Curriculum Design for a Professional Development Program to Enhance STEM Researchers' Capacity to Identify and Address the Ethical Dimensions of Their Work

Dr. Rockwell Franklin Clancy III, Virginia Polytechnic Institute and State University

Rockwell Clancy conducts research at the intersection of technology ethics, moral psychology, and Chinese philosophy. He explores how culture and education affect moral judgments, the causes of unethical behaviors, and what can be done to ensure more ethical behaviors regarding technology. Rockwell is a Research Scientist in the Department of Engineering Education at Virginia Tech. Before moving to Virginia, he was a Research Assistant Professor in the Department of Humanities, Arts, and Social Sciences at the Colorado School of Mines. Rockwell holds a PhD from Purdue University, MA from Katholieke Universiteit, Leuven, and BA from Fordham University.

Dr. Qin Zhu, Virginia Polytechnic Institute and State University

Dr. Zhu is an Associate Professor in the Department of Engineering Education at Virginia Tech, with additional affiliations in the Department of Science, Technology & Society, the Department of Philosophy, the Center for Human-Computer Interaction, and the Center for Future Workplaces and Practices. He serves as Associate Editor for Science and Engineering Ethics, Studies in Engineering Education, and Editor for International Perspectives at the Online Ethics Center for Engineering and Science. Additionally, Dr. Zhu is a member of the Board of Directors for the Association for Practical and Professional Ethics (APPE). His research explores how culture influences the cultivation of globally competent and socially responsible engineers, as well as the ethical development and deployment of AI and robotics.

Lisa M Lee, Virginia Polytechnic Institute and State University
Iris Louella Jenkins, Virginia Polytechnic Institute and State University

Curriculum Design for a Professional Development Program to Enhance STEM Researchers' Capacity to Identify and Address the Ethical Dimensions of Their Work

Introduction

This paper sketches the motivations for and nature of a workshop on research integrity/ethics that has been designed for and will be delivered to practicing researchers. This workshop is part of the IREI (Innovative Research and Ethical Impact) project at Virginia Tech, funded by NSF (National Science Foundation) Institutional Transformation grant # 2316634 through its ER2 (Ethical and Responsible Research) program. The motivations for this workshop include that while research institutions are required to provide research integrity training to researchers supported by funding from the NSF, NIH, and other agencies, there is little evidence that the current iteration of research integrity training is effective or engaging. The nature of this workshop consists of helping researchers in different disciplinary fields to identify, address, and communicate about the ethical dimensions of their research to peers and mentees/advisees.

To better motivate and further explain this workshop, this paper is divided into three parts. First, it describes the background, goals, and objectives for this project and workshop. The background involves national legislation related to research funding, and the goals include ethical competence and confidence among individual researchers, and the creation of ethical research cultures. Next, it describes the set up and method for delivering the workshop. The workshop meets four times per semester, approximately once per month, using the skills-based, learner-centered BOPS method. Finally, this paper describes the contents of the workshop, including the competencies the workshop aims to cultivate and exercises used to do so. This paper is not meant to be an exhaustive description of either the IREI project or workshop but, rather, a sketch of the motivations for and nature of workshop so far.

Background and objectives

National legislation in the US, such as the America COMPETES Act and, more recently, the CHIPS and Science Act, highlights the importance of research integrity in innovation and competitiveness of the US economy [1], [2]. Given federal funding mandates, research institutions have developed interventions and programs for research integrity training [3]–[7]. Dominant approaches to this training have been shaped by biomedical ethics, placing significant emphasis on misconduct by individual researchers, including FFP (falsification, fabrication, and plagiarism of research results) [8], [9]. However, these efforts face two related sets of challenges.

First, topics included in research integrity initiatives are quite narrow. They typically fail to consider the different kinds of ethical issues researchers face, depending on their research disciplines and the nature of their work. Second, the form of research integrity initiatives lack evidence of effectiveness. They typically consist of one-and-done training, administered online or by an instructor from outside a trainees' research discipline [9]. As a result, research integrity initiatives have often been viewed as a 'checkbox' exercise, an onerous requirement, or irrelevant to some disciplines. The IREI project seeks to address both challenges.

