

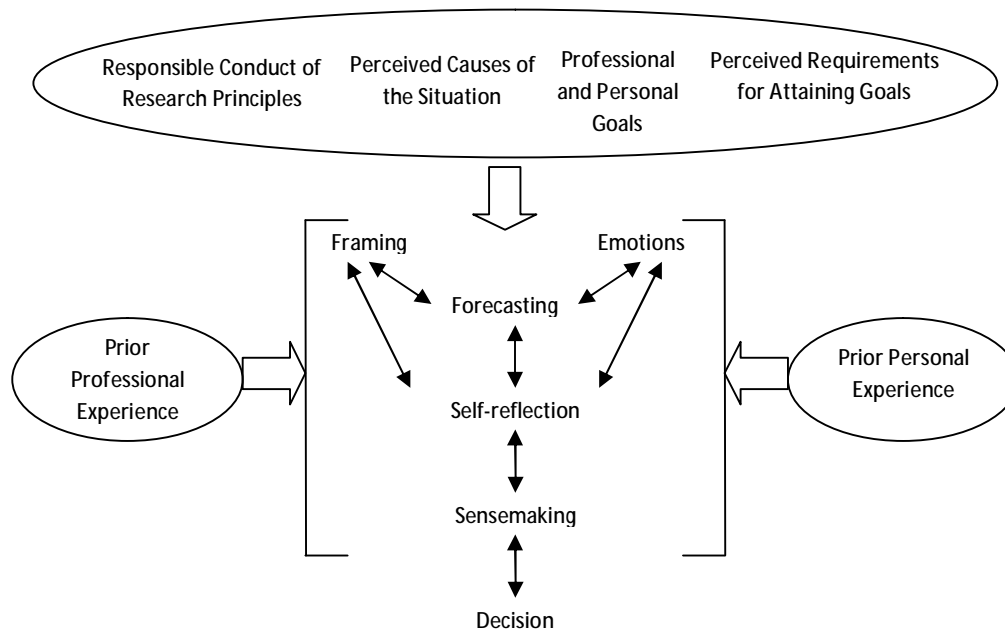
Current Issues and Directions in Ethics Instruction for Scientists and Engineers

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I. Sensemaking Model of Ethical Decision-Making

Several key premises regarding the nature of ethical research practices on the part of scientists and engineers serve as the basis of this model. First, ethical research practices arise from decisions about how to respond to complex, ill-defined work problems. Second, tradeoffs exist between various decisions, and the issues underlying these decisions are seldom black-and-white. Third, making a decision involves social implications and depends on predicting likely outcomes for oneself, others, and the work being conducted. Thus, when presented with an ambiguous, high-stakes problem, scientists and engineers arrive at a decision by engaging in “sensemaking” – a form of complex cognition concerning how one thinks through and understands the problem.

More specifically, the model proposes that several situational considerations will influence the initial appraisal of the problem, including professional codes of conduct and responsible research principles, perceived causes of the situation, personal and professional goals, and perceived requirements for attaining these goals. These considerations contribute to the complexity and ill-defined nature of the problem situation and serve as the basis for framing, or defining the nature of the problem, including recognition of whether ethical implications are inherent in the problem, and one’s role in the situation. When the problem is defined as having ethical implications and implications for the attainment of personal and/or professional goals, emotions are aroused. Framing of the situation and the activation of emotions, in turn, leads to forecasting of the potential outcomes of various courses of action. Forecasting involves reflection on prior personal and professional experiences and conceptions of self, which ultimately gives rise to sensemaking. In turn, it is sensemaking with respect to the ethical situation that yields decisions on the part of scientists and engineers.



II. Sensemaking Approach to Responsible Conduct of Research (RCR) Training

Training developed on the basis of this model requires three critical components: 1) viable case models to be drawn upon during sensemaking, 2) interactive, cooperative learning to promote social reinforcement and to emphasize the social nature of ethical problems, and 3) strategies that promote sensemaking activities during ethical decision-making (strategies outlined below).

More specifically, the training is a two-day course consisting of about 16 hours of instruction. The training consists of 10 “blocks”, or training modules, which are outlined below. These modules cover many topics, including guidelines, reasoning errors, strategies that can be used as decision-making tools, and field differences. Delivery of the training consists of short introductions of key principles provided by instructors followed by interactive activities (e.g., role-plays, cases, and discussions) which focus on generation, practice, and application of training material.

