ ). Both these ratings indicate that students generally agreed that the experience helped them develop the skills they would need to recognize and respond to ethical dilemmas in their career. This is an important finding because it is often challenging to assess how trainees actually

behave after a training especially as concerns ethical practice<sup>1</sup>; however a notable meta-analysis of training reactions has demonstrated evidence that participant post-training reactions, especially utility reactions, do show some correlations with post-training behavior<sup>10</sup>. This may be due to the participants' willingness to adjust their behavior if they see the utility of it in the training. While these meta-analytic relationship results between reactions and post-training behavior are not explicitly ethics training related, there is reason to believe that the positive reactions these students had in this particular training may indicate a future willingness to behave in a more ethical manner.

The results of these initial ratings of the role play experience indicate that students generally found the experience both enjoyable and useful. This information helps indicate that the sixth year's changes with respect to the scenario and interview procedure did not negatively impact students' general perceptions of the program. However, because these questions provide little information about how the program might be improved, student opinions concerning this topic were further solicited with a number of additional question items.

### **Representative of a Real Experience**

In order to determine if students felt that the role play provided an authentic feeling simulation experience, students were asked to rate various aspects of the experience as well as provide reasoning for their responses. First, students were simply asked: "*Do you believe the scenario was representative of a real expert witness interview?*" Students responded to the questions with either "yes", "no", or "somewhat". Of the 49 responses received, 55% said "yes", 41% said "somewhat", and only 4% or 2 responses were "no". This question was followed by an open-ended response opportunity. As the purpose was to identify how the program could be improved, responses to the first questions that were either "no" or "somewhat" were particularly noted. A sample of the responses are provided in Table 1.

To further examine the fidelity of the simulation in providing a more generalizable ethical dilemma and not just a legal focused simulation, students were also asked to rate the degree to which they felt the role play was representative of a real ethical dilemma by responding on a 4-point agreement scale to the question: "*The interview allowed me to experience an ethical dilemma as it might actually occur.*" Agreement showed a mean rating of 3.57 ( $SD = .61$ ) indicating that students at least felt they had experienced a realistic ethical dilemma. This was important to note as the goal of the role-play is for students to actual feel like they experienced a dilemma.

Additional questions were used to determine specifically if the interview simulation provided a challenge and if there was any evidence of this challenge. The following three questions were used:

- *How difficult was communicating your analysis results verbally in the interview?*
- *During the interview, did you ever consider modifying your conclusions to meet the demands of the "lawyer"?*
- *During the deposition interview, did you modify any of your conclusions to meet the demands of the "lawyer"?*

For the first question concerning the difficulty of communicating their analysis verbally, the question was rated on a 4-point scale from “not difficult at all” to “extremely difficult”. Results showed a mean rating of 2.35 ( $SD = .69$ ), indicating that, on average, students found it to be at least somewhat difficult to communicate their results verbally.

Table 1

Select Responses to “Do you believe the scenario was representative of a real expert witness interview?” and “Why or why not?”

Response	Select Open-ended Response
Yes	<i>The scenario was a good representation of a real expert witness interview because I was not allowed to describe the crash with engineering terms. I had to describe the crash in laymens terms.</i>
	<i>I had never been placed in those situation before. It was really good to see how I react when placed in ethical situations such as the ones we were placed in. I believe it was helpful even if you didn't do well because you were able to recognize what you need to improve on. These scenarios will be somewhat similar to situations in any industry.</i>
	<i>I felt that when I took it, questions were asked that would be similar to what would be asked in a regular interview.</i>
	<i>I feel like this type of situation comes up a lot and lawyers rely on engineers to provide them the information they want and that they are not afraid to pressure them into saying what they want to hear.</i>
	<i>The situation was treated as completely real and the questions were very thorough.</i>
	<i>I was pushed to give opinions that I was not prepared or ethically willing to give. They wanted me to give them an answer that satisfied their needs rather than the evidence that I had found.</i>
	<i>The interviewers tried to find out how my analysis could support their side and wanted me to guarantee I could be confident that their claims were true, which seems like what would happen in an actual scenario. I suspect in a real situation they would push harder to convince me to change my opinions.</i>
	<i>Attempts were made to change my opinions and analyses to their suiting. They analyzed my expert witness report and asked how it could be interpreted or presented in court.</i>
Somewhat	<i>Yes because the lawyers questioned how I arrived at my analysis and conclusion and their ability to actually make me doubt them.</i>
	<i>I have no experience with expert witness interviews so I can't really say whether or not it did a good job replicating one</i>
	<i>I think it a real scenario would be more compelling and difficult to resist with real money at play.</i>
	<i>I feel like the majority of what that experience was represented the majorly of the experience in an actual situation, although (thankfully) I think Daily and Lawyer/Judge/Queen of England went easy on me (as well as everyone else).</i>
No	<i>We do not have the required background to be an expert.</i>
	<i>It was my first time having an interview. So I was getting a some help in my decisions.</i>