The ultimate goal of the IREI project is to transform research cultures, making ethics as central to the research process as is the formulation of research questions, design of research studies, and selection of research methods. To do so, the IREI project aims to develop and pilot at Virginia Tech a model of peer-to-peer learning and practice that is more engaging, effective, and scalable than research integrity initiatives to date. To do so, the intermediate goals of the IREI program include (1) equipping researchers with the ability to identify and address the ethical dimensions of their work (ethical competence), (2) helping them to confidently communicate with peers and mentees/advisees ways of identifying and addressing the ethical dimensions of their research (ethical confidence), and (3) leveraging the institutional and professional networks of researchers, thereby generating scalable and sustainable impacts throughout research institutions (ethical cultures) [10]. To achieve IREI project objectives (1) and (2), a workshop on research integrity/ethics for practicing researchers is being developed. To support these project objectives, the participant outcomes of the workshop include (1) understanding professional responsibility to motivate a concern with ethics in research, (2) identifying the ethical dimensions of research, and (3) responding to the ethical dimensions of one's own research and others' research.

Setup and methods

The workshop will meet a total of four times per semester, approximately once per month. The first and third meetings will last two hours, while the second and fourth meetings will last one hour. This will allow participants more time to receive an overview of the workshop during the first meeting, and to work on and share with other participants their broader impacts statements, mentorship plans, and safe and inclusive working environments plans – further described below – during the third meeting.

Workshop participants will include influential researchers from colleges and departments throughout the university. These researchers have been identified by (1) distributing a questionnaire to researchers throughout Virginia Tech, asking them for the names of researchers in their departments that they consider successful and strive to emulate in their research, and (2) consulting with IREI program ambassadors, representatives from each of the colleges who care about ethics and are attuned to the research cultures of their colleges and disciplines. IREI ambassadors help to distribute the questionnaire and collectively decide on the list of researchers for participation in the workshop and study.

Researchers identified as influential are recruited for participation, since others look to them as examples of how to act and whose behaviors they emulate. According to the social expectations theory of norms on which the IREI project is based [11], if influential researchers take seriously ethics, then they could influence other researchers in their departments to do the same. These dynamics of influence would affect the development of norms within those departments, resulting in more ethical research cultures on a larger scale. This is one of the ways the IREI project will be scalable, by leveraging the natural dynamics of social networks to facilitate cultural change.

To assess the program and improve the workshop, both qualitative and quantitative measures will be administered before and after the workshop. These will include (1) open-ended prompts about the ethical dimensions of different stages of the research process, to assess ethical competence,

(2) an altered version of TEME (Teacher Efficacy for Moral Education measure) [12], called REME (Researcher Efficacy for Moral Engagement), to assess ethical confidence, and (3) SOURCE (Survey of Organizational Research Climate), to assess department and college research cultures/climates [13]. Only (1) and (2) will be administered to participants in the workshop and a control group before and after the workshop. (3) will be administered to researchers who do not participate in the workshop but are affiliated with departments functioning as experimental and control groups.

Meetings of the workshop will be organized according to the BOPS method. Each letter in this acronym stands for a different stage/component of the meeting. These includes (B) bridging in, presenting findings or introducing an activity to pique interest in the topics that will be covered in the meeting, (O) introducing objectives, informing participants what they will get out of the meeting, (P) pre-assessment, learning what participants know about the topics that will be covered, participatory learning, guiding participants to actively reflect as topics are introduced, and post-assessment, learning what participants understood about the topics covered, and (S) summarize the meeting, reminding participants what the objectives were and how these were fulfilled.

Curriculum contents

The workshop includes contents related to seven competencies. These competencies correspond to the workshop objectives, and participants complete several exercises used to cultivate and assess these competencies. These objectives and their corresponding competencies are as follows:

Objective one, understanding professional responsibility, to motivate a concern with ethics in research: (1) describe values and norms common to researchers across the disciplinary spectrum, (2) explain the societal function of publicly funded research, and (3) identify codes, values, and norms specific to one's field of research.

Objective two, identifying the ethical dimensions and implications of one's own research and other's research: (4) identify and explain what an "ethical dimension" of research is and (5) identify stakeholders affected by one's research and research field.

Objective three, addressing the ethical dimensions and implications of one's own research and other's research: (6) explain how to respond to the ethical dimensions of one's research and (7) initiate and sustain conversations about the ethical dimensions of one's own work and other's work.

