University of Massachusetts - Amherst
ScholarWorks@UMass Amherst

Ethics in Science and Engineering National Clearinghouse

Science, Technology and Society Initiative

3-7-2006

Proposal to the Ethics Education in Science and Engineering Program, National Science Foundation: Role-Play Scenarios for Teaching Responsible Conduct of Research

Michael C. Loui
University of Illinois at Urbana-Champaign

C. K. Gunsalus
University of Illinois at Urbana-Champaign

Follow this and additional works at: http://scholarworks.umass.edu/esence

Part of the Engineering Commons, Life Sciences Commons, Physical Sciences and Mathematics Commons, and the Social and Behavioral Sciences Commons

Recommended Citation
Loui, Michael C. and Gunsalus, C. K., "Proposal to the Ethics Education in Science and Engineering Program, National Science Foundation: Role-Play Scenarios for Teaching Responsible Conduct of Research" (2006). *Ethics in Science and Engineering National Clearinghouse*. Paper 277.
http://scholarworks.umass.edu/esence/277

This Other is brought to you for free and open access by the Science, Technology and Society Initiative at ScholarWorks@UMass Amherst. It has been accepted for inclusion in Ethics in Science and Engineering National Clearinghouse by an authorized administrator of ScholarWorks@UMass Amherst. For more information, please contact scholarworks@library.umass.edu.

PROPOSAL TO THE
ETHICS EDUCATION IN SCIENCE AND ENGINEERING PROGRAM
NATIONAL SCIENCE FOUNDATION

Role-Play Scenarios for Teaching Responsible Conduct of Research

Michael C. Loui and C. K. Gunsalus
University of Illinois at Urbana-Champaign

March 7, 2006

Project Summary

We propose to develop and assess role-play scenarios to teach central topics in the responsible conduct of research (RCR) to graduate students in science and engineering. Together the scenarios will cover plagiarism, authorship, conflict of interest, interpersonal conflicts in mentoring, and concerns about compliance with research regulations on human participants in research, animal subjects, or hazardous substances. Two scenarios will present potential whistle-blowing situations.

Intellectual merit: Few previous studies have carefully assessed the effectiveness of role-play in teaching ethics. We will conduct a rigorous, systematic assessment of role-play, using multiple methods, with a diverse group of graduate students. We will examine whether role-play helps students identify moral issues in research, understand multiple perspectives in ethical disputes, and negotiate practical solutions to moral problems. We will document how students' conceptions of RCR change. We will determine whether students retain their new knowledge and skills. For this project, we will draw on our previous experience in the scholarship of teaching and learning.

Broader impacts: Collaborating with both graduate and undergraduate students, we will develop educational materials that can be adopted by graduate programs in all science and engineering departments. These materials will be disseminated through professional meetings and archived online.

We believe that by engaging students through the role-play scenarios, we would teach graduate students to handle ethical problems in RCR effectively. As an outcome of this project, we expect to find that long after students have participated in role-play sessions, they will recall the lessons of those sessions, and they will be able to apply those lessons to a wide range of ethical problems that they may encounter in their professional careers.

Role-Play Scenarios for Teaching Responsible Conduct of Research

Project Description

1. Introduction

1.1. Ethics for Graduate Students

In science and engineering, all doctoral programs and many master's degree programs prepare students to conduct research professionally. Just as professional degree programs in medicine and in law include classes on ethical issues in professional practice, so should graduate degree programs emphasize the ethical conduct of research. The National Institutes of Health require that all NIH-supported graduate trainees receive instruction in the **responsible conduct of research** (RCR). Over the last ten years, many universities have responded to the NIH mandate by creating graduate courses and organizing workshops on RCR. Resources to support these offerings include textbooks (Macrina 2000; Penslar 1995; Shamoo & Resnik 2003; Steneck 2004), case books (Association of American Medical Colleges 1994; Bebeau et al. 1995; Schrag 1997–2002), brochures (Committee on Science, Engineering, and Public Policy 1995), and Web sites (Online Ethics Center for Engineering and Science 2004; Research Ethics Modules 2001). Heitman & Bulger (2005) reviewed and analyzed many RCR resources.

At the University of Illinois at Urbana-Champaign, every year for more than a decade, every department has been asked to hold at least one research ethics event for all of its graduate students and faculty. These events now include seminars, workshops, orientation sessions, formal courses on research ethics, research methods courses, invited speakers, and video presentations. Information about research ethics is distributed in pamphlets, student handbooks, and department Web sites. In addition, the State of Illinois requires all employees of state agencies and universities to complete an annual ethics training program.

Despite the extent and variety of RCR events, there is little evidence for the long-term effectiveness of specific pedagogical techniques for RCR (Pimple 2001). Do students retain the knowledge and skills that they gain through RCR education and training? Can students use their training when they later encounter RCR problems?

In this project, we propose to create materials to support a particularly engaging pedagogy: **paired role-play**. Further, we propose to assess systematically and rigorously the effectiveness of paired role-play sessions. Because role-play is an active learning technique, we believe that it will be effective in long term retention. We expect that students who have experienced RCR conflicts as role-plays will be able to draw on those experiences to solve RCR problems successfully in the future.

1.2. Brief Literature Review

In a role-play exercise, participants assume the roles of characters in a scenario. The scenario may be fictional or based on an actual incident. According to Brown (1994), a role-play scenario should have sufficient detail to be challenging and engaging, it should have an underlying conflict, and it should appeal to participants' imaginations. The characters in the scenario should be familiar—even stereotypical—so that participants feel comfortable with their

roles. To reduce participants' anxiety, the scenario should offer opportunities for humor, so that the roles are fun to play.

> The freedom afforded by playing a stranger … allows the players tremendous scope of exploration into the nuances and conflicts inherent in any complex situation, without exposing the player's own beliefs…. The culmination of the role play is not intended to be a public confession of wrongly held views that have been enlightened, but rather a private reflection on the issues raised that will go beyond the class and degree program. (Brown 1994)

No character should be totally virtuous or totally evil, however (Pearce 2001).

