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Let's Talk About Ethics! A Qualitative Analysis of First-year Engineering Student Group Discussions Around Ethical Scenarios

L. Bassett

J. Pascal

Richard Cimino

Kevin Dahm
Rowan University, dahm@rowan.edu

D. D. Burkey

See next page for additional authors

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Work in Progress: Let's Talk About Ethics! A Qualitative Analysis of First-year Engineering Student Group Discussions Around Ethical Scenarios

Landon Bassett, University of Connecticut

Landon Bassett is a graduate student at the University of Connecticut who focuses primarily on undergraduate engineering ethics and process safety

Dr. Jennifer Pascal, University of Connecticut

Jennifer Pascal is an Assistant Professor in Residence at the University of Connecticut. She earned her PhD from Tennessee Technological University in 2011 and was then an NIH Academic Science Education and Research Training (ASERT) Postdoctoral Fellow at the University of New Mexico. Her research interests include the integration of fine arts and engineering and developing effective methods to teach transport phenomena.

Dr. Richard Tyler Cimino, New Jersey Institute of Technology

Dr. Richard T. Cimino is a Senior Lecturer in the Otto H. York Department of Chemical and Materials Engineering at New Jersey Institute of Technology. He received his Ph.D in Chemical & Biochemical Engineering from the Rutgers University, with a focus in adsorption science and the characterization of porous materials. His research interests include engineering ethics and process safety, and broadening inclusivity in engineering, especially among the LGBTQ+ community. His previous funded research has explored the effects of implicit bias on ethical decision making in the engineering classroom.

Dr. Kevin D. Dahm, Rowan University

Kevin Dahm is a Professor of Chemical Engineering at Rowan University. He earned his BS from Worcester Polytechnic Institute (92) and his PhD from Massachusetts Institute of Technology (98). He has published two books, "Fundamentals of Chemical Engineering Thermodynamics" and "Interpreting Diffuse Reflectance and Transmittance." He has also published papers on effective use of simulation in engineering, teaching design and engineering economics, and assessment of student learning.

Dr. Daniel D. Burkey, University of Connecticut

Daniel Burkey is the Associate Dean of Undergraduate Programs and Professor-in-Residence in the Department of Chemical and Biomolecular Engineering at the University of Connecticut. He received his B.S. in chemical engineering from Lehigh University in 1998, and his M.S.C.E.P and Ph.D. in chemical engineering from the Massachusetts Institute of Technology in 2000 and 2003, respectively. His primary areas of interest are game-based education, engineering ethics, and process safety education.

Dr. Scott Streiner, Rowan University

Dr. Scott Streiner is an assistant professor in the Experiential Engineering Education Department (ExEEd) at Rowan University. He received his Ph.D in Industrial Engineering from the University of Pittsburgh, with a focus in engineering education. His research interests include engineering global competency, curricula and assessment; pedagogical innovations through game-based and playful learning; spatial skills development and engineering ethics education. His funded research explores the nature of global competency development by assessing how international experiences improve the global perspectives of engineering students. Dr. Streiner has published papers and given presentations in global engineering education at several national conferences. Scott is an active member in the Center for the Integration of Research, Teaching, and Learning (CIRTL) both locally and nationally, as well as the American Society for Engineering Education (ASEE) and the Institute of Industrial and Systems Engineers (IISE).

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Introduction

Over the past two decades, there has been a renewed interest in the scope and practice of ethics education in engineering curricula, especially in the first year [1, 2, 3]. However, the form engineering ethics education has varied considerably with each program. Active and gamified learning strategies have become increasingly common for developing ethical awareness and decision making in engineering education [4, 5, 6, 7]. Unfortunately, the practical assessment of student ethical awareness is difficult, and it is likewise challenging to assess the reasoning that students use to approach ethical decision making. At the present, several quantitative ethical reasoning instruments exist for this purpose [8, 9, 10] , based largely upon the Kohlbergian theory of ethical development [11]. While quantitative instruments can offer certain insight into underlying principles students use when making specific ethical decisions, they cannot probe the depths of the reasoning behind their decisions. Thus it is necessary to incorporate alternative, qualitative methods to more deeply investigate ethical reasoning [12,13].

The purpose of the present study is to answer the following research question: *How do engineering students reason through engineering-ethical scenarios prior to college-level ethics education?* Generally, undergraduate students are not exposed to explicit engineering ethics education prior to college [14]. Thus, the primary goal of answering this research question is to propose a framework to describe the methods which undergraduate engineering students use to approach ethical reasoning. This Work In Progress is part of a larger, multi-year study on the effects of several collaborative game-based engineering ethics interventions geared toward first year undergraduate students that is being conducted at several universities in the Northeast.

Methods

Study Design

The group discussions center around engineering ethical scenarios derived from the Engineering Ethics Reasoning Instrument (EERI) [10] developed at Purdue University, and Toxic Workplaces: A Cooperative Ethics Card Game (developed by the researchers). The questions posed to the student groups center around primary morality concepts such as integrity, conflicting obligations, and the contextual nature of ethical decision making. Please see [10] for the EERI questions used (Nurse Schedule Software, Water Quality Testing) and [15] for details of the Toxic Workplaces game.