In summary, the overarching instructional objectives are to: 1) develop students’ understanding of the ambiguous, complex nature of the problems that they might encounter in their work, 2) provide case examples, and 3) teach strategies that help students to identify and think through complex problems to make ethical decisions.

Strategies

- *Recognizing your circumstances:* Thinking about origins of problem, individuals involved, and relevant principles, goals and values
- *Seeking outside help:* Talking with a supervisor, peer, or institutional resource, or learning from others' behaviors in similar situations
- *Questioning one's own judgment:* Considering problems that people often have with making ethical decisions, remembering that decisions are seldom perfect
- *Dealing with emotions:* Assessing and regulating emotional reactions to the situation
- *Anticipating consequences of actions:* Thinking about many possible outcomes such as consequences for others, short and long term outcomes based upon possible decision alternatives
- *Analyzing personal motivations:* Considering one's own biases, effects of one's values and goals, and questioning ability to make ethical decisions
- *Considering the perspectives of others:* Being mindful of others' perceptions, concerns, and the impact of your actions on others, socially and professionally

Training Program Overview

<i>Module</i>	<i>Title</i>	<i>Objectives</i>	<i>Content</i>	<i>Cases and Exercises</i>
1	Learning Ethical Research Guidelines (self-directed pre-training)	<ul style="list-style-type: none"> Understand and apply fundamental research guidelines in ethical decision-making Understand limitations of rule based approach 	<ul style="list-style-type: none"> Guidelines Packet Cases and Questions Packet 	<ul style="list-style-type: none"> 4 Case Studies with questions
2	Complexity in Ethical Decision-Making	<ul style="list-style-type: none"> Review research guidelines Become aware of the complexity of ethical dilemmas 	<ul style="list-style-type: none"> Training introduction Discussion of what constitutes an ethical decision. Discuss Solutions to Module 1 Cases 	<ul style="list-style-type: none"> Self-Reflection Activity Pre-training EDM Measure Module 1 Case Discussion
3	Personal Biases Influencing Ethical Decision-Making	<ul style="list-style-type: none"> Understand biases in ethical decision-making Trainees forecast how they might act in an ethical dilemma. 	<ul style="list-style-type: none"> Research on how people think they will make ethical decisions Decision making errors and personal biases 	<ul style="list-style-type: none"> Self-Enhancement Demonstration Milgram Study Video Behavior Predictions Activity
4	Problems Encountered in Ethical Decision-Making	<ul style="list-style-type: none"> Understand EDM problems Identify and generate problems interfering with decision-making 	<ul style="list-style-type: none"> Myths of Ethical Decision-Making Problems that inhibit ethical decision-making 	<ul style="list-style-type: none"> Hit or Myth Activity Problem Identification Problem Generation
5	Ethical Decision-Making Model and Decision-Making Strategies	<ul style="list-style-type: none"> Understand sense-making model Understand and apply strategies to ethical situations 	<ul style="list-style-type: none"> EDM Model Introduction to and use of strategies that enhance ethical decision-making ability 	<ul style="list-style-type: none"> Strategy Generation: "Baltimore Affair" Case Training Feedback
6	Field Specific Differences in Applying the EDM Model (self-directed between sessions)	<ul style="list-style-type: none"> Locate field specific guidelines Apply EDM model Utilize Strategies 	<ul style="list-style-type: none"> Finding guidelines and considering their use Applying knowledge learned on Day 1 	<ul style="list-style-type: none"> Locate Field Specific Guideline Two Cases with Questions
7	Sensemaking in Ethical Decision-Making	<ul style="list-style-type: none"> Conceptualize complexity of EDM through sense-making model Understand sensemaking and relationship with EDM 	<ul style="list-style-type: none"> Module 6 Homework Review Sensemaking Introduction 	<ul style="list-style-type: none"> Role Play Activity: "A Clash to Remember"
8	Complex Field Differences	<ul style="list-style-type: none"> Understand ethical decision-making across disciplines 	<ul style="list-style-type: none"> Introduction to research across disciplines Group application 	<ul style="list-style-type: none"> Discuss Field Guidelines "Big Pharma" Group Case and questions
9	Understanding Different Perspectives	<ul style="list-style-type: none"> Evaluate decisions while considering multiple perspectives 	<ul style="list-style-type: none"> Consider viewpoints of people in research process Reflect on elements of Ethical Decision-Making 	<ul style="list-style-type: none"> "Wunderkind" Case Study and Role Play Activity Self-Reflection Activity Training Feedback
10	Ethical Decision-Making Post-Training Assessment	<ul style="list-style-type: none"> Review problems and strategies learned Integrate understanding Apply knowledge and skills 	<ul style="list-style-type: none"> Review training components Apply problems and strategies to scenarios 	<ul style="list-style-type: none"> Baltimore "Plot-twists" Post-training EDM Measure

The training was evaluated in three samples, including a “Scientist Sample” consisting of graduate students working in the social, biological, and health sciences, an “Engineer Sample” consisting of graduate students, post-doctoral fellows, research scientists, and faculty members in engineering, computer science, and meteorology, and, finally, an “Undergraduate Sample” consisting of undergraduates working in computer science, engineering, mathematics, and meteorology.

