The aim of this section is to expand and accelerate advances in methods of teaching bioethics.

Empowering Graduate Students to Address Ethics in Research Environments

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Abstract: In this article, we present an educational intervention that embeds ethics education within research laboratories. This structure is designed to assist students in addressing ethical challenges in a more informed way, and to improve the overall ethical culture of research environments. The project seeks (a) to identify factors that students and researchers consider relevant to ethical conduct in science, technology, engineering, and math (STEM) and (b) to promote the cultivation of an ethical culture in experimental laboratories by integrating research stakeholders in a bottom-up approach to developing context-specific, ethics-based guidelines. An important assumption behind this approach is that direct involvement in the process of developing laboratory specific ethical guidelines will positively influence researchers' understanding of ethical research and practice issues, their handling of these issues, and the promotion of an ethical culture in the respective laboratory. The active involvement may increase the sense of ownership and integration of further discussion on these important topics. Based on the project experiences, the project team seeks to develop a module involving the bottom-up building of codes-of-ethics-based guidelines that can be used by a broad range of institutions and that will be distributed widely.

Keywords: ethics; research ethics; responsible conduct of research; RCR; ethics education; graduate students

Introduction

Research is a complex process where data management, authorship issues, conflicts of interest, internal and external pressures, power imbalances, and factors beyond the scientific research process can have an important impact on the overall success both of the research process and researcher and graduate student experience. Researchers often find themselves in laboratory situations that demand complex social and ethical responses that they neither prepare for nor anticipate. The reactions of research personnel in these situations often contributes to overall lab issues of harassment, bullying, and research misconduct. Integration into graduate training programs' training for the identification and responses to these issues is critical.

In this article, we present an educational intervention that attempts to place ethics education within research laboratories as a way of helping students address ethical challenges in a more informed way, and to improve the ethical culture of research environments. We actively engage graduate students in reflecting on and articulating what

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they believe are the critical ethical issues that they encounter in their research environments. After discussing and reflecting on existing ethics codes, they were then tasked to develop guidelines that would be useful for addressing ethical issues in their respective research environments. Our assumption is that the active engagement of graduate students in identifying and discussing ethical issues, crafting draft guidelines for all lab members, and discussing and refining them with faculty, can improve the lab culture and raise ethics awareness.

Here we report on our progress in developing this program. The goal is to introduce the approach and the concepts that underlie this research. While this research is conducted within STEM fields (science, technology, engineering, and math), and relates to laboratories in STEM fields and STEM-designated programs, the approach is easily transferable to other fields such as medicine and medical research. This holds especially as there is a clear thematic overlap between research done in fields such as biomedical engineering and medical research, and the conditions in research laboratories are similar.

The Approach

The work is carried out within the National Science Foundation (NSF)-funded project "A Bottom-Up Approach to Building a Culture of Responsible Research and Practice in STEM."[1] In 2015, the NSF modified their approach to funding ethics education by offering the call for proposals "Cultivating Cultures for Ethical STEM (CCE STEM)."[2] This can be seen in the context of a number of studies which found that traditional Responsible Conduct of Research (RCR) and ethics education courses, workshops, online courses and other educational approaches tended to lack effectiveness.[3] The National Academies of Sciences, Engineering, and Medicine 2017 seminal report *Fostering Integrity in Research,*[4] echoed this need, and in Recommendation 10 they state, "Researchers, research sponsors, and research institutions should continue to develop and assess more effective education and other programs that support the integrity of research. These improved programs should be widely adopted across disciplines and across national borders."

According to recent studies on RCR and research ethics education, three factors matter considerably in effective ethics education: First, the education activities should extend beyond learning about the laws and rules governing ethical research. Second, they should include discussion of ethical issues in their relevant context and involve all stakeholders, including students' peers, mentors and supervisors.[5] Third, ethics education is most effective when it occurs within the respective *institutional culture* which comprises both the *organizational context* and the *peer environment*.[6]

Our project is driven, in part, by these recommendations. Overall, the project seeks (a) to identify the factors students and researchers consider relevant to ethical STEM in the context of their specific environment (university, department, laboratory, etc.) and (b) to promote the cultivation of an ethical culture in experimental laboratories by integrating research stakeholders in a bottom-up approach to developing context-specific, codes of ethics-based guidelines. Central to the approach is a move away from traditional classroom-based ethics education to ethics discussion integrated with the laboratory experience; in other words, education that directly addresses specific issues found in the laboratory or departmental environment. Furthermore, active involvement of graduate students is accomplished by tasking them with

leading the ethics discussion and development. For the students, their goal is to develop guidelines that address the issues they face, guidelines they consider useful for their own laboratory situation, and to discuss and further develop them with other students and faculty. Overall, the project aims to achieve cultural change in research laboratories and departments.