Results which concern the temptation students felt to modify their conclusions showed that out of 48 responses, 14 students or 29% reported that they did consider modifying their results. However, only 9 out of 49 respondents or 18% reported to actually modifying their results. The important information here is that the role play interview still appeared to pressure many students to consider changing their analyses. It is possible that perhaps some did not consider it because they were more confident in their calculations and results. In comparison to the combined data from the prior four years, of the 48 four-year combined responses to a similar question about temptation to alter the analysis, only 7 or 15% of respondents reported that they felt that pressure to change. These questions help indicate that not only is the expert witness interview method providing a similarly effective experience for students, but it may even provide one with a more realistic and challenging ethical dilemma experience.

### **Student Perceptions of Role-Play Strengths and Opportunities**

In addition to quantitative ratings, the interview experience reactions survey also included a series of further open-ended response questions. These questions were included to help gather information about specific successes and failings of the instructional program. Additionally, they were used to understand how students felt their experience compared to other forms of ethics training which they may have been exposed to. Essentially, these questions allowed for further student input and perspective on their experience. Response rate was good as each question yielded at least 47 responses each. The questions are as follows:

- *What was the most important thing that you learned through your participation in the expert witness interview exercise?*
- *What do you see as the advantages of participating in the expert witness interview exercise over hearing a lecture or reading a case study about ethical dilemmas?*
- *What do you see as the disadvantages of participating in the expert witness interview over hearing a lecture or reading a case study about ethical dilemmas?*
- *What could be changed to improve the expert witness exercise for you?*
- *Do you have any additional comments you would like to share about this activity and its usefulness for learning about ethical dilemmas in your field of science and engineering?*

The following Table 2 provides a small selection of example responses for each question that were deemed helpful in deciding how to improve the ethics training program either by adding components such as a lecture portion or ethical guideline materials or perhaps by simply including specific concepts to address in the group debriefs such as discussing how this situation may apply to non-expert witness scenarios in their career (e.g., boss pressure).