Role-play is used frequently to teach ethics in engineering (Cooley et al. 1991; Didier 2000; Herkert 1997; Loui 2000), journalism (Brislin 1995), business (Brown 1994; Raisner 1997; Sanyal 2000), clinical psychology (Johnson & Corser 1998), and medicine (Dalman-Hess et al. 1997; Garvin & Stefani 1993; Nelson & Eliastam 1991; Sofaer 1995). For example, Herkert (1997) organized a role-play of a fictional arbitration hearing of a product liability case; in Herkert's exercise, students assumed the roles of arbitrators, plaintiffs, defendants, and experts. Raisner (1997) wrote a role-play in which a fictional manufacturer considers moving production to Guatemala; to make the role-play realistic, Raisner stressed the need for careful preparation, and he provided extensive briefing materials on international labor issues for the student participants. Sanyal (2000) created a game with a series of brief episodes; for each episode, each student takes a role as employer, employee, customer, or member of society at large, and participants rotate roles between episodes. Although these published papers report high student satisfaction, they do not provide careful assessments of what students actually learned. They do not explain what aspects of the role-play exercises made them effective, and what aspects might be transferable to other situations.

Few articles report the use of role-play specifically to teach research ethics. Rosnow (1990) proposed an exercise in which students examine published articles and then play the roles of the author and the Institutional Review Board (IRB) in evaluating the costs and utilities (benefits) of the research studies reported by the articles. Strohmetz & Skleder (1992) confirmed the effectiveness of Rosnow's role-play exercise in a multi-section undergraduate course on research methods in psychology. First, students read research articles and rated the costs and benefits of the studies reported by the articles; next, they engaged in the role-play exercise; finally, they rated the costs and benefits again. Students in the role-play sections changed their cost and benefit ratings significantly more than students in the control sections, who did not experience the role-play. Bragger & Freeman (1999) concluded that undergraduates found this role-play exercise very helpful in learning about costs and benefits of research. Whereas these three articles construed "research ethics" in general terms, as costs to participants and benefits to society, in this project, we will focus on the responsible conduct of research.

Many articles report the successful application of role-play (also called **simulation**) in courses in science and engineering to teach topics other than ethics. A search of publications of the American Society for Engineering Education (ASEE) netted dozens of articles on role-play in the proceedings of the ASEE Annual Conference & Exposition and in the *Journal of Engineering Education*. For example, Pearce (2001) organized a role-play of a historical steamboat explosion case in a power engineering course. Bartz & Deaton (1996) created a role-play of an industrial project team in a digital signal processing course. In science education, role-plays often simulate natural processes. For instance, Resnick and Wilensky (1998) described several role-plays to simulate the emergence of complex phenomena from simple interactions of particles. Andrianoff & Levine (2002) summarized fifteen years of literature on role-plays for simulation of computing concepts. Although Seat and Lord (1999) speculated that engineering

students who lack interpersonal skills might resist role-playing, none of these empirical articles reported any significant reluctance of science and engineering students to participate in role-play exercises. On the contrary, Simonneaux (2001) found that biotechnology students enthusiastically embraced a role-play of an animal transgenesis case.

2. Project Goals and Their Significance

We propose to create several **role-play scenarios about common RCR and professional conduct problems** that arise in multiple disciplines. These problems will include plagiarism, authorship, conflict of interest, interpersonal conflicts in mentoring, reporting of misconduct, and compliance with research regulations on human participants in research, animal subjects, and hazardous substances. With the scenarios, we will write instructions for their use and guides for moderators. The role-play scenarios will be suitable for both graduate courses and individual workshops on research ethics.

We expect that through the role-play scenarios, participants will learn

- to perceive and identify moral issues in the conduct of research
- to understand multiple perspectives in ethical disagreements in academic research
- to negotiate practical solutions to moral problems in conducting research

Compared with standard case-study methods, role-play requires the active, personal engagement of participants. Consequently, we believe that role-play can promote deep learning about RCR.

To determine whether our role-play scenarios achieve these desired outcomes, we will assess their effectiveness. Our assessments will be both **formative**, to improve the scenarios during their development, and **summative**. We will assess participants' learning immediately after each role-play session and some months later. We will use **multiple methods of assessment** systematically and rigorously to answer the following questions:

- *How should role-plays be organized for effective learning?*
- *How do the participants' conceptions of RCR change?* Do their skills in perceiving issues and in negotiating solutions improve? Do participants retain their new knowledge and skills?
- *Which kinds of students gain what kinds of benefits?* Do students in different disciplines respond differently to the same scenarios? Do men and women differ? Do domestic students differ from international students, whose communication skills in English may be limited?

This project will represent a significant advance in the teaching of research ethics, in many ways. First, few previous studies have carefully assessed the pedagogical effectiveness of role-play to teach ethics. None has used the range of methods that we plan to employ. None has examined what participants actually learn and retain. Second, previous studies of role-play for teaching research ethics have focused on psychology courses for undergraduates, but this project will focus on graduate students in several scientific disciplines. In the United States, many graduate students in science and engineering are international students who come from a great diversity of backgrounds and cultures. Third, perhaps most important, we will provide materials specifically for teaching the responsible conduct of research that can easily be adopted by other institutions, and whose effectiveness has been thoroughly assessed.

3. Project Plan

3.1. Development and Use of Role-Play Scenarios

We will develop eight **role-play scenarios**. Each scenario will be based on an actual incident or an amalgam of incidents. Identities of those involved in the incidents will be concealed by altering details and by using fictitious names. Together the scenarios will cover an array of RCR problems that occur across disciplines, including plagiarism, authorship, conflict of interest, interpersonal conflicts in mentoring, and concerns about compliance with research regulations on human participants in research, animal subjects, and hazardous substances. Two of the scenarios will involve identifying and reporting misconduct, i.e., whistle-blowing. Blowing the whistle is difficult in every setting, but particularly daunting for graduate students. Gunsalus (1998a, 1998b) recommended specific strategies for deciding whether to report research misconduct, and how to proceed once the decision is made.

Each scenario will have two speaking characters, usually a graduate student and a professor or institutional official. **Participants** with speaking roles will receive instructions for their characters. The participants should act out their roles as realistically as possible, to negotiate a solution to an ethical problem in a professional setting.

During a session, sufficient time should be available for two or more scenarios, so that participants can change roles between scenarios and thus learn the perspectives of different parties. Alternatively, participants could switch roles for the same scenario. When we used role-plays with medical students, we found that when students switch patient and doctor roles for the same scenario, the two role-plays often run differently and highlight different issues.

A session **moderator** will explain the role-play activity and describe approaches to the activity that will maximize the benefits to the participants. Then the moderator will introduce each scenario, organize the participants into pairs, and distribute instructions. Participants with the student role will receive one set of instructions, and those with the professor or institutional official role will receive a different set of instructions. After a role-play has run for ten minutes, the moderator will facilitate a discussion among all participants about the key points raised by the scenario. The moderator will have an outline with talking points, and a list of other resources for participants who have further questions.