The bottom-up approach that we adopted is informed by the social systems theory of learning developed by Etienne Wenger[7] known as *Communities of Practice*. Wenger argues that this perspective "locates learning, not in the head or outside it, but in the relationship between the person and the world, which for human beings is a social person in a social world." From this perspective, learning occurs in the process of participation within a social group. Wenger notes that even "the simplest social unit [e.g. a lab group] has the characteristics of a social learning system." However, learning also occurs in complex social systems "as constituted by interrelated communities of practice" such as departments and professional structures. Rather than focusing on ethics education from the point of view of persons who spend minimal time in the lab, our bottom-up approach hypothesizes that ethics education is more effective when it is based on the lived experience of lab members and discussions of how codes of ethics can be applied. We hypothesize that this bottom-up approach, which is based on curated sharing of individual experiences within the social setting of the lab, has the potential to improve the efficacy of ethics education with the goal of inspiring and supporting culture change.

In this, we rely on the following conceptions: *Ethics* is understood in a very broad sense to be the normative codes of conduct or moral principles recognized in a particular professional sphere of activity or other context or aspect of human life. This conception of ethics does not involve the philosophical analysis of morality, but centers on existing moral rules and principles, and is closely related to the applied, professional sphere of practice. *Responsible Conduct of Research (RCR)* is defined by the National Institutes of Health as "the practice of scientific investigation with integrity. It involves the awareness and application of established professional norms and ethical principles in the performance of all activities related to scientific research."[8] Topics include conflict of interest, policies regarding human subjects, research involving animals, laboratory safety, mentor-mentee relationships, data management, scientific publication, authorship, and research misconduct. By *culture* we are referring to a common system of practices, beliefs, values, and symbols that are shared and/or negotiated among group members. The ethical culture of research labs has been found to directly influence the ethical decision making of students involved in research.[9] We expect that ethics education will be more effective if it occurs not only in the classroom, but also across the various environments that graduate students work in.[10]

In the United States, pedagogical approaches for ethics education have historically relied heavily on professional ethics codes and standards as a way of relaying key principles and norms to future researchers. Ethics codes help establish the foundation for how members of a profession should act in a given situation, and help build trust between members of that profession and the public.[11] However, these professional codes tend to focus on professional practice in the field, rather than in a research laboratory environment, and even fewer reflect on

the experiences of students engaged in research. An example of this is the American Physical Society's "APS Guidelines for Professional Conduct."[12] It includes detailed provisions that relate to RCR issues such as reporting research results, authorship, and working with collaborators. The code ends with the statement, "Students and mentors are especially reminded that an understanding of the ethical expectations of the physics community is an important part of a physics education." While useful for reinforcing the need for ethics education, the code offers little guidance that speaks to the lived experience of graduate students.

Guideline Development

In the bottom-up approach to ethics education we are developing, students are asked to study and discuss professional codes like those of the American Physical Society, and use these principles as the foundation for developing bottom-up, context-specific guidelines that may help fellow students, faculty and other members of their research group better navigate ethical issues that come up in the natural course of research.

The bottom-up guidelines are designed to address ethical issues specific to the authors' environment. Insofar as we expect them to vary, based on field (science, technology, engineering, math), institution, geography and the individual situation of the respective laboratories or departments, we also anticipate that they will have elements in common.

They are not intended to substitute for existing guidelines or to conflict with existing regulation, but instead to complement existing organizational and professional codes, policies and regulations. Thus, the draft guidelines will not provide a complete list of ethical issues in research laboratories, but focus on those aspects the students consider important.

An important assumption behind the approach is that direct involvement in the development of ethical guidelines may positively influence researchers' understanding of ethical research and practice issues, their handling of these issues, and the promotion of an ethical culture in the respective laboratory. The active involvement may increase the sense of ownership and integration of further discussion of these important topics. Even if the guidelines developed are not adopted by participating laboratories or departments, hallmarks of the success of this project would include increased conversation around ethical issues, evaluation of existing policies and guidelines, and changes in how lab members approach, discuss, and ultimately handle ethical questions that arise.

Evaluation tools (i.e., surveys and interviews) will serve to (1) receive feedback from graduate students and principal investigators who participated in the project; (2) monitor rate of adoption and adherence levels; and (3) analyze the influence of the educational intervention on laboratory culture over time.

Based on the project experiences, the project team seeks to develop a module involving the bottom-up building of codes-of-ethics-based guidelines that can be used by a broad range of institutions and that will be distributed widely.