Table 2

*Select Responses to Open-Ended Interview Reactions Questions*

Question	Select Response
<p>What was the most important thing that you learned through your participation in the expert witness interview exercise?</p>	<p><i>To literally look at every aspect of the case and never state your opinion, just facts. It was hard having the lawyer pry at opinions stated.</i></p>
	<p><i>Stick to what the evidence says rather than what you can make it say.</i></p>
	<p><i>I learned that admitting that you misspoke can actually help you a lot. Also that you need to stick to your original statement and don't deviate from what it says in your report.</i></p>
<p>What do you see as the advantages of participating in the expert witness interview exercise over hearing a lecture or reading a case study about ethical dilemmas?</p>	<p><i>When the only contact you have with ethical dilemmas is in a lecture, one doesn't actually get to feel what it is like to be in that situation. I enjoyed getting to feel that pressure to bend my ethics. I hadn't felt that pressure before and I now can respond to future dilemmas in a much better fashion.</i></p>
	<p><i>It's way more engaging. Case studies are interesting at best and boring at worst. The interview was completely engaging and required you to interact with the ethical dilemma directly.</i></p>
<p>What do you see as the disadvantages of participating in the expert witness interview over hearing a lecture or reading a case study about ethical dilemmas? What could be changed to improve the expert witness exercise for you?</p>	<p><i>It was very intimidating and someone who is very introverted or not comfortable with public speaking may have trouble with the assignment.</i></p>
	<p><i>It was a lot more work than sitting through a lecture. That was the only disadvantage.</i></p>
	<p><i>A lecture could cover a wider range of situations, while this exercise covered only one. A lecture could also describe what is considered an ethical response in the field of engineering instead of leaving it to our decisions.</i></p>
	<p><i>I would worry that it narrows the focus and detracts attention from other types of ethical dilemmas. There may be ones that involve pressure from your boss or just from within yourself and while those have similar motivations to the interview role play, it might be nice to learn more about them too.</i></p>
<p>What could be changed to improve the expert witness exercise for you?</p>	<p><i>At least one lecture to cover the main points and theories to perform a crash reconstruction.</i></p>
	<p><i>Having more background about ethical practices before going into the interview would be more helpful. I kind of felt like I was walking in blind. But, I learned a lot by talking to the interviewers after about what to do better. I feel having a few lectures beforehand about ethics would be helpful.</i></p>
<p>Do you have any additional comments you would like to share about this activity and its usefulness for learning about ethical dilemmas in your field of science and engineering?</p>	<p><i>Maybe giving out reading material or other cases to think about would be helpful. I have a small book that was given to me about engineering ethics and it is super interesting so maybe giving out a book or requiring a book reading would be helpful. (it was like 70 pages long so it wasn't excessive.)</i></p>
	<p><i>It was far more useful than I expected.</i></p>

## Evaluating the Effectiveness of the Group Debrief Addition

An addition that was made to the year six ethics instruction was a post role-play debrief. In year five, when circumstances forced a single lecture in lieu of the role-play simulation, the authors discovered that students were not always sure of what ethics meant and how the topic applies in their field. Furthermore, several of the open-ended responses to the reaction surveys from previous years indicated that students may need more support in interpreting how their experience applies to other non-litigation situations in their field. Examples of responses that indicate this are:

*“We do not have the required background to be an expert.”*  
*“Maybe giving out reading material or other cases to think about would be helpful.”*

Because of this identified need for further assimilation, as mentioned above, a role-play debrief was conducted with groups of 12-15 students lead by the course instructors and one of outside acting “lawyers”. A question was included on the final post-test survey regarding this action along with an open-ended opportunity to explain. The question was, *“Do you think the group review session was helpful?”* Of the 50 responses, 49 were *yes* and only 1 was *somewhat*. The following Table 3 provides a selection of the responses.

Table 3

Select Responses to: *“Do you think the group review session was helpful? Why or Why not?”*

Select Response
<i>I learned what I did wrong in the report and during the interview session. I shouldn't have made any assumptions when I don't have enough information and when I don't have the expertise in the subject.</i>
<i>We were all able to reflect on our different experiences and thoughts. Everyone had a slightly different viewpoint so it was really good to see all sides of the situation in order to learn that much more.</i>
<i>It helped me understand the point of the exercise. Up until the group session, I was honestly very frustrated with the project, but hearing why certain things were done helped me understand the point of it more.</i>
<i>It showed us the other side of the interview and let us discuss the problems we had and how to combat those problems. I felt very unprepared for the interview, even unnerved, but I felt the review session put those fears to rest.</i>
<i>It was nice to be asked questions that forced us to think about the various levels of ethics training. It was also good to hear feedback from other students; some of them made points that hadn't come to mind before.</i>
<i>Speaking as an international students, the review session is a good summary for what we have done during the interview and what we should do in the future.</i>

Results of this question provided ample support for continuing to conduct some method of group oriented debrief of the expert witness role play instruction. These reactions and the others provided above provided ample insight into how students felt about and interpreted the benefits of the role-play method of ethics instruction. Still, further evaluation was needed to determine if and how students might actually change as a result of their entire learning experience.

## **Summative Evaluations**

In examining what additional information was needed to determine if this expert-witness role play method of ethics instruction is effective several questions needed to be answered. Specifically, there was a need to determine if students were actually learning anything from their experience and if they were changed as a result. The authors essentially had the following questions:

- Were the students learning?
- What were they learning?
- How might their experience impact their future behavior?