In order to recruit first-year engineering students at an accredited New England university, an announcement was made to their first-year course. From there, interested students filled out an availability/interest form in order to be chosen for participation. Students were chosen from the pool in the order they signed up and were placed into groups on a first come first serve basis. Students under the age of 18 or ones that did not consent were removed from the pool, as well as

students that did not respond. Consent was obtained for the discussions via electronic IRB-approved forms and again verbally at the beginning of each session.

During the Fall semester, three first year students participated across two practice sessions, each run within a secured WebEx meeting. Each practice session was run by two researchers who had their cameras on. One researcher interacted with the students and guided them through the discussion by presenting scenarios and asking questions. The other researcher observed the discussions and took field notes. For the practice session, the researchers were observed by the rest of the team who had their cameras off and did not interact with the students. The researchers were observed so that they could run each session with consistency. The practice sessions consisted of two participants each. In the event that a first-year student who was unable to make it, a graduate student filled in for them so that each practice session had two participants. The students were given one scenario at a time and asked to read it aloud. Then they were given a few questions to promote discussion amongst themselves. The questions are shown in the list below. Questions 1, 2, and 8 were mandatory and asked during each scenario. The remaining prompt questions were read to the students in the event the conversation lulled, in order to re-engage the discussion. The students were asked to answer the questions and were given ample time before moving on. Much like the practice sessions, the real sessions will also be recorded as well as observed by a researcher. These recordings will be automatically transcribed by WebEx, and the transcripts will be analyzed qualitatively (see **Data and Analysis**, below). The study will start in earnest during the 2021 Spring semester, and will be conducted virtually utilizing WebEx.

Discussion Questions

Initial Mandatory Questions

1.) Recap the scenario with your group. What is the issue that must be addressed?
2.) Explain your individual course of action to your group (want to allow students to have more than binary yes/no responses to instrument questions)

Prompt questions:

3.) Who do you identify the most with in this scenario? The least?
    a.) Whose opinions/interests (of the people in the situation) matter the most? The least?
4.) Who would be affected by your decision? Of those, whose interests are the most important? The least?
5.) How might those affected by your decision react to your decision? Does it matter?
6.) How ethical does your choice of action feel to you?
7.) What aspect of the scenario do you feel affected your decision the most?

Final Mandatory Question

8.) After discussing the situation with your peers, do you still feel the same way as you did when you first made your decision? Why or why not?

Data and Analysis

The data from this study will be in two formats: written transcriptions of the audio-recorded discussions and video recordings of the students. The transcribed discussions will be analyzed using an a priori coding schema to evaluate the emergent themes present in student responses to each scenario. Review of the transcripts will be accomplished by multiple researchers, who will assign to each idea-unit within the discussion an emergent theme using a short phrase. These themes will be collected into a code book that will serve as the basis for coding of student responses in future years of the study. Since the data are coming from discussions (as opposed to one-on-one interviews), it is also of interest to qualify the interpersonal dynamics that occur during the discussions. As such, the researchers will also analyze the video recordings of the discussions to evaluate the behavioral themes present during the discussions with respect to engagement, participation, interest level, and comfort.

Research Quality Considerations

The Quality in Qualitative Research (Q3) Framework [16] will be used when preparing to collect and analyze the discussion group data. Procedural validation steps include constructing the discussion questions in a manner that strives to prevent power dynamics in the data collection process (between the data collector and the student participants, and also between the student respondents). Communicative and pragmatic validation is achieved by designing the protocol to allow the students to freely share their responses and likewise, students will always be allowed to change their responses/decisions at any time. Procedural and communicative validation will be achieved through allowing all researchers to to discuss the coding decisions, to ensure the best quality results. Finally, the researchers are maintaining an audit trail of any changes made to the protocol as a form of ongoing process reliability.

Limitations

While the study presented here provides a framework to capture engineering students' ethical decision making in real-time, it has some limitations. A study such as this one is not easily scalable, and has the potential to be impacted by biases (of the students and facilitators) and group dynamics. Implicit biases and stereotyping [17, 18] of the students and facilitators could likewise have impacted the ethical decision making of the students. Furthermore, the lack of overall participation led to a sample that is not representative of all first year engineering students: in our experience, recruitment of students was challenging, with only 33/441 responding initially with the possibility of an incentive. Of those 33, 1 to 3 students would commit to participating in each session, with several canceling at the last minute. However, this framework has the potential to be easily adopted and implemented at other universities, due to its entirely virtual format.

Summary and Next Steps

This Work in Progress provides an initial procedure for probing how first year engineering students discuss engineering ethics scenarios prior to formal college level ethics instruction. Practice

sessions of discussions with student volunteers were conducted to calibrate the research team and provide feedback to improve facilitation. The framework described here uses a set of curated engineering ethics scenarios derived from the Toxic Workplaces game with post verbal probing that can be readily adopted by other researchers and educators.

Future work includes recruitment of additional students from multiple universities to participate in discussions and analysis of data (transcriptions and video recordings) that will establish a baseline for first year engineering students' ethical reasoning. This information will be used in future years of the study as a point of comparison to inform the development of future scenarios as well as ethics-related courses and curricula in undergraduate engineering.

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