Participants who are reluctant to assume speaking roles may serve as **observers** for a role-playing pair. Observers take notes as the scenario is played out. Each observer will have a guide to assess how well each participant conveyed the character's position, what points were missed by each speaker, where the interaction may have taken a turn for better or worse, and other factors relevant to the outcome. In the "fishbowl" variation, only two participants have speaking roles, and all other participants serve as observers.

A role-play can be organized as a **jigsaw**. In the jigsaw method, students are organized into home groups, and within each home group, each student is assigned responsibility for a distinct part of an entire lesson. Students with the same part first meet in expert groups to prepare their part. Then the students reassemble in their home groups, in which each member teaches the others in the home group one part of the lesson. In a jigsaw role-play (Brislin 1995), students who play the same character meet in their expert groups to prepare their character's positions. Then they assemble in home groups to run the role-play.

A role-play session can be organized in **teams**, with a team of three or four participants assigned to a character (Loui 2000). Following the principles of cooperative learning (Millis &

Cottell 1998), each team is structured with a speaker, a facilitator, and a timekeeper. Before the role-play runs, the participants in each team analyze their character's situation, prepare questions that their character might ask, anticipate questions from the other character, and formulate responses to those questions. By collaborating and sharing ideas, the participants can creatively expand the range of options that their character considers. During the role-play, the speaker can receive advice and suggestions from other team members.

A role-play session can be **computer-mediated**, in which participants interact through a Web discussion board. The role-play is held during a synchronous online session. If the role-play is conducted in teams, then students within each team exchange ideas either face-to-face if they are in the same room, or in a private chat space if they are physically separated. The team's speaker posts publicly the statements made by the team's character.

Although slower than a face-to-face role-play, a computer-mediated role-play has many advantages. First, participants need not be co-located. Second, participants who are reticent or shy in person may express their ideas articulately online. Finally, the textual interaction can be stored for later analysis without a separate transcription step.

We will develop instructions for the moderators, speakers, and observers. As an example of the materials that we will develop, we provide a draft of a role-play on an authorship dispute in Section 8 below.

Our role-play scenarios will share some of the beneficial characteristics of the **academic controversy** method (Johnson et al. 1996). In both the role-play scenarios and the academic controversy method, participants take opposite sides of an intellectual conflict, but they strive to negotiate a resolution. In academic controversy, after advocating for one side, participants switch sides to advocate the other side; in a role-play session, between scenarios, participants will switch roles. In both cases, the cooperative handling of a conflict stimulates fresh analyses and creative solutions. According to the research studies summarized by Johnson et al. (1996), academic controversy, in which participants endeavored to reach the best possible decision, produced better learning outcomes than classic debate, in which participants focused merely on winning: academic controversy yielded longer retention of knowledge, higher quality of problem solving, stronger motivation, and better social competence.

3.2. Testing

Before we test the materials, we will obtain approval from the local Institutional Review Board (IRB) for research with human participants. We expect that this project would be exempt from full IRB review under the provision for research in established educational settings. We will obtain the informed consent of all who participate in the tests used for assessment, as well as for any videotaping and later presentations of videos at professional meetings.

To ensure diversity among disciplines, we will test the materials with graduate students in several departments at Illinois. For **formative assessment**, we will choose three departments: a biological or agricultural science, a physical science or engineering, and a behavioral science. For **summative assessment**, we will choose five departments: one each from agriculture, engineering, behavioral science, biological science, and physical science. We will also test the materials in two departments at **Howard University**, a historically black institution, with approval from its IRB. See the letter of support from T. Broome.

At Illinois, we will test the materials during the mandatory annual sessions on research ethics in selected departments with fairly large graduate programs; see Table 1 for enrollments in

some departments in which we have recently led RCR programs. Thus we expect to obtain enough research participants for the quantitative assessments when we administer anonymous surveys and case analyses (see Section 3.3) during these sessions. To ensure diversity among students for the qualitative assessments, we will work with graduate program directors in these departments to recruit both men and women, and both domestic and international students, including members of underrepresented groups. For the qualitative assessments, as is customary, we would offer the volunteer research participants a small amount of money as compensation.

Table 1. Graduate Student Enrollments in Selected Programs at Illinois, Fall 2005

Graduate Program	***Graduate Enrollment***
Electrical and Computer Engineering	551
Materials Science and Engineering	171
Mechanical and Industrial Engineering	241
Molecular and Cellular Biology	435
Natural Resources and Environmental Sciences	94
Psychology	177

We will test the materials with both computer-mediated sessions and face-to-face sessions in various configurations—one-on-one role plays, team role-plays, and fishbowl role-plays. We will videotape the face-to-face tests for analysis. We will work with professionals at the university's public television station to videotape a few role-play sessions suitable for dissemination: to show at professional meetings and to train people to use these materials.

3.3. Assessment

We believe that role-play is an effective pedagogy because it engages participants both personally and actively, it requires creative solution of problems, and it promotes empathy with the perspectives of different parties. We will seek to explain the pedagogical benefits of role-play through rigorous assessment of how participants conduct a role-play and what they learn from the experience.

For formative and summative assessment, we plan to use multiple methods: surveys, case analyses, transcript analyses, focus groups, and individual interviews. In three of these five categories, we will apply methods recently developed specifically for the assessment of learning about professional ethics in science and engineering, rather than general tests of moral reasoning such as the Defining Issues Test (Rest et al. 1999). With sufficient quantitative data from the surveys and case analyses, we will check for correlations of the results with characteristics of participants: women vs. men, domestic vs. international, disciplinary differences, etc.

Surveys: We will administer surveys that assess the participants' understanding of topics covered by an RCR session. For example, a survey might ask participants to list characteristics of good research mentoring, to explain the reasons against copying the background section from an old article for a new article, or to define the criteria for co-authorship on an article in their discipline. Participants will complete a survey before the RCR session, immediately after the session, and several months later. To develop the surveys, we would borrow some questions from the baseline test of RCR knowledge that has been created and validated by Heitman et al.

(2005) at Vanderbilt University. This test emphasizes scientific misconduct, data management, human and animal subjects, and authorship and publication.

Case Analyses: Whereas a survey assesses a participant's thinking in the abstract, a case analysis probes the participant's ability to analyze a specific, realistic situation. For a case, participants will be asked to identify the RCR issues, suggest courses of action, imagine possible consequences of those actions, evaluate those consequences, and finally, recommend the best actions, with appropriate justifications. Participants will analyze a case before the RCR session and a similar case after the session. The participants' responses will be scored and compared according to the methodology of Sindelar et al. (2003). They showed that when readers are trained to apply explicit scoring rubrics, assessment by case analysis can be reliable and valid.