An important consideration that was added in the year six instruction evaluation was a pre-test post-test assessment. Although, a major goal of the role-play instruction is that students enjoy and find the experience useful, another perhaps more important goal is that it actually facilitates learning. While students may report that they believe they learned and developed their skills, an assessment of changes in the learner will help support their self-assessments<sup>1</sup>. Trainee learning may be examined in a number of ways<sup>3</sup>. An expert in training evaluation, Kraiger recommends considering learning as either affect change, cognitive development, or change in actual skills<sup>5</sup>. In assessing learning, he encourages trainers to consider which assessments might provide the most useful information and which aligns with the actual focus of the training<sup>5</sup>. In the present case, ethics instruction was targeted at developing the skills needed to recognize and respond to ethical dilemmas. The goal was for students to be better aware of ethical dilemmas in their field and to be prepared to respond consciously. With these goals of training in view the pre- and post-tests contained questions aimed at these targets for providing this information.

## **Awareness, Preparedness, Expected Behavior**

One method of evaluating if the students changed as a result of the role play experience was to survey the students both before and after the experience to see if their responses to certain questions changed significantly. Questions were intended to examine elements of student knowledge, awareness, feelings of preparedness, and behavioral confidence. More specifically, these questions were intended to examine if students were aware of ethical dilemmas in their field and how confident they were in their ability to respond to them. Questions were asked concerning:

- *How knowledgeable students felt about their field's ethical practice and guidelines*
- *How aware they were of the challenges of ethical decision making in their field*
- *How prepared they felt they were with respect to being able to respond to ethical dilemmas*
- *How likely they felt they would be to be able to behave ethically in their field*

Fourteen questions were asked in total. The first question asked students if they felt they were aware of what is considered ethical practices in their field and utilized a 5-point response scale which ranged from 1 = “*definitely not*” to 5 = “*definitely yes*”. With the exceptions of this first question, all other questions were posed as statements which students rated on a 4-point scale of agreement with 1 = “*disagree*”, 2 = “*somewhat disagree*”, 3 = “*somewhat agree*”, and 4 = “*agree*”. The questions are provided in the following Table 4.

Table 4

*Pre-test, Post-test Questions about Ethics Knowledge, Awareness, Preparedness, and Behavior*

Code	Question
<i>Ethics Knowledge</i>	
K1	Are you aware of what is considered ethical practice in the field of science and engineering?
K2	I am aware of what the ethical guidelines are for my field.
<i>Awareness</i>	
A1	Ethical decisions in science and engineering are usually easy to make.
A2	At times, it is challenging to make ethical decisions while working in science and engineering.
A3	At times, the right response to an ethical dilemma in science and engineering may be unclear.
A4	At times, it is challenging to act ethically in science and engineering.
<i>Preparedness</i>	
P1	I am confident that I will be able to recognize ethical dilemmas in my career.
P2	I feel like I am adequately prepared to make decisions related to ethical dilemmas during my career.
P3	I feel like I am adequately prepared to respond to ethical dilemmas during my career.
<i>Behavioral</i>	
B1	I will always act ethically in my career.
B2	There will be times in my career when I will be asked to act unethically.
B3	It will be challenging to act ethically at times during my career.
B4	There may be times in my career when I do act unethically.
B5	I am confident in my ability to act ethically during my career.

Because students responded to all 14 questions both before they were given the expert witness assignment and after they completed the group debrief, a paired samples *t*-test was conducted for each question. Results of the *t*-test for each of the individual questions are provided in the following Table 5.

Table 5  
*Pre- and Post-test Means, Standard deviations and Paired Sample t-test*

Question	Pre-test		Post-test		<i>t</i> (46)	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Ethics Knowledge						
K1	3.70	0.72	4.13	0.58	-3.64 *	.001
K2	3.06	0.64	3.38	0.61	-2.61 *	.012
Awareness						
A1 (reverse coded)	2.81	0.74	2.43	0.77	2.65 *	.011
A2	2.89	0.79	3.43	0.71	-3.31 *	.002
A3	3.28	0.65	3.40	0.58	-1.18	.243
A4	2.70	0.81	3.13	0.71	-3.23 *	.002
Preparedness						
P1	3.28	0.54	3.36	0.64	-0.75	.456
P2	3.17	0.60	3.02	0.61	1.36	.181
P3	3.13	0.65	3.06	0.53	0.60	.554
Behavioral						
B1	3.66	0.52	3.68	0.63	-0.21	.837
B2	3.11	0.89	3.34	0.89	-1.67	.102
B3	2.87	1.03	3.30	0.88	-2.87 *	.006
B4	2.11	0.91	2.28	1.08	-1.07	.290
B5	3.64	0.49	3.60	0.50	0.47	.642

Note. \*  $p < .05$  (two-tailed).