Training evaluation was based on the completion of parallel pre-post ethical decision-making measures. These measures present real-world ethical problems and require participants to choose two decisions, from eight possible response options, that they believe are most appropriate for the situation. The responses are complex; they are not transparent, indeed, all are plausible responses.

Scores were obtained for ethicality of decision-making in four domains of research conduct, namely data management, study conduct, professional practices, and business practices. In addition, these measures provided scores for strategies underlying decisions options. Thus, evaluation was based on pre-post comparison of ethicality and strategy scores; the effect sizes are reported below. Given standard interpretations of Cohen’s *d* effect size (i.e., small = .20, moderate = .50, and large = .80), the results showed moderate to large gains across the decision-making domains in addition to moderate to large gains for the strategies.

Pre- to Post-test Changes	Effect Size (Cohen’s <i>d</i>)		
	Scientist Sample ^a	Engineer Sample ^b	Undergrad Sample ^c
<u>Decision-Making Ethicality</u>			
Data Management	.66**	.53*	1.79**
Study Conduct	1.46**	.66*	.34
Professional Practices	.61**	1.06**	1.68**
Business Practices	.49*	1.82**	1.09**
<u>Strategies</u>			
Recognizing one’s circumstances	1.24**	.16	.35
Seeking help	.84**	-0.65*	-0.01
Questioning one’s judgment	1.27**	1.92**	2.45**
Dealing with emotions	.90**	1.51**	2.56**
Anticipating consequences	.77**	.33	.79**
Analyzing personal motivations	1.36**	.60*	1.05**
Considering others’ perspectives	.45**	.08	.27

^a N = 59; ^b N = 29; ^c = 13. * p < .05; ** p < .01.

III. Ethics Instruction Meta-Analysis

Existing ethics courses in the sciences were examined using meta-analytic techniques to determine the overall effectiveness of ethics training and characteristics of instruction (e.g., learning goals, instructional content, and delivery methods) associated with more effective instruction. In aggregate, overall instructional effectiveness was low to marginal. However, instructional programs of high quality yielded fairly sizable effects compared to below average and average instructional quality. Thus, if instructional programs are well-designed, they have the potential to be moderately to highly effective. This study provided some indication of what characteristics of instruction promote greater effectiveness. Before turning to the key findings, it is of note that the meta-analysis findings are subject to the evaluation measures utilized in the studies. Thus, the findings may be inflated or attenuated as a

function of the criterion measures utilized by the different studies. In fact, different effects were obtained for different criterion types, and higher effects were obtained for studies where the criterion measure utilized matched the intended instructional objectives.

With respect to key findings, a cognitive, decision-making approach to instruction was rather effective, followed by ethical sensitivity approaches focusing on the social-interactive nature of ethical problems. Moral development approaches were least effective. In support of the effectiveness of a cognitive approach, it was also found that covering reasoning errors was especially valuable. Moreover, providing cognitive strategies for working through problems was associated with greater effectiveness. Training that presented specific content areas, such as ethical domains and standards, was associated with more effectiveness. In addition to providing this foundational knowledge, providing cases was more effective than using a standard lecture-style classroom format. In addition to the exemplars provided by cases, training that utilized multiple activities and was highly interactive was more effective. In summary, these findings imply the following “recipes” for effective and ineffective ethics instruction.