Transcript Analyses: We will transcribe the videotapes of role-play sessions and examine the records of the computer-mediated role-play sessions. Because transcribing the role-play sessions will be labor-intensive, we will select a small number of sessions randomly. We will apply standard content analysis techniques to the transcripts to find common themes and striking differences between participants (Denzin & Lincoln 2003).

Focus Groups: For formative assessment, we will convene focus groups of randomly selected participants from the same department who experienced the same role-play scenarios. Following standard procedures (Krueger & Casey 2000), we will ask the participants what they learned, what surprised them, and what changes could be made to improve the effectiveness of the role-plays.

Individual Interviews: To complement the written responses to the surveys and case analyses, we will interview selected participants, following a structured protocol. The protocol will feature a multiple variation scenario (Hashemian & Loui 2005). In the multiple variation scenario, the original version of the scenario presents benign problems that are straightforward to solve. Successive variations increase the stakes and difficulty. The participant is asked what he or she would do in each variation. We have used multiple variation scenarios to document how a course on engineering ethics changes students' understandings of professional responsibility: students who completed the course express greater confidence about taking action even when they have no assigned responsibility for a problem; compared with students who had not taken the course, these students have a more capacious understanding of professional responsibility as stewardship for society and the environment.

3.4. Duties of Graduate and Undergraduate Research Assistants

Throughout the project, we will collaborate with graduate and undergraduate research assistants. They will

- Pilot test the scenarios and instructions
- Help write the surveys, case analyses, and interview protocols
- Administer and score the surveys and case analyses
- Conduct the focus groups and interviews
- Videotape the face-to-face role-plays for assessment
- Transcribe and analyze the videos of the role-play sessions and audiotapes of the interviews
- Analyze the computer-based role-play sessions
- Write and present scholarly papers

This project will result in theses for the graduate students and possibly for the undergraduate students as well.

3.5. Schedule

Table 2 presents the project schedule by quarters.

Table 2. Project Schedule

	Year 1				Year 2				Year 3			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Draft and pilot-test scenarios and instructions	X											
Review scenarios and instructions with the advisory committee (see Section 7)	X											
Formative assessment: test scenarios in three departments at Illinois, administer surveys and case analyses, conduct focus groups and interviews, transcribe recordings		X	X									
Analyze formative assessment data with the research team and advisory committee			X	X								
Revise scenarios and instructions				X								
First phase of summative assessment: test scenarios in five departments at Illinois and in two departments at Howard University, administer surveys and case analyses, conduct interviews, transcribe recordings					X	X	X					
Analyze summative assessment data with the research team and the advisory committee						X	X					
Deliver interim reports at scholarly conferences							X	X				
Second phase of summative assessment: follow-up surveys, case analyses, and interviews to determine long-term impact								X	X			
High-quality professional video recording of selected role-play sessions for showing at professional meetings									X			
Analyze summative assessment data with the research team and advisory committee									X	X		
Write papers for submission to scholarly journals										X	X	
Demonstrate role-play at professional meetings											X	X
Archive materials at Online Ethics Center for Engineering and Science (see Section 4)												X

Because of budget limitations, we will seek separate funding for the high-quality professional video recording of selected role-play sessions.

4. Outcomes and Dissemination

We expect that this project will produce the following materials:

- A collection of role-play scenarios with instructions for speakers, observers, and moderators
- Videos of role-play sessions to show at conferences to reach potential adopters
- Assessments of the effectiveness of the role-play scenarios

Besides publishing conventional papers in scholarly conferences and journals, we plan to disseminate our results to multiple audiences in four ways:

1. To train **people who teach research ethics**, we plan to demonstrate the role-play technique at the annual Teaching Research Ethics workshop at Indiana University. See the letter of support from K. Pimple.
2. To reach **academics who teach applied ethics**, we intend to demonstrate a role-play at special sessions at the annual meeting of the Association for Practical and Professional Ethics and at the annual meeting of the Society for Ethics Across the Curriculum.
3. To inform **graduate deans**, we expect to show a video of a role-play session at meetings of the Midwest Association of Graduate Schools and the Council of Graduate Schools. See the letter of support from R. Wheeler.
4. To archive the materials for **electronic access**, we will post the complete set of role-play scenarios and instructions at the Online Ethics Center for Engineering and Science. We will ensure that these materials meet standards for accessibility by users with disabilities. See the letter of support from C. Whitbeck.

5. Qualifications and Duties of the Principal Investigators

C. Kristina Gunsalus is currently Special Counsel, Office of University Counsel, and Adjunct Professor, Colleges of Law and Medicine. Over a period of two decades, she previously served as Associate Provost and Associate Vice Chancellor for Research with overlapping service as Conflict of Interest Officer, as Executive Secretary to the Campus IRB and as Research Standards Officer, all at the University of Illinois at Urbana-Champaign. Gunsalus is a past member of the United States Commission on Research Integrity and the Association of American Medical Colleges Committee on Research Integrity. She served for four years as Chair of the AAAS Committee on Scientific Freedom and Responsibility and is an elected Fellow of the AAAS. She has published numerous articles and book chapters on issues of responsible conduct in research, is frequently invited to present RCR training programs, and continues to advise on and to participate as an invited member of investigation panels for universities and government agencies. She uses role-play and other active learning techniques in the courses she has developed and taught at the College of Law (Negotiation; Counseling, Fact Investigation and Interviewing) and at the College of Medicine (Communication, Conflict Resolution and Ethics modules in the Medicine and Society course) at Illinois. Her forthcoming book *The College Administrator's Survival Guide*, to be published by Harvard University Press, addresses how to handle conflict situations and ethical dilemmas in university departments. She will be primarily responsible for developing the role-play scenarios.

Michael C. Loui is Professor of Electrical and Computer Engineering and University Distinguished Teacher/Scholar at the University of Illinois at Urbana-Champaign. He was an associate dean of the Graduate College at Illinois from 1996 to 2000 and the campus's Research Standards Officer (research integrity officer) from 1998 to 2000. He uses role-play exercises

when he teaches courses on engineering ethics and on professional ethics. He has served on the Advisory Board of the Online Ethics Center for Engineering and Science since its inception; he also serves on the Executive Board of the National Institute for Engineering Ethics, on the Board of Governors of the IEEE Society for Social Implications of Technology, and on the editorial boards of *College Teaching*, *Accountability in Research*, and *Teaching Ethics*. He has reviewed research and graduate programs at five other universities. He has collaborated with both undergraduate and graduate students in educational research projects (e.g., Chmiel & Loui 2003; Hashemian & Loui 2005). He has led many sessions on RCR on campus. In April 2004, he co-led (with N. Steneck) a day-long RCR workshop at Northern Illinois University. In 2003, he was named a Carnegie Scholar by the Carnegie Foundation for the Advancement of Teaching, to contribute to an emerging scholarship of teaching and learning. In 2006, he was elected Fellow of the IEEE for leadership in teaching engineering ethics. He has studied the effect of ethics instruction on the development of professional identities of engineering students (Loui 2005b). For this project, he will oversee the assessment efforts.

