3
Ethics Education in Science and Engineering

APPROACHES TO ETHICS EDUCATION

Workshop participants generally agreed that a major goal of ethics education is to encourage faculty and students to question the decisions, practices, and processes around them so they can make better informed decisions and help shape a community of which they want to be part. In the "Pierre-example" in the textbox, has Pierre been taught about the importance of documenting his decisions and considered what the codes of ethics at various corporations might tell him about the desired procedures?

> Since I direct an RCR course, I like to start with cases. We have got Pierre here . . . a postdoctoral fellow . . . trying to get a job . . . about to go to a national meeting to present his work. He has been told that the representative from the company he wants to work for will be there. Some of his data points he thinks are questionable, so he thinks about leaving them out. . . . Are we helping Pierre make the right decision?
> *Wendy Reed Williams, The Children's Hospital of Philadelphia*

Some attendees pointed out that most graduate students and postdoctoral fellows currently learn research practices primarily through ad hoc, informal exposures in their individual laboratories, rather than through formal training. These ad hoc approaches are unlikely to be effective, they said, and therefore the expectations of ethical conduct and beneficial outcomes on the part of professional societies, employers, government funding agencies, and the public are unlikely to be met.

Several participants said that a consistent approach to ethics education and mentoring would make it easier for students and faculty to meet academic and professional standards and employer expectations. Others said the focus of formal training should go beyond professional ethics and research practice to the development of competencies in analyzing how social and technical factors interact. At that point, they said, faculty and postdoctoral and graduate students would have the skills to evaluate the cultures of organizations and the institutions where they were employed.

> Once you get outside the context of universities, there is very little sort of collective framework—collective venues for ethics talk. . . . We need to think about how we can change . . . institutions like weapons labs, industries, and so on . . . so that people have venues where they feel it is okay to talk through these issues .
> *Hugh Gusterson, George Mason University*

Charles Huff, St. Olaf College, reported results of research that had involved numerous collaborators and sources of support. The researchers, he told the group, decided that, rather than examining individual ethical decisions, they would take a performance-based approach (one looking at the progression of a career over time) to the question of developing an ethically exemplary career in computing.

Huff analyzed two major types of morally exemplary individuals in computing, those oriented toward craft (e.g., those concerned with computer accessibility for disabled users) and those oriented toward reform (e.g., those concerned with computing and privacy). These types, he said, represent different moral ecologies (i.e., environments in which individuals can develop ethically exemplary careers). Characteristics in a "model"

of ethical performance over time include "moral ecologies, individual personality, relevant skills and knowledge, and the integration of morality into the individual self."

Understanding these complexities, workshop attendees pointed out, leads to understanding the limitations of approaches to ethics education that focus only on individual decision points. Training in the skills and knowledge necessary to address particular ethical issues in research can provide guidance for an analysis of particular situations but cannot inoculate individuals against questionable practices. Understanding the complexities encourages an ethics perspective that goes beyond compliance toward ethical ideals.

> We need to think about peoples' moral . . . and ethical commitments in a larger picture of the different kinds of moral careers that people might structure for themselves. …. "I do this because I'm just that kind of an engineer.". . . moral creativity [is] particularly important in design issues. How do you come up with designs that satisfy multiple constraints, many of them . . . social constraints?
> *Charles Huff, St. Olaf College*

Materials submitted by Huff and workshop participant Stephanie Bird, an independent consultant in research ethics and leader of the lunchtime discussion of the ethics scenario, identified skills and knowledge that should be developed in ethics education. The required skills include:

- Recognizing and defining ethical issues.
- Identifying relevant stakeholders and socio-technical systems.
- Collecting relevant data about the stakeholders and systems.
- Understanding relevant stakeholder perspectives.
- Identifying value conflicts.

- Constructing viable alternative courses of action or solutions and identifying constraints.
- Assessing alternatives in terms of consequences, public defensibility, institutional barriers, etc.
- Engaging in reasoned dialogue or negotiations.
- Revising options, plans, or actions.

Both Huff and Bird stressed that ethics education should address both domain-specific and general content areas. Domain-specific areas might include issues of privacy or safety, access, intellectual property, methods of data collection and analysis, and technical knowledge of constraints and opportunities**.** General content might cover appropriate ethical guidelines, characterization of socio-technical systems, ethical argument, and ethical dissent and whistle-blowing.

Science and engineering students require both skills and knowledge to make ethical decisions. Many participants pointed out, however, that skills and knowledge are not sufficient if the individual does not have the personal and social motivators that encourage praiseworthy behavior. Environments must be structured to reward individuals who demonstrate ethical behavior.

CHARACTERISTICS OF EFFECTIVE ETHICS EDUCATION

Workshop participants noted that NSF, the National Institutes of Health (NIH), and the Office of Research Integrity all fund projects in research ethics. Successful strategies for teaching research ethics generally include

> I have some strong—from my experience in industry—strong beliefs in how ethical issues can be discussed. . . . There are rules, but much of the learning happens in highly ambiguous case studies where groups of practitioners sit around a table and enrich the discussion by [describing] how they would have approached the solution to that case example.
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> *Paul Citron, Medtronic (retired)*

required (rather than optional) participation in ethics education, active participation by relevant faculty, and interactive and recurring programs. Programs must also be tailored to meet the needs of researchers in specific fields. The specifics of biomedical ethics education, for example, do not translate directly to other fields, just as the specifics of ethics education for laboratory chemistry do not translate directly to field biology, ecology, archaeology, or engineering.

In his presentation during Panel I, Joseph Helble of Dartmouth noted that students entering graduate school face many challenges. They are no longer searching for "the right answer," he said, but for new answers. Advisors and senior students in their new laboratories usually have established ways of doing things and expectations that their junior colleagues may not understand, especially if they have not taken courses in research procedures. Faced with pressure to produce, students may go along with procedures that make them uncomfortable, or they may cut corners to come up with timely results. Campus-wide ethics training can prepare students to face these ethical difficulties, he said. In addition, such a campus-wide program or set of activities can improve an institution's competitiveness with funding agencies—an example of "doing well by doing good."

In a small group discussion on the second day of the meeting, participants identified additional challenges that ethics activities and programs may face. Faculty members may not believe the programs are needed; students may be faced with inconsistencies between formal ethics training and lab cultures and investigators' priorities; faculty may lack expertise or feel uncomfortable about teaching ethics; institutions may lack resources to

support ethics activities; and instructional methods must be appropriate for the target audience.

In addition, several participants pointed out, in presentations and discussions, that working with graduate students and postdoctoral fellows from other countries raises particular questions: whether students from other countries understand the content of ethics training; how teachers can learn from and accommodate students from different backgrounds; and how diversity among graduate students and postdoctoral fellows can improve learning opportunities and outcomes.

In Session III (Outreach and Assessment), Joseph Whittaker, Morgan State University, pointed out that the lack of data on what works, what doesn't work, and what has had mixed results has impeded the development of programs that build on prior successes and avoid prior failures. Some courses meet with student satisfaction and achieve intellectual goals, he said, but the content, techniques, and long-term outcomes of those courses are not assessed or measured.

Participants in discussions also flagged several areas for improvement. First, they recommended looking beyond classroom learning and individual conduct to broad programs that teach the importance of integrity by stressing shared standards, such as transparency in research, and indicators of meritorious practices. Second, universities should establish rewards for faculty members who participate in ethics education and use metrics to measure individual and institutional changes. Third, professional societies should play a more active role in establishing and promoting ethical standards. They might, for instance, establish ethics columns in their newsletters and journals, as some organizations and employers have done successfully.