The Process

The project is being piloted at a private, technology-focused research university located in the Midwestern part of the United States. In the 2017–2018 academic year, 63 percent of the graduate student population consisted of international students from over 100 different countries. The graduate student population is 39 percent female and 61 percent male. The interdisciplinary

project team includes members from philosophy, library science, anthropology, psychology and engineering.

We held guideline development workshops in four highly research-active departments of the university: Biology (BIO), Biomedical Engineering (BME), Physics (PHY), and Chemical and Biological Engineering (CBE). The department of Mechanical, Material & Aeronautical Engineering (MMAE) served as a control department.

In each active department, a *Graduate Student Committee on Ethics in STEM* was convened to collectively develop code-of-ethics-based guidelines for their departments. Each committee met for six sessions, with the sessions lasting approximately 90 minutes each. The BME and BIO student committees were convened in the first semester of the 2017-2018 academic year, and the PHY and CBE committees in the second semester. This iterative process allowed us to incorporate experiences had and lessons learned during the first semester into the design and procedure of the second semester's sessions.

During the sessions, starting from discipline-specific codes of ethics, graduate students in the different departments developed draft guidelines on RCR-related and other issues they considered of relevance to their laboratory environment and practice. The draft guidelines developed as well as the issues considered of relevance for ethical STEM practice form the basis of a discussion with graduate students, faculty, staff and post-docs in the respective departments. During this discussion process, the draft guidelines will undergo refinement until, ideally, they are adopted by laboratories or departments.

In order to have the guideline development process go smoothly, in each active department (BIO, BME, PHY, CBE), we recruited a faculty member who actively supports the project. Furthermore, with the help of the departmental faculty members we chose an experienced graduate student (on a stipend) to serve as a student facilitator for each department. We trained those students on facilitating the guideline development process and leading the workshop sessions.

The project team then contacted graduate students in the respective departments by email, and supported by the student facilitators, convened a Graduate Student Ethics Committee with interested student volunteers. Incentives for students joining the committee included a letter of participation certifying their active involvement in the project, free lunches during each of the meetings, and the opportunity to play an active role in potentially addressing ethical issues in research in their respective departments.

Six sessions of the Student Ethics Committee were held. The topics of these sessions were as follows:

1. Introduction to ethics, ethics codes and guidelines;
2. Discussion of real-life case studies encountered by participating students/analysis of discipline-specific ethics codes;
3. Extended discussion of the students' own laboratory situations and the ethical issues encountered;
4. Beginning to draft guidelines;
5. Discussion and refinement of draft guidelines;
6. Discussion and final refinement of draft guidelines.

In the first meeting and in subsequent meetings, fictional case study discussions helped the students to begin reflecting and talking about their own experiences, and the ethical issues encountered. Cases were chosen both as ice-breakers and based on the ethical issues that came up in the previous meetings. For example,

during the second iteration we brought in some mini-cases that highlighted issues of diversity, both gender and culture, to help initiate further discussion about these issues in the context of the research environment.

Topics Addressed

The draft guidelines developed by the students in the various departments differed considerably, both in form and content. However, a considerable number of recurring topics were addressed. These included: communication, data management, role of the graduate student, mentor-mentee relationship, working hours, discrimination, power dynamics, workplace safety, sharing of resources, confidentiality, and publication.

To give some more detailed examples, the draft guidelines mentioned aspects such as:

- Establishing written responsibilities and expectations between the student and the Principal Investigator (PI) at the beginning of each research project (including timeline, salary, leave, vacation, and data management) and reviewing them regularly;
- Transparency and reproducibility of experiments: keeping electronic records, reporting what was done;
- Training all laboratory personnel in all relevant aspects of laboratory safety;
- No use of disparaging or disrespectful language in meetings and correspondence;
- Training lab personnel in proper workplace behavior, especially regarding multicultural awareness, workplace harassment, and accommodating those with special needs;
- Working hours: not forcing students to work more hours than a typical full-time work schedule or to come in on weekends and holidays;
- Graduate students being primarily responsible for the successful completion of their own research projects;
- All students being responsible for maintaining cleanliness and organization of shared workspace, and maintaining shared equipment; and
- For all individuals identified as authors to review all data contained in a paper, as they will all be responsible for the veracity of claims made in the paper.

Communication with Faculty

A crucial step, which could be considered as the critical threshold of the overall approach, is to get faculty involved in discussing and further developing the draft guidelines compiled by the graduate students. Only if faculty are willing to cooperate, embrace the bottom-up approach, and support the idea of department-specific guidelines, can the draft guidelines be further refined and finally adopted in the departments or laboratories.