6. Results from Prior NSF Support

NSF Grant SES-0138309
National Institute for Engineering Ethics Video Project: A Sequel to Gilbane Gold
PIs: J. H. Smith, W. D. Lawson, M. C. Loui, S. P. Nichols, P. E. Ulmer, V. Weil
$183,577, from March 1, 2002 to February 28, 2005

We developed a new video *Incident at Morales*, which dramatizes a fictional but realistic case study in engineering ethics. The new video is directed to a broad audience, including engineering students, practicing engineers, and others who work with engineers. The video emphasizes everyday concerns rather than whistle-blowing situations, and it shows engineering in an international context. The video shows positive and negative role models of engineers who strive to reconcile conflicting ethical, technical, and economic constraints. We wrote a detailed study guide that accompanies the video, and we sent one free copy of the video and study guide to the dean of each engineering school in the United States. We showed the video at a conference on Ethics and Social Responsibility in Engineering and Technology, and at meetings of the Association for Practical and Professional Ethics and the National Academy of Engineering. In 2003, we demonstrated the pedagogical use of the video with two cooperative learning techniques in a special session at the Frontiers in Education Conference. We assessed the educational effectiveness of the video, using multiple instruments, with both student and professional audiences (Loui 2006). A single showing of the video produced statistically significant positive changes in viewers' opinions about engineering practices, and statistically significant improvements in the sophistication of viewers' moral reasoning skills. Both VHS and DVD versions of the video are now available for purchase through the National Institute for Engineering Ethics (www.niee.org).

Publications supported by this grant

Allender, E., Loui, M. C., & Regan, K. W. (2004). Complexity theory. In A. Tucker (Ed.), *The Computer Science Handbook* (pp. 5-1 to 5-30). Boca Raton, Fla.: CRC Press.

Chmiel, R., & Loui, M. C. (2003). An integrated approach to instruction in debugging computer programs. *IEEE Transactions on Education*, to appear. Preliminary version: In *Proceedings*

of the Thirty-Third ASEE/IEEE Frontiers in Education Conference, Westminster, Colo., November 5–8, 2003 (pp. S4C-1 to S4C-6).

Chmiel, R., & Loui, M. C. (2004). Debugging: from novice to expert. In *Proceedings of the Thirty-Fifth ACM Technical Symposium on Computer Science Education*, Norfolk, Va., March 3–7, 2004 (pp. 17–21).

Hashemian, G., & Loui, M. C. (2005). Work-in-progress: Engineering courage: from "not my business" to positive responsibility. *Proceedings of the Thirty-Fifth ASEE/IEEE Frontiers in Education Conference*, Indianapolis, Ind., October 19–22, 2005 (pp. S3D-17 to S3D-18).

Liao, I., & Loui, M. C. (2005). Work-in-progress: Do women score lower than men on computer engineering exams? *Proceedings of the Thirty-Fifth ASEE/IEEE Frontiers in Education Conference*, Indianapolis, Ind., October 19–22, 2005 (pp. T3D-7 to T3D-8).

Loui, M. C., LeFevre, E. W., Nichols, S. P., Skooglund, C. M., Smith, J. H., Suppe, F., Ulmer, P. E., and Weil, V. (2003). *Incident at Morales*: an engineering ethics video. In *Proceedings of the Thirty-Third ASEE/IEEE Frontiers in Education Conference*, Westminster, Colo., November 5–8, 2003 (pp. S1H-1 to S1H-2).

Loui, M. C. (2005a). Educational technologies and the teaching of ethics in science and engineering. *Science and Engineering Ethics*, *11* (3), 435–446.

Loui, M. C. (2005b). Ethics and the development of professional identities of engineering students, *Journal of Engineering Education*, *94* (4), 383–390. Preliminary version: *Proceedings of the Thirty-Fourth ASEE/IEEE Frontiers in Education Conference*, Savannah, Ga., October 20–23, 2004 (pp. T2E-11 to T2E-12).

Loui, M. C. (2006). Assessment of an engineering ethics video: *Incident at Morales*. *Journal of Engineering Education*, *95* (1), 85–91. Preliminary version: *Proceedings of the Thirty-Fifth ASEE/IEEE Frontiers in Education Conference*, Indianapolis, Ind., October 19–22, 2005 (pp. S3D-19 to S3D-20).

Pae, S-I., and Loui, M. C. (2005). Optimal random number generation from a biased coin. In *Proceedings of the Sixteenth Annual ACM-SIAM Symposium on Discrete Algorithms*, Vancouver, Canada, January 23–25, 2005 (pp. 1079–1088).

7. Institutional Context and Commitment

The **University of Illinois at Urbana-Champaign** is an ideal site for this project. Because graduate programs in science and engineering disciplines are large and diverse, and because departments are required to offer research ethics events annually, we expect to gather sufficient data for meaningful quantitative assessments of the role-play scenarios. In addition, as an institutional participant in the Carnegie Academy for the Scholarship of Teaching and Learning, the University is committed to supporting scholarly investigations of teaching and learning across the campus.

The **Office of the Vice Chancellor for Research** (OVCR) at the University of Illinois at Urbana-Champaign develops and maintains policies on research integrity, conflict of interest, animal subject use, human subject use, and software piracy. The OVCR works closely with the Graduate College on these matters. The OVCR also maintains a list of activities that departments and research units employ in meeting requirements on responsible conduct of research.

The **Graduate College** at the University of Illinois at Urbana-Champaign has oversight responsibility for approximately 9,000 graduate students in over 100 master's and doctoral degree programs. In 2001, the University ranked third in the United States in the number of

doctoral degrees awarded. The Graduate College develops and safeguards standards of graduate work, and it promotes the maintenance of the highest standards in the responsible conduct of research. The Graduate College is the primary contact for both faculty and graduate students when issues of research integrity arise.

For this project, the Dean of the Graduate College will appoint an advisory committee to assist with the project. We expect that the committee will include research faculty from the departments in which we test the scenarios, two senior graduate students, a representative from the OVCR, and an associate dean of the Graduate College. Committee members will review the scenarios and instructions, and they will help interpret the results of the formative and summative assessments. See the letters of support from R. Wheeler and C. Zukoski.

