A Study of Integrating Societal and Ethical Issues into NNIN REU

Merrill Brady
Politics and Pre-Medical Studies, Bates College

NNIN REU Site: Cornell NanoScale Science and Technology Facility, Cornell University, Ithaca, NY
NNIN REU Principal Investigator: Dr. Katherine McComas, Department of Communications, Cornell University
NNIN REU Mentor: Gina Eosco, Ph.D. Student, Department of Communications, Cornell University
Contact: mbrady3@bates.edu, kam19@cornell.edu, gme7@cornell.edu

Abstract:

Societal and Ethical Issues (SEI) in nanotechnology have gathered recent attention and importance given its federal focus under the 21st Century Nanotechnology Act [1] (2003). Perceptions of how effective SEI training is, as well as to what extent ethical conceptions penetrate into undergraduate work and beyond, is of particular interest in order to better the Research Experience for Undergraduates (REU) Program of the National Nanotechnology Infrastructure Network (NNIN). Interviews of both current education coordinators at NNIN REU sites and former REUs from the Cornell NanoScale Facility (CNF) are used to accumulate and compare SEI training practices. The review and interview results are used to formulate a summary report of findings and best practices for NNIN sites to use as a program guide.

Program	REU Program Goals	Skills Learned
UPenn SUNFEST VaNTH BIO REU Workshop 2010	Professional presentation	Communicate effectively and professionally, develop appropriate communication for certain audiences
Penn State	Think insightfully, problem solve	Personally reflect on ethical topics, develop a moral imagination
Carnegie Mellon University	Think insightfully, problem solve	Understand the ethics of care, recognize environmental applications of engineering
University of Washington	Study natural disasters	Recognize societal issues; human and economic consequences

Figure 1: Goals and projected skill sets common among evaluated programs.

Introduction:

The 21st Century Nanotechnology Act [1] (2003) emphasized the need to address societal and ethical issues of nanotechnology. This study set out to contribute to that initiative by first conducting a literature review on Research Experience for Undergraduates (REU) programs. The review compiled educational experiences from the REU programs and other non-REU undergraduate programs that teach societal and ethical issues to students within a science or technology domain. A total of ten institutions or programs were analyzed to contribute to part I of the summary report. As seen in Figure 1, certain program goals and skills targeting undergraduates to think critically about ethical and societal considerations resonate throughout the literature. The specific practiced and evaluated types of activities include PowerPoint presentations, lunch discussions, news articles or legislative documents to read, case studies and role-playing to perform, small panel discussions, societal and ethical issues (SEI) lunches, field trips to industries, or weekly classes on ethics in science.

NNIN Coordinator Interviews	Former CNF REU Interviews
1. Size of REU program 2. Amount of SEI education already in place before you started 3. PI/staff interest and support for SEI 4. Current program; practices used 5. Personal opinion on adequacy of SEI program 6. Personal opinion on challenges to presenting effective SEI education 7. Amount of information and idea sharing among NNIN coordinators 8. Personal opinion on the best practices for SEI education	1. Relationship with PI 2. Relationship with mentor 3. Relationship with fellow REUs 4. Amount of talk about nanotechnology in casual conversation 5. Amount of SEI in casual conversation versus in training discussion 6. Source of SEI discussion 7. Motivation for SEI consideration during REU summer 8. Current opinions; your values regarding SEI 9. Suggestions for SEI education

Figure 2: Categories encompassing interview questions of each subject group.

To explore the usefulness of these ideas, interviews with the education coordinators in the NNIN were conducted to gather a comprehensive look at how education coordinators are implementing SEI activities in their respective REU programs. In addition, interviews with previous REUs were conducted to assess what they think about society and ethics, and if they believe their REU experience at all influenced their thinking.

Results and Discussion:

The NNIN Education Coordinators (EC) participated in phone interviews lasting between 10-20 minutes. Figure 2 provides the categories of questions. Similar to the literature review findings, the ECs also found that lectures and informal discussions were the easiest type of event to organize and most liked by the undergraduate participants. The literature review found that there was an emphasis on training mentors to communicate the ethics of their project to their undergraduates. The ECs commented that although that was a great idea, there was limited time to train the mentors in addition to training the REU participants.

As a suggestion, ECs could work with SEI coordinators to increase the mentors' comfort for such topics, as this could foster a friendlier and more informative relationship between mentors and their respective undergraduate student.

There are three main findings from both the EC interviews and the previous REU student phone interviews. To better the communication of ethics and increase societal awareness, mentors and ECs should focus on the connections, conversations, and critical thinking skills of the undergraduates REU participants. The *connections* break down into the student's work environment, which is a critical for motivating and engaging SEI discussion. Students need to feel that their mentors and principal investigators (PIs) are approachable and friendly to spark the second finding, *conversations*. *Conversations* refer to the length and frequency of societal and ethical discussions between an undergraduate and their mentor or PI on their respective project. The friendliness and amount of socialization during the internship between undergraduate and mentor, PI, or other facility users, and the nature of such casual narrative with those involved in the research project influence how the student thinks about SEI.

Both the connections and conversations maintain the third domain for better SEI education, which is the level of *critical thinking* for undergraduates to develop. Raising awareness about their research projects' ethics and societal implications during the summer builds a framework of thought for their future careers. The challenge of communicating the paramount topics of SEI is a process that is continually built upon tried practices and current successes.

To further study the motivation and degree of ethical considerations by REU interns, a short survey was conducted of the 2012 REU participants. The survey tested such factors as motivation and its relationship to one's personal sense of moral responsibility.

Acknowledgments:

References:

[1]   21st Century Nanotechnology Research and Development Act, 108th Congress Public Law 153 (2003).