Effective Instruction

1. Provide cases
2. Provide strategies for working through problems
3. Use multiple activities throughout training
4. Encourage participant interaction
5. Conduct ethics training outside normal coursework

Ineffective Instruction

1. Provide low interaction (e.g., online training)
2. Cover guidelines only
3. Use lecture style predominantly
4. Provide ethics training within normal coursework

Summary of Key Findings

	<i>Md</i>	<i>SD</i>	<i>K</i>	<i>N</i>
Overall Effectiveness	.42	.27	26	3041
<u>Criterion Type</u>				
Moral Development Criterion	.36	.26	17	2229
Ethical Analysis Criterion	.61	.16	9	812
<u>Instructional Program Quality</u>				
Below Average	.18	.25	5	674
Average	.39	.02	8	1301
Above Average	.72	.15	6	445
<u>Study Quality</u>				
Below Average	.16	.23	10	817
Average	.48	.20	12	1688
Above Average	.65	.20	4	536
<u>Investigator’s Field</u>				
Health/Medicine	.38	.17	9	1313
Philosophy	.54	.21	4	648
Psychology	.80	.00	6	441
<u>Mandatory Course</u>				

No	.53	.25	10	909
Yes	.32	.23	13	1818
<u>Program Setting</u>				
Integrated into Curriculum	.37	.22	11	1832
Stand-alone Seminar	.51	.30	15	1209
<u>Instructional Approach</u>				
Decision-Making/Problem Solving	.52	.15	9	1234
Ethical Sensitivity	.42	.11	7	780
Moral Development	.17	.28	4	619
<u>Type of Skills</u>				
Real-World, Global	.64	.11	9	744
Limited, Domain-Specific	.35	.27	15	2257
<u>Reasoning Errors Covered</u>				
No	.33	.17	10	1845
Yes	.57	.30	9	575
<u>Decision-Making Strategies Covered</u>				
No	.22	.25	7	1229
Yes	.52	.20	13	1245
<u>Content Domains Covered</u>				
No	-.11	.14	4	460
Yes	.48	.14	16	2014
<u>Delivery Method</u>				
Classroom-Based	.36	.25	8	1091
Case-Based	.53	.14	9	1214
<u>Learning Activities Utilized</u>				
3 or more	.12	.34	8	692
4 or more	.48	.14	13	1995
<u>Level of Participant Interaction</u>				
Low	.05	.10	4	411
Moderate	.37	.16	6	1198
High	.63	.09	7	722

k = no. of effect sizes; *N* = no. of participants; *Md* = Mean d; *SD* = standard deviation

IV. Instructional Evaluation Using Ethical Decision-Making Measure

Using Mumford and colleagues' ethical decision-making measure as a consistent index across courses, evidence was obtained for the effectiveness of RCR courses provided at several universities across the nation. Course participants completed the parallel pre-post ethical decision-making measure. Scores were obtained for ethicality of decision-making in the four research domains in addition to underlying psychological processes, including strategies and social-behavioral response patterns inherent in responding.

The courses were at R1 universities and were taught primarily by senior-level faculty who all had prior experience teaching ethics. The courses were semester-long, required courses with biomedical audiences. On average, instructors reported that their courses were moderately time intensive and included coverage of the NIH Guidelines, presentation of cases, and the use of individual and group activities.

As presented below, overall the results revealed that there were no or negative effects of instruction on the ethicality of decisions. With regard to the strategies, a mixed pattern of positive and negative effects of instruction emerged. The social-behavioral responses endorsed by participants revealed primarily a negative effect of instruction. These data seem to indicate that ethics instruction may induce self protection and/or self enhancement in course participants.

Pre- to Post-test Changes ^a	Effect Size (Cohen's <i>d</i>)	Interpretation of Effect of Instruction
<u>Decision-Making Ethicality</u>		
Data Management	.17	no change
Study Conduct	.05	no change
Professional Practices	-0.21	no change
Business Practices	-0.37*	negative
<u>Strategies</u>		
Anticipating consequences	-0.28	no change
Recognizing one's circumstances	.86**	positive
Questioning one's judgment	.99**	positive
Dealing with emotions	.38**	positive
Analyzing personal motivations	.56**	positive
Seeking help	-1.79**	negative
Considering others' perspectives	-0.29**	negative
<u>Social-Behavioral Patterns</u>		
Involving Others	.19	no change
Selfishness	.10	no change
Active Involvement	-0.35	no change
Avoiding Responsibility	.78**	negative
Deception	1.53**	negative
Retaliation	1.16**	negative
Closed-ended actions	.59**	negative

^a N = 53; * p < .05; ** p < .01.

V. *Implementation of RCR Training at the University of Oklahoma*

The University of Oklahoma has adopted the sensemaking RCR training described above. The training originally began as a research project, but as positive evaluation data were obtained and students expressed that they enjoy it, university leaders became interested and initial planning ensued. The planning process entailed answering a number of key questions which are outlined below, in addition to their answers.