8. Example of a Role-Play Scenario and Instructions

As an example of the role-play scenarios that we propose to develop, we present a draft of a scenario on an authorship issue.

8.1. Instructions for the Moderator

Whose Chapter Is It? A Question of Authorship

In this scenario, a graduate student meets the graduate program director in the student's department to discuss an authorship problem. Working with Professor Randall Plottner, the student drafted several versions of a chapter for a forthcoming book. The student has learned that Plottner has submitted the book chapter for publication without listing the student as a co-author.

1. First explain the role-play activity. Assure the participants that although they may feel apprehensive, the more authentically they engage in their roles, the more they will learn.
2. Organize the participants into groups. Each group should have two participants with speaking roles: the graduate program director and the graduate student. Each group may also have one or more silent observers. Participants who feel uncomfortable with speaking roles should serve as observers. If a participant with a speaking role finds that the scenario strikes too close to home, that participant may switch roles with an observer. Observers frequently have insights about the interaction that the speakers do not notice as they play their characters. At least some participants should serve as observers.
3. Distribute sheets with instructions to the participants. The instructions for each of the three roles should be on different colored paper. Each observer should read the instructions for both speaking roles too.
4. Start the role-play. During the role-play, circulate among the groups. Listen for recurring themes and patterns to highlight during the open discussion period (Step 6 below).
5. The role-play should run for ten to fifteen minutes. Stop the role-play when most groups have elicited the full story in the scenario and are well into exploring possible courses of action.
6. Conduct a discussion among all of the participants, incorporating the recurring themes that you observed. Ask what was happening in the interactions. Piece together the overall situation. Alternately ask those who played each speaking character how they felt:
    - Ask those playing the graduate student about the student's concerns.
    - Ask those playing the graduate program director how they understood the situation from their perspectives.

- How do the graduate program director's preconceived notions about the student affect the interaction? Does this happen often? What can be done about this?

7. Ask for hypotheses about the missing facts in this situation. Encourage the participants to brainstorm different possibilities, rather than simple black-and-white interpretations.
8. Ask what departmental or institutional policies apply to this situation.
9. If not all of the relevant facts have emerged in the discussion so far, ask participants who played students to exchange instructions with those who played graduate program directors, and to read each other's instructions. Comment on the importance of understanding the perspectives of other people.
10. Ask for possible solutions to the problem:
    - What should the graduate program director do next?
    - Should the student proceed with a formal complaint or not?
    - What are possible or likely consequences of those actions?
    - Is a good outcome possible?
    - What elements might make a good outcome more likely?
11. Discuss the principles that apply to authorship and attribution of credit in research. Outline definitions of plagiarism. Describe the local policies on allegations of research misconduct that apply to this situation and safeguards for the student. If time permits, follow the steps in "How to Blow the Whistle and Still Have a Career Afterwards" (Gunsalus 1998b).
12. Close by telling the end of the story of the incident on which this role-play is based. The student did file a formal complaint, and a research integrity inquiry followed. The inquiry committee obtained the submitted draft chapter from the book editor and compared it with the student's drafts. Other than the title, there was no resemblance. The committee interviewed Professor Plottner, who told the committee that the student's work was so bad that he had discarded all of it, and he had written the submitted chapter hastily himself. He felt nothing could have been salvaged from the student's work. The committee found that Plottner had not committed plagiarism or violated authorship standards, but that he had failed to meet standards for mentoring graduate students. Plottner's graduate faculty privileges were suspended by the dean of the college because the department head did not want to rock the boat. (At the request of the dean, the department head stepped down at the end of the academic year.) The dean then required Plottner to meet with him monthly until the dean was personally satisfied that he met the institution's standards for serving as a member of the graduate faculty. These meetings lasted almost two years.

    Notwithstanding his own unacceptable conduct, Plottner was outraged that his integrity had been impugned. In his ire, Plottner wanted to expel the student from the institution. Instead, the student found another advisor in another department who had higher professional standing than Plottner. The student eventually completed the doctorate, about one year later than he had originally expected. He found an academic job and earned tenure. We hope he's treating his own students well, but we don't know for sure.

8.2. Instructions for Role-Play of the Graduate Program Director

What follows is an outline of your role. You will need to improvise to some extent. Be creative, but try to stay within the bounds of what seems realistic. Assume that anything the student says is in writing, and that documents the student shows you are authentic.

You are the new graduate program director in your department. A graduate student has made an appointment with you to talk confidentially about a problem with the student's research advisor.

Before the appointment, you review the student's graduate records file. You note that the student is on academic probation, an extremely unusual situation in your department. You also read documents in the file that indicate that the student has talked with the department head and the previous graduate program director about concerns about several different faculty members. In every case, the student declined to submit a formal complaint, even when the complaint might have been warranted. It appears that the student just wanted to vent frustrations with someone sympathetic. You see in the file that the student's research advisor is Randall Plottner.

Plottner is prominent in your discipline. He publishes prolifically, and he is frequently quoted as an expert in the *New York Times* and the *Wall Street Journal*. Because of his national reputation, he was offered a prestigious endowed chair by an Ivy League university last year. Your institution mounted a major retention effort, and you guess Plottner received a big raise in salary to stay. The offer and the counter-offer were reported at length in both the local newspaper and the *Chronicle of Higher Education*. (Neither newspaper mentioned that his elderly mother lives about thirty miles away, and he was reluctant to leave town.) You know that Plottner is extremely disorganized and usually late with whatever he does. You also know that Plottner is arrogant and obnoxious, and that everyone in the department—in fact, anyone who has ever worked with him—dislikes him intensely.

8.3. Instructions for Role-Play of the Graduate Student

What follows is an outline of your role. You will need to improvise to some extent. Be creative, but try to stay within the bounds of what seems realistic.

After several sleepless nights, you have made an appointment to talk with the new graduate program director in your department. This professor is known as a champion of students—very pleasant and easy to talk to. You hope you are making the right decision, but you don't have any other ideas.

