Abstract

In 2010, the National Science Foundation (NSF) began to require all faculty, postgraduate, graduate, and undergraduate students participating in sponsored research to receive responsible conduct of research training emphasizing authorship, plagiarism, data handling, and research misconduct.

The majority of studies published to date investigating the efficacy of CCR training have shown that current methods, such as courses and workshops, appear to promote an intellectual understanding of research ethics but fail to change students’ attitudes or behavior. Most of this work has focused on the training of postgraduates or graduate students. A 2007 study that tested the CCR knowledge of 251 new graduate students from three health science universities showed that students had inadequate and inconsistent knowledge of CCR, irrespective of their prior education or experience. The mean scores on the tests was 74% correct, indicating that the even incoming trainees with previous graduate CCR education may have gaps in core CCR knowledge.

A three-year study that measured chemistry and engineering undergraduate students’ knowledge before and after participating in a research ethics training workshop showed similar results. Mabrouk found that students could often define ethical terms, such as authorship and intellectual property, but were unable to apply them to their own undergraduate research projects.

In light of these findings, there has been a push to understand what type of ethics training is most effective. May and Luth have shown that ethics training can enhance students’ perspective-taking, moral efficacy, and moral courage. Their 2013 study suggests that embedded ethics modules in the regular curriculum may provide better opportunities for students to integrate ethics into their professional identities than standalone ethics courses.

Goal

The current study sought to understand some of the potential factors causing the gap between students’ intellectual understanding of authorship standards and the application of those standards to their research experiences, and to identify best practices in authorship training.

Method

Institutional Review Board (IRB) approval was sought and received for Human Subjects Research at the outset of this study. Semi-scripted anonymous interviews were conducted with eight pairs of research faculty and their undergraduate research students recruited from Brown, COE, and COS. Both the faculty and student groups were diverse, covering a wide range of fields and many levels of experience, as shown in Figure 1. The interviews ranged from 20-60 minutes. Questions for faculty sought to understand when, how, and why they provide their undergraduate research students with CCR training, particularly authorship training. Questions for students sought to understand if they were interested in authorship opportunities and whether they felt they were adequately trained in authorship standards. Both groups were also asked some common questions, as shown in Figure 2.

Each of the interviews was transcribed. The undergraduate research assistant and the principal investigator (PI) used a grounded approach to independently identify themes in the interviews. A comparison of the themes found made sense of the data and a list of a priori codes was agreed upon. The research assistant and PI then each coded the interviews in NVivo and produced several emergent codes during the process. A series of discussions led to the formation of one common master list of codes.

An analysis of the various codes revealed consistent patterns among the interview pairs. The research assistant and the PI used these patterns to identify common problems and propose a solution to address them.

Method (cont.)

Demographics Table (Figure 1)

<table>
<thead>
<tr>
<th>Faculty</th>
<th>Undergraduate Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male associate professor of civil engineering</td>
<td>Male third-year mechanical engineering major - no prior research experience</td>
</tr>
<tr>
<td>- has led a research group for about 11 years</td>
<td></td>
</tr>
<tr>
<td>- mentioned 17 undergraduates in last 5 years</td>
<td></td>
</tr>
<tr>
<td>Male professor of electrical engineering</td>
<td>Male third-year chemical engineering major - experience at 3 research labs on campus - experience at 1 research lab in Spain while on a university trip</td>
</tr>
<tr>
<td>- has led a research group for about 14 months</td>
<td></td>
</tr>
<tr>
<td>- mentioned 22 undergraduates in last 5 years</td>
<td></td>
</tr>
<tr>
<td>Female associate professor of biology</td>
<td>Female third-year pharmacy major - directed-study research experience that focused on grant writing</td>
</tr>
<tr>
<td>- has led a research group for about 4 years</td>
<td></td>
</tr>
<tr>
<td>- mentioned 20-35 undergraduates in last 5 years</td>
<td></td>
</tr>
<tr>
<td>Male professor of pharmacological sciences</td>
<td>Male fourth-year physics major - 2 co-ops in research labs on campus</td>
</tr>
<tr>
<td>- has led a research group for about 20 years</td>
<td></td>
</tr>
<tr>
<td>- mentioned 15 undergraduates in last 5 years</td>
<td></td>
</tr>
<tr>
<td>Male professor of physics</td>
<td>Male fourth-year physics major - 2 co-ops in research labs on campus</td>
</tr>
<tr>
<td>- has led a research group for about 33 years</td>
<td></td>
</tr>
<tr>
<td>- mentioned 10 undergraduates in last 5 years</td>
<td></td>
</tr>
<tr>
<td>Male assistant professor of physics</td>
<td>Female second-year behavior neuroscience major - no prior research experience</td>
</tr>
<tr>
<td>- has led a research group for about 34 years</td>
<td></td>
</tr>
<tr>
<td>- mentioned 12 undergraduates in last 5 years</td>
<td></td>
</tr>
</tbody>
</table>

Method (cont.)

Sample Interview Questions (Figure 2)

Student Questions
Did you ever receive any formal research ethics training? Was this a course? Workshop?
Did you ever receive any informal research ethics training in which issues related to authorship, confidentiality, openness, conflict of interest, fabrication/falsification of data, etc. were discussed?
Are there reasons or obstacles that have prevented you from learning about the requirements for authorship in your laboratory?

Faculty Questions
Do you provide research ethics training for your undergraduate researchers? How does your lab meet the CCR training requirement?
How would you describe your approach to teaching what is your thought process when deciding if someone should be an author?
When and how do you inform undergraduates about the requirements for authorship in your laboratory?

Common Questions
What are the requirements for authorship in your laboratory?
Imagine you are a member of a team designing science ethics training about authorship for undergraduate research students.
What are the factors that you believe the committee should consider in designing this training? These factors could include the mechanism for the training (face-to-face/online/single-shot workshop, case-based study or anything else you think of).

Results

Research Ethics Training

- None of the students interviewed had formal ethics or authorship training.
- Faculty and students were only discussed informally and usually only when issues arose.
- Faculty cited a lack of time as the reason they could not address more CCR topics with undergraduates.

Definitions of Authorship

- Very little consensus in definitions of authorship held by students and faculty.
- Different views on the roles of data collection, writing, and experiment design in authorship.
- Many faculty members mentioned a student’s time commitment and effort in the project as a factor in determining authorship.

Making Authorship Decisions

- Faculty said they prioritized opportunities for student authorship during initial interviews.
- Most students did not perceive these conversations as explicit or fully explanatory.

Graduate students in the lab were repeatedly leveraged as mediators in deciding who should be an author.

Suggestions for CCR Training

- Faculty suggested a research ethics course.
- Students preferred less time-consuming workshops.
- Both groups agreed the training should be formalized as a discussion.

Conclusions

Possible CCR Training Solution: Leveraging Graduate Students as Peer Mentors

- Utilizes pre-existing hierarchy of lab setting.
- Many faculty already delegate authorship decisions to graduate students.
- Requires little adjustment to student and faculty schedules.
- Takes advantage of time undergraduate and graduate students already spend together in the lab.
- Facilitates open dialogue, as undergraduates feel comfortable asking questions.
- Less of a power differential between graduate and undergraduate students than students and faculty.

Benefits every level:

- Prepares undergraduates to handle authorship decisions.
- Prepares graduate students for potential futures in academia.
- Facilitates deep and consistent ethical discussions that are directly applicable in the lab.

Acknowledgements

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References