As can be seen in the Table 5, the two questions concerning students' knowledge and awareness of the ethical guidelines and practices in their field were significantly improved after the expert witness instruction process. Additionally, three out of the four questions concerning the student awareness of the challenges of ethical dilemmas in their career were also significant. Important to observe here is that students reported that they felt ethical dilemmas in their field would be more challenging than they originally reported. This is actually a change in the expected direction because the authors believed that the expert witness role play provides greater fidelity and a more accurate exposure to ethical dilemmas than the methods of ethics instruction that students may have already had. Specifically, the hypothesis is that students will become more aware of the *actual* challenges associated with ethics in their field as opposed to not knowing how such dilemmas may exist.

Three questions in which students were asked to respond with the degree to which they felt prepared to (1) recognize, (2) make decisions related to and (3) respond to ethical dilemmas during their career showed no significant difference from pre-test to post-test. It is interesting that while knowledge and awareness of both ethical practices and guidelines (K1 and K2) significantly increased as a result of the ethics role-play, students did not report feeling significantly more prepared (P1-3). Something to consider though is that their awareness of the challenges of ethical dilemmas did also significantly increase (A1-4) which may indicate that,

although they know more, they are also more aware of challenges and therefore even if they may feel more prepared, their new perspective on the challenges they may face may not translate into greater responses on these preparedness questions.

Finally, the results of the *t*-tests for the behavioral questions showed only one question as being significantly different. The results of this question statement, “*It will be challenging to act ethically at times during my career*” (B3) are interesting because the question itself includes reference to the challenge aspect of behaving ethically which is similar to the awareness of the challenges of ethical dilemma questions that also showed significant differences. Indeed, examining item correlations between this question and the awareness question shows some significant correlations with as high as a .53 correlation between the behavior question and the awareness question of “*At times, it is challenging to act ethically in science and engineering*” (A4). This may indicate that this question may be more related to the other awareness questions and the other behavioral questions may be more related to the intended assessment concerning whether students feel they can behave ethically in their career. The lack of significant results may also be due to similar reasoning as with the preparedness questions in that as students became more aware of the challenges they may face, they may not be as naively confident as they were before.

### **Overall Experience Reactions**

As mentioned, the sixth year program was an accumulation of the formative development of the program. As such it included many elements of instruction that were not initially conducted. In order to obtain a final assessment of the program from the perspective of the participants a series of final reactions questions were asked at the end of the post-test survey. The questions are as follows:

- *Do you think that the OVERALL ethical experience assignment was beneficial? Why or Why not?*
- *What was the most important thing that you learned through this assignment?*
- *Should professors continue to include this type of assignment in this course in the future?*
- *Do you have anything else you would like to share?*

Students responded to the first question about the overall experience with either “yes”, “somewhat” or “no”. Of the 51 responses received, 45 (88%) said “yes”, 5 (10%) said “somewhat”, and only 1 response (2%) was “no”.

This question was followed by an open-ended response opportunity. As the purpose was to identify what the overall perceptions were of the ethics instruction method all responses were valuable. A selection of responses are provided in Table 6.

Table 6

Select Responses to “Do you think that the OVERALL ethical experience assignment was beneficial? Why or Why not?”

