Application and Assessment of an Online Course for Training in Research Ethics in a Summer REU Program

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Abstract

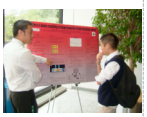
Biomedical engineers are faced with an opportunity to have significant impact on medicine and society. The recent well-publicized incidents of irresponsible conduct in research and continuing discussion of ethics in public policy provide clear examples of how these opportunities can be manipulated or misused. Underlying these issues is the need for a rigorous standard of ethics within every research lab. Choices made when facing day-to-day ethical issues may shape future decisions to be made by researchers confronting significant ethical dilemmas.

The early integration of ethics training in student research experiences provide the opportunity to build these standards into their every day practice. The goal of this work is to integrate ethics training and discussion into a summer REU program at the Illinois Institute of Technology that focuses on the application of engineering principles to the understanding and treatment of diabetes and its complications. A collaborative online course (openseminar.org/ethics) will be used to guide weekly discussions of ethics in their research projects. Topics to be covered include, but are not limited to, animal subjects, plagiarism, authorship, conflicts of interest, and human subjects. Pre and post-assessment tests have been developed and will be applied to the 19 students from engineering and science programs throughout the nation participating in the summer program. The results of this work will be presented along with continued development of BME specific modules for the open seminar course.

REU Program

Engineering Research in Diabetes
Summer Research Experience for Undergraduates

The Biomedical Engineering Department at IIT provides the foundation for this summer program. The primary goal of this program is for students to complete a diabetes related research project working with an engineering mentor from IIT. Students are paired with faculty at IIT based on the interests of the student and the faculty's expertise. Diabetes is a complex disease that can lead to a number of health complications. The projects offered in this program reflect this diversity, with topics in biomaterials for islet cell encapsulation, software models of glucose metabolism, medical imaging techniques for prognosis/diagnosis of disease, tissue regeneration strategies for the treatment of ulcers and ischemic limbs, vascular changes in diabetic retinopathy, complications of thrombosis in islet cell transplantation, and many other topics. You can find out more about previous research performed and the application process at http://www.grad.iit.edu/reu/.



Methods

Weekly Ethics Discussion

The REU program lasted for 10 weeks from June 4-August 11, 2007. Students met for one hour every week with faculty from the BME Department and the Center for the Study of Ethics in the Professions at IIT to discuss topics in research ethics. Assigned reading and discussion material was taken from the online collaborative course at openseminar.org/ethics. The specific topics covered were:

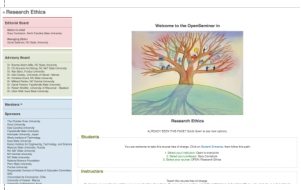
- Introduction and BME code of ethics
- Heroes and Heels
- Note taking/recordkeeping
- Bias/Probability ineptness
- Conflicts of interest
- Authorship
- Plagiarism
- Animal subjects
- Human subjects
- BME ethical challenges

Modules for all of these topics are available through the online course.

Testing and Assessment

Students were given identical assessment exams at the beginning and end of the 10 week program. Scores on the pre and post tests were compared using paired Student's *t* tests. $p<0.05$ was considered statistically significant. Students also completed an end-of-program survey in which they scored and commented on each aspect of the REU program, including the ethics component. In the student's final research reports, students were required to discuss ethical considerations and implication of their research.

Online Course (openseminar.org/ethics)



The Research Ethics course at openseminar.org/ethics is a collaborative online course developed as part of The Land Grant University Research Ethics (LANGURE) collaboration. Introduction to Research Ethics is LANGURE's core course and contains modules related to research ethics .

The modules developed for training in research ethics are open to all in the research community. Faculty can be given access to openseminar.org and develop course specific content by selecting from the broad range of modules available.

LANGURE is a national collaboration of eight land grant and historically black universities, a private corporation, a national consortium for education in responsible conduct of research, and an open source software group. LANGURE involves more than 130 faculty and graduate students dedicated to developing a model curriculum in research ethics for doctoral candidates in engineering and the physical, social, and life sciences. North Carolina State University, home of the three directors, is the lead institution. Our work is sponsored by a major grant from the National Science Foundation for 2005-2008 called "A Model Curriculum for Land Grant Universities in Research Ethics."

Assessment

Table 1: Overall assessment scores (mean ± standard deviation)
p = 0.004, n=15

Pre-test	Post-test
71 ± 9%	78 ± 8%

Table 2: Improvements in scores in topic areas
Note: Paired statistical analysis

Topic area	Pre-test	Post-test	p
Record Keeping	53 ± 13%	67 ± 24%	0.02
Conflicts of interest	63 ± 63%	100%	0.01
Animal subjects	65 ± 26%	77 ± 21%	0.07

Students were given the same test on research ethics at the beginning and end of the summer program The scores were significant higher for the post-test in comparison to the post-test (Table 1). Despite the increase scores were lower than anticipated. In the assessment survey, students showed significant improvement in questions related to record keeping, conflicts of interest, and animal subjects (Table 2).

In the program exit surveys, students voiced complaints with the emphasis of the ethics program on the daily tasks of research instead of the well-publicized incidents of irresponsible conduct in research and ethics in public policy.

BME Specific Modules

The REU program was used as a testing ground for newly developed BME-specific modules for the openseminar course. Ethics modules were developed in the following areas:

- Brain-Machine Computer Interface
- Embryonic Stem Cell Research
- Device Standards and Testing

The new modules include an introduction to to the research area, identification of controversial ethical issues, and discussion questions. Students were more involved in these and discussion more Suggestions for improvement of the modules were made from input from the class and instructors and the modules are now available for use in the openseminar course.

Conclusions

- An online ethics course was used to guide training in research ethics in a 10-week summer REU program
- Students had statistically significantly higher scores on the assessment test following the training program
- Modules based on ethical issues encountered in the field of Biomedical Engineering were developed and evaluated by students and faculty in the REU program
- Students expressed that ethic training related to the day-to-day issues of research was not exciting. In the future, these ethical issues will be presented with examples showcasing the significant personal and societal impact that poor choices in this area can have.

Acknowledgements

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