To cultivate and assess these competencies, five different exercises will be used. These exercises are scaffolded, beginning with simpler, basic concepts and skills that build on each other and facilitate the cultivation and practice of more advanced, complex concepts and skills. These exercises include the following:

1. Pre- and post-project study measures – These include the two project study measures described above: (1) open-ended prompts about the ethical dimensions of different stages of the

research process, assessing ethical competence (Figure 1); (2) REME, assessing ethical confidence. This exercise will help researchers to develop competencies associated with objectives 1 and 2.

Figure 1. Stages of the research process
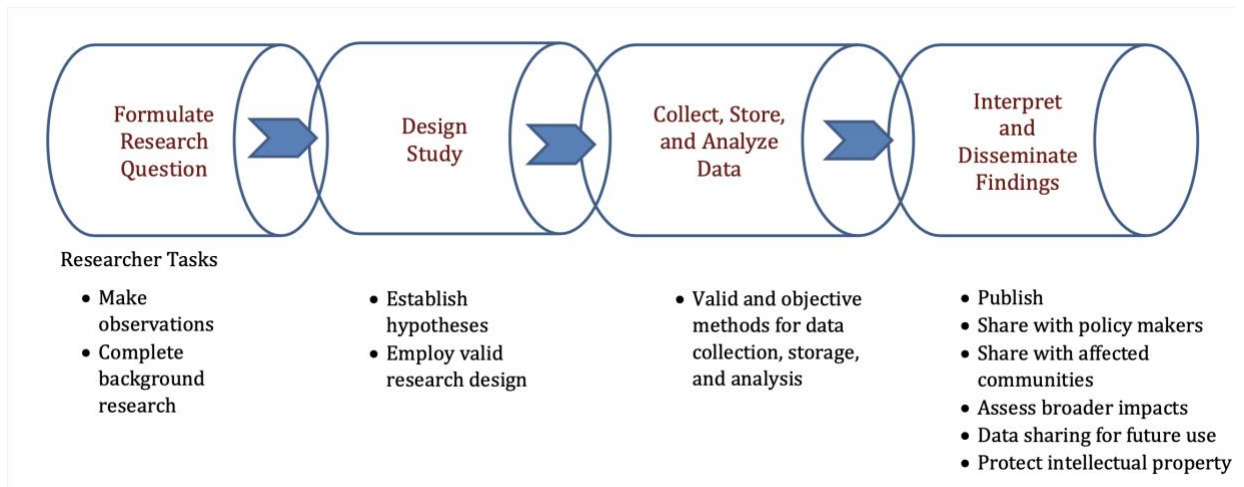
2. Discipline-specific ethical codes – Researchers will find and read the code of ethics/conduct for the professional society with which they are affiliated, or one closely aligned with their field of research. They will reflect and take notes on the following questions: What values are embodied in and promoted by the code? Do any entries strike you as unexpected or surprising? Are there aspects you believe should be included but are absent? Was the code developed in response to an event or issue? If so, what was the event or issue, and how does it impact the ways research in your field is conducted? This exercise will help researchers to develop competencies associated with objective 1.

3. Ethics-related news story – Researchers will find a news story or anecdote from the past five years that touches on the ethical dimensions of research in their fields. Researchers will consider and take notes on the following questions: Who was affected in this story? How were they affected, for better or worse? What might have been done to eliminate or minimize harms and maximize benefits associated with this research? Who might have been consulted throughout the research process? This exercise will help researchers to develop competencies associated with objective 2.

4. Broader impacts statement, mentorship plan, and safe and inclusive working environments plan – Researchers will choose a current or planned research project and answer the following questions: Who is interested/invested in this type of research? Why are people interested/invested? What are the potential positive and negative impacts of this research? Where are these people and impacts throughout the research process, including advisees/mentees? How would you ensure these people are engaged/being considered throughout the research process? Are there individuals or groups that disagree with this research? If so, why? What process would you use to assess the impact of this research? Based on answers to these questions, participants will identify potential conflicts/priorities, considering an appropriate decision-making approach,

and then describe how they would implement and evaluate the decision. Answers to these questions/considerations will inform the development of broader impacts statements, mentorship plans, and safe and inclusive working environments plans for their current or planed research projects, which they can use when applying for NSF grants. This exercise will help researchers to develop competencies associated with objectives 1, 2, and 3.