Response	Select Response to Why or Why not?
Yes	<i>I learned things I think I know but in reality I don't. It gave me more understanding about ethics in the field of science and engineering.</i>
	<i>It is beneficial because it did not have one right answer, and it was realistic.</i>
	<i>Yes! I don't think we get enough engineering ethics experience while in school. It is a huge part of the profession of being an engineer and the more exposure you have before you get out in the real world, the better.</i>
	<i>It was something new that nobody has ever experienced. At the very least it was a new experience to learn from.</i>
	<i>Ethical dilemmas are something that you will face as an engineer. It is important to make the right decision in this situations by being proactive. This exercise gets you to think about ethics in a way that a simple lecture cannot. Ethics lectures are pointless in my opinion. There needs to be a dialogue and conversation for ethics education to work.</i>
	<i>I now know more about engineering ethics than i did before.</i>
	<i>It was a good way to actually confront an ethical situation and not discuss it theoretically.</i>
	<i>There's no better way to teach us about ethics than putting us in an interview where our ethics are tested. The emotions that came with being pushed to do be unethical will stick with me.</i>
	<i>It's difficult to say where the ethical line is, and it's helpful to get experience with that in a relatively low risk environment</i>
	<i>Absolutely yes, I am surprised that we don't have more extensive training on ethics in engineering school, and I thought this exercise helped to inform of us of how ethical dilemmas can come up in settings we are more likely to experience in the field.</i>
Somewhat	<i>I thought it was beneficial in regards to having to deal with something new and handling not having enough information. I don't think it really pertained to ethics too much. At least, my lack of understanding of the technical side prevented me from being able to approach and consider the ethical part.</i>
	<i>It was good exposure to a real life situation where we were put on the spot and forced to make decisions. However, I got so lost in not knowing enough about the technical aspect of the project that I didn't really have a basis for my conclusions so my ethics were not really tested because I didn't have an argument that I thought was valid.</i>
	<i>i dont think it belongs in this class</i>
	<i>I think the professional experience was extremely useful, but I don't know that it helped me learn anything significantly more about ethics tself</i>
No	<i>Because, I did not do it perfectly.</i>

To further assess what students felt they gained from the training, the open-ended question “*What was the most important thing that you learned through this assignment?*” was included. Select responses are provided in Table 7. What is interesting to note about these responses is that while some directly involve learning what it means to be ethical there are a variety of other topics of learning such as learning about aspects of the profession such as the presence of ambiguity and the value of being technically prepared. Further analysis of the responses to this questions might be conducted by content coding the themes of the responses to see what all was represented. As an overall summary, it is apparent that the students could articulate their take-away messages and that they did learn something they deemed important both ethically related but also professionally.

Table 7

Select Responses to “*What was the most important thing that you learned through this assignment?*”

Select Response
<i>I learned that most situations don't have a cut and dry correct answer. There are reasons to do something and reasons to not do something in all situations so it is up to the engineer to decide what to do. Most times, this won't be an obvious answer so the engineer needs to have a code of ethics to follow to help them through the situation.</i>
<i>Using the resources to get more understanding in the assignment. How people will question what you do and how you should prepare yourself not to waver just because of what the other people is saying. Not to make assumptions without the appropriate evidence and reasoning.</i>
<i>Stick to the math and do not answer problems that you are not capable of answering.</i>
<i>Trust your opinion, and do not make any assumptions on the spot.</i>
<i>You can only say things that your calculations can prove, don't make assumptions you can't support.</i>
<i>When making a decision, know it is correct based on the math behind it</i>
<i>It is ok to be wrong and not completely understand something just as long as you are upfront about it.</i>
<i>It made me realize that many engineering problems have much uncertainty in them.</i>
<i>Just because you want to remain ethical doesn't mean there wont be pressure to make unethical decisions or that the right decision will always be immediately visible or even easy.</i>
<i>There's not always a clear answer when you really want there to be one.</i>
<i>That you need to be honest when you don't know the answer. Still be sure to share your findings, but if you cannot backup a final ethical conclusion with those findings do not interject personal opinion into the dilemma.</i>
<i>That sometimes telling a client you don't know is the most ethical thing; you aren't obliged to give them an answer if you aren't sure</i>
<i>The most important thing that I learned is that it is okay to say no, and that it is better to get spend longer getting the best answer you can than rush out an inferior product.</i>
<i>In short, how to say "no" to something you want more than anything to say "yes" to.</i>
<i>You won't always have all the answers</i>
<i>Don't try to talk about things you know nothing about.</i>
<i>To not let personal opinions get in the way of ethics.</i>



Another summative question which students responded to was “*Should professors continue to include this type of assignment in this course in the future?*”. They responded with either “yes”, “no”, or “maybe”. Of the 50 responses, 45 (90%) said yes, 2 (4%) said no, and 3 (6%) said maybe. This questions did not have a direct open-ended follow up, however, of the responses that were either “no” or “maybe”, one “maybe” response was from a student that did not attend the group debrief, and a “no” response was followed by a response to the final additional information request that the project was “*challenging for the students*”. It is clear from the remaining final open-ended response question, “*Do you have anything else you would like to share?*” that many students did very much enjoy the project and did find in beneficial in their education. A small sample of the responses are provided in Table 8.

