122nd ASEE Annual Conference & Exposition
June 14 - 17, 2015
Seattle, WA
Paper ID #13041

Guidelines for Constructing Expert Witness Role Plays for Engineering Ethics

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 and individual differences in the workplace. He also investigates the use of role play simulations for teaching ethics.

Dr. Jeremy S. Daily P.E., University of Tulsa
Prof. Jason T Stauth, Dartmouth College

Guidelines for Constructing Expert Witness Role Plays for Engineering Ethics

This paper describes guidelines and considerations for designing and implementing an expert witness role play pedagogy for teaching engineering ethics. Previous experiences creating an expert witness role play are used to define a set of guidelines and decision points for designing a role play that accomplishes the learning objectives of a specific instructor within the resource constraints of that instructor. These guidelines were used to develop and implement a new role play in a different institution covering different engineering disciplines. The role play was also adapted to the constraints of the course in which it was used. This process allowed for an initial test of the process for expanding the expert witness role play pedagogy to new topics and course structures. Specifically, the experiences and implementation of a traffic crash reconstruction expert witness role play in a department of Mechanical Engineering provided the basis for guidelines that were used to create a new role plays focused on issues in renewable energy generation and development to motivate an expert witness litigation exercise centered on a range of benefits an externalities associated with large-scale photovoltaic development. Recommendations and implementation improvements for future role plays are discussed.

Expert Witness Role Plays

Expert witness role plays are interactive simulations where engineering students play the role of expert witnesses in some part of the litigation process. This pedagogy affords the students an opportunity to experience real world ethical dilemmas and engage in ethical decision making and actions while using the technical rigor of higher level engineering classes.[1] Role plays have been shown to be an effective technique for a variety of learning outcomes, including ethics education.[2,3,4,5] Theoretically, this pedagogy provides different learning opportunities than other approaches to ethics education such as lectures, computer-based instruction, and case-studies.[6,7,8]

Our previous expert witness role play scenarios focused on traffic crash reconstructions where students used concepts from engineering dynamics to determine specific answers to how the event occurred. This project was part of the lab component of a junior level Machine Dynamics course. The student completed the analyses and consolidated their findings in a report following US Code 26 (Rule 26 report). A Rule 26 report should disclose the data and other information considered by an expert including exhibits and charts. The report should reflect the testimony to be given by the expert and must be signed by that expert. We have used versions where the students either worked alone or in teams. The student was then then "hired" by a law student who was role-playing an attorney and deposed to render their opinion on the crash. Provided the students were technically competent, the goal of the exercise was for the engineering student expert to experience the temptation associated with advocating for one side of a legal dispute potentially compromising their engineering integrity.

Our previous research has shown that students find these experiences to be challenging and worthwhile. They have reported being tempted to change their results, but most students have not violated their ethical principles as engineers in this simulation. However, to date only one expert witness role play has been constructed and tested. This role play resulted from a unique collaboration and coordination between professors in Mechanical Engineering, Law, and

Psychology using courses in both Law and Mechanical Engineering. This situation is unlikely to be replicated at other institutions. Also, the attempt to have both law students and mechanical engineering students experience this simulation lead to inconsistencies in the experiences of students and more difficulty in assessing learning outcomes. If this pedagogical technique is to become more broadly impactful, the efficacy of this approach to engineering ethics education needs to be assessed more systematically. However, for this to occur, other educators need to be able to adapt the approach to their intuitions and areas of expertise.

Learning Objectives

All training should begin with the learning objectives of the educational experience. These objectives can include changes in knowledge, skills, problem solving strategies, and attitudes or beliefs.[9] These learning objectives can then be used then shape strategic choices about the design, delivery method, and assessment of the training. Learning objectives are thought to be a critical piece in the design of simulations because the added complexities of designing realistic scenarios can distract instructors from the purpose of the experience.[10,11,12]

Our expert witness role plays allow for learning objectives within three broad areas relevant for engineering education: Technical Skills, Professionalism, and Ethics. Learning associated with these objectives is co-dependent in the successful navigation of expert witness testimony. An engineering ethical framework depends on technical skill and an awareness of the distinguishing attributes of the engineering profession. Educators can craft their version of the role play with different emphasis on each of these learning objectives, yet all aspects should be addressed. Possible learning objectives within each of these categories and options for assessing them are discussed in more detail in the following sections.

Technical Skills

Engineers must have the technical skills to complete the analyses necessary to answer the questions asked of an expert witness. These skills will vary based on the specific topic of the role play. Educators have the option of adjusting the both the difficulty and the importance of technical skills within the design of their expert witness role play. For example, in our crash reconstruction role play learning objectives for technical skill included:

1. Calculate speed of vehicles and impact dynamics from skid marks with confidence intervals.
2. Know the implications of using techniques when calculation build on each other (potentially compounding error in initial estimates).