Here is the problem. Your research advisor, Randall Plottner, was invited to contribute to a forthcoming book, and you have been working on the book chapter with him. Originally Professor Plottner gave you the letter inviting his participation, and he suggested that this would be a good project for you. You have the letter with Professor Plottner's note scrawled across the bottom: "Take a stab at this. —RP"

You have gathered your drafts; you have written so many, you're not sure you have all of the drafts, but you have at least five different versions. Each version is dated and has handwritten comments by Professor Plottner in the margins that suggest revisions and additions; the handwriting matches the handwriting on the letter. These drafts show the evolution of the chapter, as you incorporated each of Professor Plottner's suggestions in each successive version. At the end of the most recent version is a note saying, "This is fine. No more work will be necessary. —RP." *You can offer all of these documents during your conversation; the other role-player will accept your claim that these documents are authentic.*

Your best friend works in the main office of the department. Last week your friend mailed a package for Professor Plottner to submit the chapter to the editor of the book. Your friend told you that the chapter had the same title as the chapter that you had been drafting for months, but the only name listed as an author of the chapter was Professor Plottner's.

At first you couldn't decide what to do. Yesterday you went to see Professor Plottner. You thought you handled the situation well. You asked about the chapter, and he told you not to worry about it. Finally you screwed up your courage and asked him when it would be published, because you would like to list the chapter on your resume as a co-author. His answer stunned you. He said (these are his exact words), "Oh, don't worry about that. This was a learning exercise. You'll get to co-author things later." You don't want any trouble with Professor Plottner, but you feel that you have been unfairly deprived of credit for your work. You plan to talk with the graduate program director to figure out what to do.

8.4. Instructions for the Observer

Watch the interview and take notes.

- What is the student trying to convey?
- What is the graduate program director trying to achieve in this meeting?
- Did the student read the signals from the graduate program director well? What cues did you see?
- Did the graduate program director listen carefully to the student? How could you tell?
- What questions should have been asked but were not? What else could have been said?

9. Summary

In this section, we state clearly what we will do and what we will not do in this project.

First, as in the academic controversy method (Johnson et al. 1996), we will structure each role-play scenario to encourage participants to resolve the conflict by reaching a consensus. We chose this structure primarily to achieve the pedagogical benefits of cooperative conflict, not merely to teach conflict resolution skills. Thus we would not duplicate the conflict resolution program developed at Michgan State University (Klomparens & Beck 2004). In the Michigan State program, graduate students and faculty advisors learn conflict resolution skills by discussing brief video vignettes. In our proposed project, participants will not watch videos but will instead perform role-plays. Our role-plays could substitute for the video vignettes as part of a larger program to teach conflict resolution skills. We believe that participants will learn more from engaging in the role-plays than from experiencing problems vicariously by watching videos or reading text cases.

Second, we would not establish an ongoing campus-level program of RCR education that would require institutional commitment to its sustainability. Instead, we will develop and disseminate educational materials on core RCR topics, and we would conduct rigorous research on the effectiveness of these materials.

In conclusion, we will examine a potentially powerful pedagogical technique, paired role-play. We will use quantitative and qualitative methods to carefully assess the effectiveness of role-play in achieving key learning objectives in RCR education, with diverse graduate students from multiple science and engineering departments at two different institutions. Through this project, we expect to significantly advance the practice of teaching in research ethics.

References

Andrianoff, S. K., & Levine, D. B. (2002). Role-playing in an object-oriented world. *ACM SIGCSE Bulletin*, *34* (1), 121–125. Retrieved January 8, 2006, from ACM Portal.

Association of American Medical Colleges. (1994). *Teaching the Responsible Conduct of Research Through a Case Study Approach*. Washington, D.C.: Association of American Medical College.

Bartz, M., & Deaton, R. J. (1996). Role playing in engineering education. *Proceedings, ASEE Annual Conference & Exposition*, Washington, D.C., June 23–26, 1996 (Session 1532). Retrieved January 8, 2006, from http://www.asee.org.

Bebeau, M. J., Pimple, K. D., Muskavitch, K. M. T., Smith, D. H., & Borden, S. L. (Eds.). (1995). *Moral Reasoning in Scientific Research*: *Cases for Teaching and Assessment*. Bloomington, Ind.: Poynter Center for the Study of Ethics and American Institutions, Indiana University. Retrieved January 7, 2006, from http://poynter.indiana.edu/mr-main.shtml

Bragger, J. D., & Freeman, M. A. (1999). Using a cost-benefit analysis to teach ethics and statistics. *Teaching of Psychology*, *26* (1), 34–36. Retrieved January 7, 2006, from EBSCO.

Brislin, T. (1995). Active learning in applied ethics instruction. *Journal on Excellence in College Teaching*, *6* (3), 161–167. Retrieved January 7, 2006, from http://ject.lib.muohio.edu.proxy2.library.uiuc.edu/

Brown, K. M. (1994). Using role play to integrate ethics into the business curriculum: a financial management example. *Journal of Business Ethics*, *13* (2), 105–110. Retrieved January 7, 2006, from ProQuest.

Chmiel, R., & Loui, M. C. (2003). An integrated approach to instruction in debugging computer programs. In *Proceedings of the Thirty-Third ASEE/IEEE Frontiers in Education Conference*, Westminster, Colo., November 5–8, 2003 (pp. S4C-1 to S4C-6).

Committee on Science, Engineering, and Public Policy, National Academy of Sciences, National Academy of Engineering, and Institute of Medicine (1995). *On Being a Scientist: Responsible Conduct in Research* (2nd ed.). Washington, D.C.: National Academy Press. Retrieved January 7, 2006, from http://www.nap.edu/readingroom/books/obas

Cooley, W. L., Klinkhachorn, P., McConnell, R. L., & Middleton, N. T. (1991). Developing professionalism in the electrical-engineering classroom. *IEEE Transactions on Education*, *34* (2), 149–154. Retrieved January 8, 2006, from IEEExplore.

Dalman-Hess, E., Ruddy, R. A., & Hernandez, L. (1997). Creating solutions to an ethical dilemma. *Nurse Educator*, *22* (4), 6. Retrieved January 8, 2006, from Ovid.

Denzin, N. K., & Lincoln, Y. S. (Eds.). (2003). *Collecting and Interpreting Qualitative Materials*, 2nd ed. Thousand Oaks, Calif.: Sage.

Didier, C. (2000). Engineering ethics at the Catholic University of Lille (France): research and teaching in a European context. *European Journal of Engineering Education, 25* (4), 325–335. Retrieved January 6, 2006, from EBSCO.

Garvin, W., & Stefani, L. A. J. (1993). Genethics—genetic disorder and diagnosis: a role-play exercise. *Journal of Biological Education*, *27* (1), 51–57. Retrieved January 7, 2006, from EBSCO.

Gunsalus, C. K. (1998a). Preventing the need for whistleblowing: practical advice for university administrators. *Science and Engineering Ethics*, *4* (1), 75–94.