Table 8

Select Responses to “*Do you have anything else you would like to share?*”

Select Response
<i>I just really enjoyed this project. It was very helpful and gave some real world experience in a topic that we aren't exposed to much in school.</i>
<i>I enjoyed the uncertainty of the exercise.</i>
<i>I think this kind of projects is what widens students knowledge more and makes them think out of the box.</i>
<i>overall, it is a great experience.</i>
<i>over all the course was really helpful and everyone must learn from this course</i>
<i>Wonderful experience! Maybe a separate ethical dilemma next semester?</i>
<i>Nope! That's all. Thank you!</i>
<i>I think this assignment is a very good exercise for us to learn and get the idea of what we will face in the future.</i>

These summative student reactions to the complete ethics instruction provided within the course help indicate that this assignment and all of the components (e.g., report, role-play interview, group debrief) are providing students with a generally positive, well-received and useful experience.

## Conclusion

To summarize both the formative and the summative results provided by the sixth year of evaluations of this expert witness role-play method of ethics instruction, there is evidence to suggest that this innovative form of instruction is related to change in the students. Furthermore, there is also quantitative and qualitative reaction data and results which indicate that students enjoy the experience and find it useful and developmental. Although evaluating this program required ample student time and research analysis to evaluate this method of ethics instruction, the intention of this paper was to demonstrate the benefits of collecting various forms of evaluative data. Each method of evaluation has been valuable in making decisions about whether to continue to invest in conducting the instruction and how to improve the instructional procedure. Future directions with this method of instruction include continuing to conduct the ethics instruction as it was done in year six with particular respect to the one student only interviews and the group debrief sessions. Some adjustments that may be made and assessed for effectiveness may include adjusting the “lawyer” actors to not include the instructor but rather

incorporate more outside professionals trained to conduct a systematic interview. Additional evaluations may also be included to help further understand what students learn as a result of their role-play experience. In summary, this expert witness ethics teaching method has proven effective in many ways and the evaluations that are being conducted have proven to be beneficial towards further adjusting and improving the program.

## **Acknowledgements**

This material is based upon work supported by the National Science Foundation under Grant Number 1545211.

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. Steele, L. M., Mulhearn, T. J., Medeiros, K. E., Watts, L. L., Connelly, S., & Mumford, M. D. (2016). How do we know what works? A review and critique of current practices in ethics training evaluation. *Accountability in research*, 23(6), 319-350.
2. Mumford, M. D., Steele, L., & Watts, L. L. (2015). Evaluating ethics education programs: A multilevel approach. *Ethics & Behavior*, 25(1), 37-60.
3. Golstein, I. L., & Ford, J. K. (2002). *Training in organizations* (4th ed.). Belmont, CA: Wadsworth.
4. 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): pp. 77-95.
5. Kraiger, K. (2002). *Creating, implementing, and managing effective training and development: State-of-the-art lessons for practice*. Jossey-Bass.
6. 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*.
7. 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*.
8. Kerr, A., Brummel, B. J., & Daily, J. S. (2016). Using the Engineering and Science Issues Test (ESIT) for Ethics Instruction. Paper presented at the 123rd annual American Society of Engineering Education Conference, New Orleans, LA.
9. Alliger, G. M., & Janak, E. A. (1989). Kirkpatrick's levels of training criteria: Thirty years later. *Personnel psychology*, 42(2), 331-342. From training class.
10. Sitzmann, T., Brown, K. G., Casper, W. J., Ely, K., Zimmerman, R. D. (2008). A review and meta-analysis of the nomological network of trainee reactions. *Journal of Applied Psychology*, 93, 280-295.