These learning objectives were assessed using:

1. Graded answers on students' written Rule 26 reports.
2. Coded student explanations during the depositions.

Professionalism

Engineers should produce a professional report and maintain a professional demeanor while serving as an expert witness. They should be able to work in their team, schedule meetings, and deliver a product that the lawyer would want to pay them to produce. Again, these skills will vary based on the specific design of the role play. Educators have the option of adjusting the design of their expert witness role play to focus on different professionalism skills. For example, in our crash reconstruction role play learning objectives for professionalism included:

1. Know the structure and content of a report following US Code 26 (Rule 26 report).
2. Complete all aspects of the project on time.
3. Clearly articulate findings in both written and oral forms of communication.
4. Dress appropriately for mock deposition.
5. Estimate appropriate costs for time and expertise.

These learning objectives can be assessed using:

1. Graded answers on students' written Rule 26 reports.
2. Coded student appearance and explanations during the mock depositions.
3. Student self-reports.

Ethics

Engineers will need to make a number of ethical decisions in the preparation of their Rule 26 reports and the presentations of their findings while being deposed. This primarily revolves around the scientific ethic of presenting the truth. However, it also involves honestly representing expertise and admitting when they are less confident on elements of the report. The specific decisions and ethical pressures will vary based on the specific design of the role play. Educators have the option of adjusting the design of their expert witness role play to focus on different ethical decisions and levels of social pressure. For example, in our crash reconstruction role play learning objectives for ethics included:

1. Experience the pressure to give a lawyer the responses they are looking for.
2. Develop strategies for remaining truthful in the face of pressure.
3. Honestly represent the confidence in the quality of analyses – acknowledge any limitations in the analysis.
4. Know the specific ethics code for the area of engineering the deposition covers.
5. Only charge lawyer for hours worked on project.
6. Decline to offer expert testimony if you do not have necessary expertise.

These learning objectives can be assessed using:

1. Coded student responses during the depositions.
2. Student self-reports of temptation to change results.

A Note on Ethical Performance

In the process of coding student responses to the ethical pressures within the Rule 26 report and the crash deposition, we came up with 4 potential levels of (un)ethical behavior relating to the work done and the reported work.

1. Analyses are done correctly. Reported as correct.
2. Analyses are partially correct. Admission of parts that are guesses/potentially incorrect.
3. Analyses are incorrect. Admission of incorrect/incomplete results.
4. Analyses are incorrect. Reported as correct.

Level 1 is the most desirable and level 4 is the least desirable and potentially dangerous. We believe that this level approach to evaluating and explaining the possible reactions to an expert witness situation provides a unique and potentially important learning opportunity for engineers. In our experience, engineering students have a tendency to put down anything to get partial credit in class assignments and tests. The tendency to be rewarded for this strategy might prompt them toward less ethical approaches to expert witness testimony and other engineering practices.

Expert Witness Role Play Design Guidelines

Given our experience designing our initial expert witness role play, we came up with the following steps for designing a new version of an expert witness role play. These steps were followed in the construction of a new role play which is described in the following sections.

1. Select a scenario that complements the current course of study. The scenario could be modified from a real world example or created by the instructor. The benefit of modifying real cases is that the students can be provided with the real story which could enhance their motivation.

2. Determine the learning objectives of the role play. These expert witness role plays have the potential to facilitate learning objectives related to technical skills, professionalism, and ethics. The designer must decide on the relevant objectives and the difficulty of those objectives.

3. Assess the resources available to conduct the expert witness role play. These role plays can be very time and labor intensive. Depending on the resources available to the instructor and learning objectives, different approaches to the design can be considered. Some potential variations include:

    - Having the students work in teams instead of as individuals.
    - Providing a completed Rule 26 report and focusing on the ethical learning objectives.
    - Having the student interview with a role-playing lawyer who would hire them instead of completing a more formal deposition.
    - Choosing only a couple students to role play the exercise in front of the class.