Gunsalus, C. K. (1998b). How to blow the whistle and still have a career afterwards. *Science and Engineering Ethics*, *4* (1), 51–64.

Hashemian, G., & Loui, M. C. (2005). Work-in-progress: Engineering courage: from "not my business" to positive responsibility. *Proceedings of the Thirty-Fifth ASEE/IEEE Frontiers in Education Conference*, Indianapolis, Ind., October 19–22, 2005 (pp. S3D-17 to S3D-18).

Heitman, E., Anastidou, L., & Bulger, R. E. (2005). Testing new graduate student's baseline knowledge of RCR (Unpublished presentation), Graduate Education for the Responsible Conduct of Research: A Meeting for Institutions Participating in the CGS/ORI RCR Project, Council of Graduate Schools Summer Workshop, Santa Fe, N. Mex., July 9, 2005.

Heitman, E., & Bulger, R. E. (2005). Assessing the educational literature in the responsible conduct of research for core content. *Accountability in Research, 12* (3), 207–224.

Herkert, J. R. (1997). Collaborative learning in engineering ethics. *Science and Engineering Ethics*, 3 (4), 447–462.

Johnson, D. W., Johnson, R. T., & Smith, K. A. (1996). *Academic Controversy*: *Enriching College Instruction through Intellectual Conflict.* ASHE-ERIC Higher Education Report Vol. 25, No. 3. Washington, D.C.: The George Washington University, Graduate School of Education and Human Development.

Johnson, W. B., & Corser, R. (1998). Learning ethics the hard way: facing the ethics committee. *Teaching of Psychology*, *25* (1), 26–28. Retrieved January 7, 2006, from EBSCO.

Klomparens, K. L., & Beck, J. P. (2004). Michigan State University's conflict resolution program: setting expectations and resolving conflicts. In D. H. Wulff & A. E. Austin (Eds.), *Paths to the Professoriate*: *Strategies for Enriching the Preparation of Future Faculty* (pp. 250–263). San Francisco: Jossey-Bass.

Krueger, R. A., & Casey, M. A. (2000). *Focus Groups: A Practical Guide for Applied Research*, 3rd ed. Thousand Oaks, Calif.: Sage Publications.

Loui, M. C. (2000). Fieldwork and cooperative learning in professional ethics. *Teaching Philosophy*, *23* (2), 139–156.

Loui, M. C. (2005b). Ethics and the development of professional identities of engineering students, *Journal of Engineering Education*, *94* (4), 383–390.

Macrina, F. L. (2000). *Scientific Integrity: An Introductory Text with Cases* (2nd ed.). Washington, D.C.: American Society for Microbiology Press.

Millis, B. J., & Cottell, P. G. (1998). *Cooperative Learning for Higher Education Faculty*. Phoenix, Ariz.: Oryx Press.

Nelson, M. S., & Eliastam, M. (1991). Role-playing for teaching ethics in emergency medicine. *American Journal of Emergency Medicine*, *9* (4), 370–374.

Online Ethics Center for Engineering and Science (2004). Retrieved January 7, 2006, from http://onlineethics.org

Pearce, J. A. (2001). Constructing classroom role playing exercises. *Proceedings, ASEE Annual Conference & Exposition*, Albuquerque, N. Mex., June 24–27, 2001 (Session 2632). Retrieved January 8, 2006, from http://www.asee.org.

Penslar, R. L. (Ed.). (1995). *Research Ethics: Cases and Materials.* Bloomington, Ind.: Indiana University Press.

Pimple, K. D. (2001). Assessing teaching and learning in the responsible conduct of research. Retrieved January 7, 2006, from the Indiana University Web site: http://mypage.iu.edu/~pimple/iom3.pdf

Raisner, J. A. (1997). Using the "ethical environment" paradigm to teach business ethics: the case of the maquiladoras. *Journal of Business Ethics*, *16* (12–13), 1331–1346. Retrieved January 7, 2006, from ProQuest.

Research Ethics Modules (2001). Retrieved January 7, 2006, from the North Carolina State University Graduate School Web site: http://www.fis.ncsu.edu/Grad/ethics/modules/index.htm

Resnick, M., & Wilensky, U. (1998). Diving into complexity: developing probabilistic decentralized thinking through role-playing activities. *Journal of the Learning Sciences*, *7* (2), 153–172.

Rest, J., Navarez, D., Bebeau, M., & Thoma, S. J. (1999). A neo-Kohlbergian approach: the DIT and schema theory. *Educational Psychology Review*, *11* (4), 291–324.

Rosnow, R. L. (1990). Teaching research ethics through role-play and discussion. *Teaching of Psychology*, *17* (3), 179–181. Retrieved January 7, 2006, from EBSCO.

Sanyal, R. N. (2000). An experiential approach to teaching ethics in international business. *Teaching Business Ethics*, *4* (2), 137–149. Retrieved January 7, 2006, from ProQuest.

Schrag, B. (Ed.). (1997–2002). *Research Ethics: Cases and Commentaries* (Vols. 1–6). Bloomington, Indiana: Association for Practical and Professional Ethics. Retrieved January 7, 2006, from http://www.onlineethics.org/reseth/appe/index.html

Seat, E., and Lord, S. M. (1999). Enabling effective engineering teams: a program for teaching interaction skills. *Journal of Engineering Education*, *88* (4), 385–390.

Shamoo, A. E., & Resnik, D. B. (2003). *Responsible Conduct of Research*. New York: Oxford University Press.

Simonneaux, L. (2001). Role-play or debate to promote students' argumentation and justification on an issue in animal transgenesis. *International Journal of Science Education*, *23* (9), 903–927. Retrieved January 8, 2006, from EBSCO.

Sindelar, M., Shuman, L., Besterfield-Sacre, M., Miller, R., Mitcham, C., Olds, B., Pinkus, R., & Wolfe, H. (2003). Assessing engineering students' abilities to resolve ethical dilemmas. *Proceedings, 33rd Annual ASEE/IEEE Frontiers in Education Conference*, Westminster, Colo., November 5–8, 2003 (pp. S2A-25 to S2A-31).

Sofaer, B. (1995). Enhancing humanistic skills: an experiential approach to learning about ethical issues in health care. *Journal of Medical Ethics*, *21* (1), 31–34.

Steneck, N. H. (2004). *ORI Introduction to the Responsible Conduct of Research*. Rockville, Md.: Office of Research Integrity.

Strohmetz, D. B., & Skleder, A. A. (1992). The use of role-play in teaching research ethics: a validation study. *Teaching of Psychology*, *19* (2), 106–108. Retrieved January 7, 2006, from EBSCO.