The topics and questions related to these exercises will serve as jumping off points for discussions during the workshop meetings. Rather than treating researchers participating in the workshop as students – where they are simply instructed in what it means to be ethical – the goal of the IREI workshop and project is to build a community of practice. This means that the expertise, concerns, and perspectives of the researchers participating in the workshop will drive its direction. Because of their expertise, researchers at the forefront of their fields are in a unique position to identify and address the ethical dimensions in their work [14].

Conclusion

Integrity is critically important to research, but there is little evidence that initiatives aimed at research integrity are effective. Many such initiatives are educational in nature, aimed at conveying information to individual researchers rather than at ensuring ethics within broader research cultures. Furthermore, the focus of research integrity initiatives is often too narrow, focusing on ethical concerns that arise in or are related to biomedical research. To address these concerns, the IREI project aims at developing and implementing a model of research integrity education aimed at creating and sustaining more ethical research cultures. Part of this project is a semester-long workshop developed for and delivered to practicing researchers. To better ensure the effectiveness and scalability of the program, the workshop targets influential researchers in colleges and departments throughout the university, helping them to identify, address, and communicate about ethical dimensions specific to their research. This paper has described the setup, methods, and contents of that workshop.

References

[1]   *H.R.4346 - Chips and Science Act*. 117th Congress (2021-2022), 2022.
[2]   T. Phillips, F. Nestor, G. Beach, and E. Heitman, "America COMPETES at 5 years: An Analysis of Research-Intensive Universities' RCR Training Plans," *Sci. Eng. Ethics*, vol. 24, no. 1, pp. 227–249, Feb. 2018, doi: 10.1007/s11948-017-9883-5.
[3]   M. W. Kalichman, "A Brief History of RCR Education," *Account. Res.*, vol. 20, no. 5–6, pp. 380–394, 2013, doi: 10.1080/08989621.2013.822260.
[4]   N. H. Steneck and R. E. Bulger, "The History, Purpose, and Future of Instruction in the Responsible Conduct of Research," *Acad. Med.*, vol. 82, no. 9, pp. 829–834, Sep. 2007, doi: 10.1097/ACM.0b013e31812f7d4d.
[5]   E. Heitman and R. E. Bulger, "Assessing the Educational Literature in the Responsible Conduct of Research for Core Content," *Account. Res.*, vol. 12, no. 3, pp. 207–224, Jul. 2005, doi: 10.1080/08989620500217420.

[6]   T. J. Mulhearn, L. M. Steele, L. L. Watts, K. E. Medeiros, M. D. Mumford, and S. Connelly, "Review of Instructional Approaches in Ethics Education," *Sci. Eng. Ethics*, vol. 23, no. 3, pp. 883–912, 2017, doi: 10.1007/s11948-016-9803-0.

[7]   R. T. Pennock and M. O'Rourke, "Developing a Scientific Virtue-Based Approach to Science Ethics Training," *Sci. Eng. Ethics*, vol. 23, no. 1, pp. 243–262, 2017, doi: 10.1007/s11948-016-9757-2.

[8]   L. M. Lee, "Research Integrity and the Regulatory-Industrial Complex," *Account. Res.*, Feb. 2023, doi: 10.1080/08989621.2023.2179395.

[9]   APPE, "Improving Research Integrity: The Role of Accountability Across the Research Enterprise," 2024.

[10]   "Innovative Research and Ethical Impact," 2025. https://www.research.vt.edu/sirc/innovative-research-ethical-impact.html (accessed Apr. 15, 2025).

[11]   C. Bicchieri, *Norms in the Wild*. Oxford: Oxford University Press, 2016.

[12]   D. Narvaez, J. L. Vaydich, J. C. Turner, and V. Khmelkov, "Teacher self-efficacy for moral education: Measuring teacher self-efficacy for moral education.," *J. Res. Character Educ.*, vol. 6, no. 2, pp. 3–15, 2008, [Online]. Available: http://ezproxy.umsl.edu/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=psyh&AN=2011-19985-001&site=ehost-live&scope=site%5Cndnarvaez@nd.edu.

[13]   B. C. Martinson, C. R. Thrush, and A. Lauren Crain, "Development and Validation of the Survey of Organizational Research Climate (SORC)," *Sci. Eng. Ethics*, vol. 19, no. 3, pp. 813–834, 2013, doi: 10.1007/s11948-012-9410-7.

[14]   H. C. Luegenbiehl and R. F. Clancy, *Global Engineering Ethics*. New York: Elsevier, 2017.