4. Make sure to include elements that provide the ethical framework and dilemma for the students so that the solution is not obvious. Some of these elements include:

    - A relevant guiding document or philosophy on ethics from a professional engineering society should be provided to the students at the beginning of the exercise. For the example of the crash reconstruction scenario, the Society of Automotive Engineers has published J2314: "Ethics for Accident Investigation and Reconstruction" that is handed out with the assignment.
    - The legal outcome is not certain. The scenario and analysis should be designed such that both parties involved share some of the responsibility. The scenario should not invade the providence of a jury, yet require technical analysis to determine what actually happened.
    - The engineering students should be "hired" by one side or another and then asked to help advocate for their side. This creates an ethical dilemma and temptation to modify the opinions rendered in a way that benefits the client.
    - Students should render a written report that complies with legal standards. For example, Rule 26 of the Federal Rules of Civil Procedure describes the requirements for written disclosure by an expert witness. This written document also provides a basis for grading of the technical content.

5. Plan for the assessment of learning objectives. Some of the learning objectives that are generated for these role plays can be assessed through standard grading procedures for labs or assignments. However, objectives that need to be assessed with coding of performance during the role plays or with self-report surveys. This may require some planning. We have used both paper and online surveying tools for the self-report surveys. We have also coded student performance in the role play by videotaping the deposition. Another option is to have the person role playing the lawyer to rate the engineering student's performance after the role play. This could be done using a Behaviorally Anchored Rating Scale like the example shown in Table 1.

6. Include some form of debriefing in a group forum so that students can discuss their experiences and the instructor can help the students make sense of the experience they have had. Sense making is specific feature of many form of ethics instruction, and it allows for the instructor to make sure the right lessons are learned from the experience. This could take the form of a group discussion, revealing what happened in the real situation the role play was based on, or in smaller focus groups that allow students to discuss how they experienced the role play.

Table 1. Proposed Grading Rubric for Expert Witness Interview

Professionalism

Unacceptable	Mediocre	Acceptable	Good	Excellent
1	2	3	4	5
Late, Unprepared, Rude		On time, respectful		Dressed up, timely, polite
Notes:				

Technical Competence

Unacceptable	Mediocre	Acceptable	Good	Excellent
1	2	3	4	5
Calculations wrong and unfinished		Everything correct, not able to explain all to lawyer		Everything correct, Explained clearly
Notes:				

Ethical

Unacceptable	Mediocre	Acceptable	Good	Excellent
1	2	3	4	5
Willing to lie about findings		Honest about limits in knowledge competence		States that an engineer must always tell truth
Notes:				

Rating as a Potential Effective Advocate/Expert on the Stand

Unacceptable	Mediocre	Acceptable	Good	Excellent
1	2	3	4	5
Never use, make look incompetent		Knows science, but not persuasive		Persuasive, articulate
Notes:				

Solar Energy Example

The Solar Energy role play was developed at a different university from the initial crash reconstruction role play. The scenario was developed around the issue of land use in solar energy. The role play was designed to teach the students about the ethical issues involved with advocating for a specific use of land. Ethical learning objectives involved feeling the pressure of advocating for a position and realizing the impact of hidden or unknown information on decision making.

The exercise began with a 30 minute primer lecture on energy issues and the prospects for renewable energy. This lecture included the concept of externalities (costs that result from an activity that are paid by an otherwise uninvolved party). In addition to the positive aspects of solar energy, such as lower CO_2 production, some negative aspects such as the need for large amounts of land that is heavily impacted during construction were discussed. These negative impacts were evidenced by a number of lawsuits from environmental and Native American groups.

The role play exercise consisted of a group deliberation and discussion based on a hypothetical case based on a new solar technology. An overview of the new technology was presented in class providing a basis of publicly available information for the following group deliberation. The class was then split up into groups of six and each group further segmented into three groups of two. Each subgroup represented a point of advocacy for a position in the deliberation. In this case, one group of two represented a solar developer that was proposing to construct and profit from a new photovoltaic array. A second group of two represented an environmental organization that was generally opposed to the new development due to a perceived externality on the local ecology. The final group of two represented the general public (role playing the congressional representation for the district where the development was proposed). The role play exercise was structured to stress an ethical dilemma for each group involved. The ethical dilemma was created through the following structure:

- Publicly available information (information that everyone has that sets a basis for the discussion).
- An incentive structure for the points of advocacy (e.g. a job promotion, monetary compensation, or social capital incentive that is provided if they ‘win’ the deliberation).
- Privately available information (information that each point of advocacy has solely; typically this would weaken their position if it were publicly available).

In the deliberation the two points of advocacy (solar developer and environmental organization) presented their case to the group representing the general public. Unknown to the solar developer and environmental group, the arbiter (congressional representative for the general public) also had both a pro and con incentive structure. In this case, they had to face a dilemma that involved an economic benefit for the local community (job creation and cash infusion due to the development) and also specific negative externalities that would impact their district as well as neighboring communities.