In order to facilitate achieving a balanced discussion, the project team mediates between graduate students and faculty. This involves several steps: (a) meeting with and discussing the draft guidelines with two "faculty advocates," one of whom ideally is the department chair. During a meeting, the guidelines are reviewed with them and the team talks with them about the points they consider helpful, and the points they consider problematic, requests for suggestions for improving the draft guidelines, and also reflections on how to move forward within the respective department; (b) adding the suggestions made by the "faculty advocates" to the draft guidelines; (c) students take faculty suggestions and modifications into consideration, and revise the draft guidelines;

(d) discussing the amended, modified draft guidelines at a department faculty meeting, and if necessary, making additional modifications; (e) departments or PIs decide whether they want to adopt the guidelines within the respective departments and/or within individual laboratories.

As at the time of writing, the project had only gone through the steps (a), (b) and (c). We do not yet have any experiences concerning the possible adoption of the guidelines by individual departments or laboratories.

Conclusion

From our preliminary experiences, it is our impression that the project provides an engaging ethics education experience that has helped students identify ethical issues and develop mechanisms that may help them face ethical issues that may occur in research laboratories. By participating in the project, the students reflected on their situation as graduate students in research laboratories, exchanged their own experiences, and worked toward possible future solutions. The bottom-up approach has helped to give students a voice, and to empower them to speak up on issues that can have profound impacts on their educational career.

Notably, the topics discussed by the students were much broader than the classical RCR topics, and also included a broad range of social and interpersonal issues. In addition, there was a tendency for the students to be too prescriptive, so that the guidelines sometimes tended to take the shape of "Ten Commandments." However, both the students and project team realized the need to avoid language that faculty may consider off-putting, and to search for wordings that PIs and faculty may consider acceptable. The iterative drafting of the guidelines described above, involving both faculty and students, led to changing the wording from "shall" to "should" in some guidelines, and pushing for more discussion of topics among students and PIs, rather than adopting hard and fast "commandments." Furthermore, the discussions and guidelines also showed a need for students to adopt a culture of responsibility and accountability, and of self-ownership of work and hours, as their work as graduate students is not a typical 9-5 job, but instead is experience for future careers in research.

Overall, the guideline development is an iterative process that takes time. The guideline development process facilitates communication between graduate students and faculty, increases understanding between graduate students and faculty, and raises awareness of the ethical issues students feel are most important.

The conversations also revealed a different understanding of ethics by faculty and graduate students. Faculty tended to have a top-down view focusing on plagiarism, data quality, and NIH and NSF requirements. In contract, students assumed a broader bottom-up view, with a stronger focus on communication, power imbalances, and social issues. In some cases, faculty did not perceive the relationship and power issues as ethics, or relevant broadly to what the guidelines "should" address.

Furthermore, the guidelines development process and discussion of the draft guidelines raised awareness of existing policies, among both students and faculty. In the department-specific draft guidelines, it is advisable to add links to existing policies, professional ethics codes, and handbooks for both students and faculty. The draft guidelines in some cases reinforce these policies, and in other cases try to provide

some ways of interpreting these guidelines for research scenarios.

Among faculty, we have seen a broad spectrum of reactions so far, from clear support to open rejection. In the conversations about the draft guidelines, faculty tended to refer to existing policies, which made them think about whether and how the points raised by the students were actually covered by existing policies. Some faculty considered the draft guidelines a chance to have an open discussion with students about issues that may arise in research laboratories, and as a means of clarifying topics and points that otherwise might have gone unsaid, or have been more difficult to address otherwise. On a positive note, there was even a suggestion to expand the approach to the whole college. There were also more reluctant and critical reactions. Some faculty criticized the draft guidelines as being not well-informed, or raised concerns that the guidelines might have legal implications with unwanted and problematic consequences. Furthermore, the discussion process involved complex power dynamics between faculty and students.

Overall, what we see is that the project already has influence on the graduate students and faculty involved, even though we are still in the process of developing the guidelines. The guidelines development module and draft guidelines are tools that help departments and laboratories achieve cultural change. While ideally, the draft guidelines will finally be adopted by the department and/or serve as a conversation piece for laboratories, the mere guidelines-development process may already induce an improvement in the ethical culture of research laboratories. Even if the draft guidelines are not adopted, there may be influence on the culture of a laboratory or department in the sense that PIs, faculty, or department chairs reflect on the student feedback given through the draft guidelines. This may make them think about changing aspects considered problematic in their laboratories or departments.

The overall goal of the project is not necessarily to have the guidelines adopted, but to achieve cultural change. Cultural change may be achieved sustainably by adopting the guidelines, but it may also be achieved through the guidelines development process and by influencing decision makers.

Notes

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