1. Who will be required to participate?

All graduate students at the OU Norman campus, including Master's and Ph.D. students in all fields. Given the unique needs of students in different fields, three tracks will be offered:

- Track 1: Sciences (i.e., biological, health, and social sciences)

- Track 2: Physical Sciences and Engineering (i.e., engineering, computer science, meteorology, and physics)
- Track 3: Fine Arts and Humanities (i.e., photography, painting, drama, philosophy, history, English)

2. Will participation be mandatory?

Participation will be required for progress towards degree completion. Graduate students must participate in order to apply to complete their general exams or defense of a thesis. Certificates of course completion will be issued by the Graduate College, and training completion will be indicated on paperwork submitted to request to take general exams or defend the thesis.

3. What will it cost?

Development of a cost estimate required estimating costs for personnel (i.e., instructors, teaching assistants, and training coordinator), materials (i.e., instructor materials, teaching assistant materials, trainee materials, train-the-trainer workshop materials, and general office supplies), and initial start-up costs (supplies for refreshments, rolling carts, etc.). Based on these estimates, it was determined that training will cost approximately \$100.00 per student participant.

4. How will it be paid for?

The tentative plan is for graduate students to pay the cost to participate in semester fees at about \$25.00 per semester.

5. What is a realistic timeline for implementation?

Piloting testing took place from August 2005 until January 2007. In May 2007, faculty members were invited to attend training workshops to become trainers. Over the next year and a half, these new instructors taught several classes to determine whether faculty members unfamiliar with the training could be trained and subsequently be successful at instructing the course. In May 2008, another training session was held to bring more faculty instructors on board. From August 2005 training sessions through the January 2008 sessions, all student participation was on a voluntary basis. Beginning with the incoming class for the Fall of 2009, the training requirement will be implemented. However, the requirement will be ratcheted up so that, in the first year of the new requirement only students on funded research projects will be required to participate. In the next year, all Ph.D. students will be required, and in the third year, all Master's students will be required to participate.

6. Who will serve as instructors?

Faculty members will instruct the Ph.D. students, and Master's students will be instructed by Ph.D. student instructors. Any faculty member, with at least 3 years of experience, is invited to become an instructor. These faculty members will then instruct courses on an "as needed" basis.

The cadre of Ph.D. student instructors will consist of several “core” instructors who will train Master’s students as their Graduate Assistantship. The core instructors will be industrial/organizational psychology students. In addition to these core instructors, several “supplemental” Ph.D. students from other fields will help to teach and assist the course as a quarter-time supplemental appointment. These trainers provide relief for the core instructors and will help to train students in fields who will particularly benefit from a trainer who is familiar with their particular field.

7. How will instructors be trained?

Instructors will be trained at a two-day Train-the-Trainer workshop where they are presented with the training materials. The objectives of the course and the utilization of the course materials are explained during the first day of training. On the second day of training, each potential instructor prepares a section of the training and delivers it to the group. Day 2 allows the attendees to learn about the content and flow of the actual training course, and also allows them to practice some of the material.

8. When will training sessions be held for students?

Training for Ph.D. students will be held during the intersessions before the fall and spring semester. The winter intersession course will be held during January, the week before classes begin, and the summer intersession course will be held during August, the week before classes begin. Classes will consist of approximately 25 students.

Training for Master’s students will be held during the fall and spring academic semesters. The sessions will be held on Fridays and Saturdays with approximately 30 students per class.

9. Who will be responsible for various aspects of the training?

There are four main aspects of the training: 1) administration, 2) coordination, 3) instructing, and 4) assisting. Below is an outline of the responsibilities for each of these aspects.

Administration

Administrative tasks will be handled by the Graduate College. Some of the tasks include: recruiting trainers, scheduling training dates, securing locations for training sessions, organizing and providing refreshments for training sessions, informing and tracking student enrollment, providing pre-course materials to students, arranging for payment of instructors and assistants, and sending certificates of completion to students.

Coordination

The Training Coordinator position will be filled by a Ph.D. graduate student in Industrial/Organizational Psychology. The coordinator is responsible for updating and maintaining the training content and for training the instructors. In addition, this student analyzes the ongoing evaluation data and trains the teaching assistants.

Instruction

Faculty and Ph.D. students will be responsible for instructing. Their role is to attend the Train-the-Trainer workshop, study and practice the training content, and deliver the content to students.

Teaching Assistant

Teaching assistant positions will be filled by graduate students in any field. They are responsible for preparing the materials and supplies for the course and collecting evaluation data. They are expected to have completed the course and to attend the teaching assistant training sessions.

VI. Sources

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