The role play exercise proceeded in group discussion until the arbiter of each team of six had made a decision. Then, in class discussion, each group of six presented their decision and the reasons for that decision. Following announcement of the decisions, the remainder of privately held information was presented to the class. The class then went through each group's decision process, and the feelings of each of the advocates regarding disclosure of their privately held information. This presented an excellent opportunity to confront and discuss the ethical dilemmas faced by each party involved.

The benefit of the role play exercise was that it provided an opportunity for students to feel a realistic ethical dilemma, confront it, and then work through their decision making process. The class discussion uncovered a number of common behaviors associated with confrontation of ethical scenarios, but it also provided a chance to discuss appropriate and ethical ways to handle those situations.

This version of the role play approach was quite different from the initial crash reconstruction approach. This design required fewer resources and the learning objectives focused exclusively on ethics. This approach was able to give the students a chance to invest in and experience the types of issues that they might work on as engineers without spending a substantial portion of the semester on the technical issues involved in the scenario. They were also not pushed to perform as an expert at the same level of intensity as in the crash reconstruction deposition. The evaluation opportunities in this approach are limited to self-report following the experience. Depending on the instructional objectives, this could be a limitation of the approach taken for this role play design.

Conclusion and Future Work

The first attempt to distil the principles used to construct and implement the Crash Reconstruction role play resulted in the Solar Energy role play described about. While the instructor and students successfully used some of the design guidelines for the Solar Energy role play, the role play did not include learning objectives relating to technical skill or professionalism. Additionally, the role play did not include any real evaluation of the effectiveness of the ethics learning objectives. The initial Crash Reconstruction role play evaluated its learning objectives primarily through self-report surveys of ethics and graded reports for the technical content. We are currently designing a role play based on an industrial lift collapse which should incorporate all three areas of learning objectives with a more fully realized assessment framework. This should allow us to more fully assess the effectiveness of this expert witness role play pedagogy for teaching technical skills, professionalism, and ethics. However, we also believe that there is strong potential for educational value in teaching ethics using the role play model used in the Solar Energy case. As we continue to develop different variations of these role plays, we plan to further refine our guidelines for helping other educators adapt this technique to their areas of expertise, their resource limitations, and their specific learning objectives. We also plan to investigate the effectiveness of this approach more rigorously so that educators can determine if the effort it takes to conduct an expert witness role play is worth the learning achieved by the students.

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., Gunsalus, C. K., Anderson, K. L., & Loui, M. C. (2010). Development of role-play scenarios for teaching responsible conduct of research. *Science and engineering ethics, 16*, 573-589.

3. Seiler, S. N., Brummel, B. J., Anderson, K. L., Kim, K. J., Wee, S., Gunsalus, C. K., & Loui, M. C. (2011). Outcomes assessment of role-play scenarios for teaching responsible conduct of research. *Accountability in Research, 18*, 217-246.

4. Numminem, O., Leino-Kilpi, H., van der Arend, A., & Katajisto, J. (2011). Comparison of nurse educators' and nursing students' description of teaching codes of ethics. *Nursing Ethics, 18*, 710-724.

5. Waples, E. P., Antes, A. L., Murphy, S. T., Connelly, S., & Mumford, M. D. (2008). A Meta-Analytic Investigation of Business Ethics Instruction. *Journal of Business Ethics, 87*, 133-151.

6. Simmons, M. J., Jackson, A. T., & Brummel, B. J. (2015, August). Appropriate training should turn ethical reasoning into ethical practice. Poster accepted for presentation at the annual convention of the American Psychological Association, Toronto, CA.

7. Weber, J. A. (2007). Business Ethics Training: Insights from Learning Theory. *Journal of Business Ethics, 70*(1), 61-85.

8. Sims, R. R. (1994). *Ethics and Organizational Decision Making: A Call for Renewal*. Westport, CT: Quorum Books.

9. Goldstein, I. L., & Ford, J. K. (2002). Training in Organizations: Needs Assessment, Development, and Evaluation (4th ed.). Belmont, CA: Wadsworth.

10. Thornton, G. C. I., & Mueller-Hanson, R. A. (2004). *Developing organizational simulations: A guide for practitioners and students*. Mahwah, NJ: Lawrence Erlbaum.

11. Rupp, D. E., Gibbons, A. M., Baldwin, A. M., Snyder, L. A., Spain, S. M., Woo, S. E., . . . Kim, M. J. (2006). An initial validation of developmental assessment centers as accurate assessments and effective training interventions. *Psychologist Manager Journal, 9*, 171-200.

12. Hertel, J. P., & Mills, B. J. (2002). *Using Simulations to Promote Learning in Higher Education*. Sterling, VA: Stylus.