Using Technology to Develop Ethical Choice in Engineering Students

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Abstract

This paper describes the interactive technology that we have added to an undergraduate course titled "Engineering Ethics and Impact on Society." The purpose of this technology is to develop students' awareness of cultural differences in engineers' approaches to ethical practice, and to develop students' abilities to communicate in a global workplace. These goals are being pursued through a website that is publicly available, titled Reflective Choices http://ReflectiveChoices.ttu.edu. We describe the development of the website and results from the first several months of implementation. A major purpose of this paper is to make our colleagues aware of this website and to encourage them to contribute featured articles related to engineering ethics and professional practice.

1. Introduction

The widespread availability of internet technology through applications like Facebook, Snap, and blogs has been credited with, among other things, the Arab Spring, alt-right, and alt-left movements. We, too, have been struck with the current exponential growth in AI and social media. These are not simply fads – they are real, and for us, promising tools to develop and research for academic purposes.

In the internet application described here, we are adding interactive technology to an undergraduate course "Engineering Ethics and Impact on Society." The technology is being used to connect engineering students in this course with students worldwide. Course objectives are geared toward promoting discussion and learning around issues involving ethical choices facing practicing engineers here and abroad. The major task is to kindle reflective analysis of present-day engineering and technology dilemmas from different perspectives – e.g., a U.S. student reflecting on a dilemma facing an engineer in India; an Indian student reflecting on an engineering decision faced by a U.S. engineer. More specific goals are to improve undergraduate education in the area of global communication, to involve large numbers of students, to exploit current technology in creative ways, and to raise the visibility of supporting institutions in promoting the development of ethical sensibilities in students.

The Texas Tech course ENGR 2392 Engineering Ethics & Impact on Society, led by Dr. William Marcy, and the website http://ReflectiveChoices.ttu.edu are the primary channels through which this project is being developed and implemented. The project combines traditional pedagogical theory with cutting-edge instructional and assessment technology. Our intent is to internationalize the curriculum of this course and provide an interface for Texas Tech students to learn about and benefit from cultural differences associated with ethical thinking.

2. Method

We began work on the project in May 2017. The primary personnel have been Dr. William Marcy (College of Engineering) and Dr. Roman Taraban (Department of Psychological Sciences). We received substantial assistance in establishing the *ReflectiveChoices* website through the Texas Tech Office of Information Technology. Dr. Marcy has developed much of the content of the website. Research assistants working with Dr. Taraban have aided in assessment of student contributions to the website. In addition to Drs. Marcy and Taraban, there is a third member of the website Advisory Board: Dr. Shiva Prasad H.C, Professor, Department Humanities and Management, Manipal Institute of Technology, Karnataka, India. Dr. Walt Schaller, Philosophy Department, Texas Tech, contributed an article that is posted to the *Reflective Choices* website. Dr. Sukant Misra provides support for the project through the Office of International Affairs.

The project consists of multiple interconnected goals:

1. to create a platform within ENGR 2392 that allows us to partner with foreign faculty and students on topics of engineering and technology ethics issues

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2. to create a website that provides an interface between Texas Tech and foreign students to exchange ideas regarding ethics and ethical practices
3. to recruit foreign faculty partners who teach engineering ethics in order to develop a common cross-cultural base for the exchange of ideas among students
4. to recruit foreign students to analyze and comment on articles and case studies on the *Reflective Choices* website
5. to recruit U.S. and foreign faculty to author articles and case studies to post to the *Reflective Choices* website
6. to develop and apply analytic tools for students' contributions to the website.

The status of each of these goals will be detailed next.

3. Results

Re 1. In June 2017, Dr. Marcy began authoring case studies to be used on the *Reflective Choices* website. The initial set of materials was completed by August 2017.

Re 2. In August 2017, the Office of Information Technology at Texas Tech assisted in the creation of the *Reflective Choices* website.

Re 3. In August 2017 we began the process of identifying and recruiting foreign faculty who teach ethics in order to create a common ground with ENGR 2392 for the exchange of analyses and comments on engineering case studies. We currently have firm commitments from Prof. Serhii Zasiekin at Lesya Ukrainka National University in Lutsk, Ukraine, and Prof. Shiva Prasad at Manipal Institute of Technology in Manipal, India, to assist in establishing cooperative relationships with ethics faculty at their institutions. Dr. Taraban has recently traveled to the *27th Annual Conference of the National Academy of Psychology* in Kharagpur, India, to promote participation in the *Reflective Choices* project.

Re 4. In parallel with efforts to identify and recruit faculty who teach ethics, we are pursuing participation from foreign students in the *Reflective Choices* website.

Re 5. In order to enrich representation of ethics and ethical practice on the Reflective Choices website, we are recruiting U.S. and foreign faculty and advanced graduate students to contribute case studies and articles to the Reflective Choices website. These contributions will provide a more diverse base for students' reflection and analysis of ethics. This effort was successfully piloted in Fall 2017 with the addition to the website of an article by Dr. Walt Schaller, Department of Philosophy, Texas Tech.

The home page and Articles and Case Studies on the *Reflective Choices* website are open to the public. There were 243 unique persons visiting the website in Fall 2017.

There were 804 visits to the articles and case studies on the website. In order to submit a comment on the website, you must register on the website and be approved by Drs. Marcy or Taraban. In Fall 2017, 50 individuals joined the website. Thirty-eight of the website members are students. Thirty students in ENGR 2392 wrote an analysis for extra credit on one of the Reflective Choices case studies. These data are not posted to the website. Twenty-three students commented on the case studies and articles on the website. These data are posted to the website and accessible by all members.

Re 6. The development of analytic tools has two primary goals: to improve students' communication skills; and to implement rigorous analyses of students' submissions to the website. To improve students' communication skills we are exploring online tools that can assist students in composing and editing their contributions. These tools are intended for application to the less formal submissions to the website as comments, and to more structured analyses of case studies. The tools will be especially helpful to foreign students who may be motivated to seek feedback and suggestions for editing their website submissions. To implement rigorous analyses of student submissions, we are developing and applying machine-based analyses of their comments and reactions to the ethical dilemmas and featured articles on the website.

The machine tools that we have begun to develop and test include IBM Watson Natural Language Classifier https://www.ibm.com/watson/services/natural-language-classifier/, LIWC (Linguistic Inquiry and Word Count) http://liwc.wpengine.com/, MEH (Meaning Extraction Helper) https://meh.ryanb.cc/, and LDA (Latent Dirichlet Allocation) [1]. These four tools are being used to both improve students' communication skills and analyze their website submissions. Our preliminary results with these tools can be found in the *2018 ASEE-GSW Proceedings* [2].

4. Discussion

The Reflective Choices website http://ReflectiveChoices.ttu.edu provides new directions for the enhancement of instruction in engineering ethics. Our goals going forward are to recruit foreign faculty and student participation in *Reflective Choices*, to further develop and apply online tools to assist students in their communication skills, and to further develop and apply machine-based tools for the analysis of students' website submissions. We will continue developing machine-based tools, like IBM Watson, that will be able to aid students in improving their communication skills, and machine-based tools, like LIWC and MEH, to analyze the content of student compositions.

In the coming months we will continue to develop

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collaborations with faculty at universities outside the U.S. At the same time, we welcome and encourage contributions from U.S. faculty that discuss ethical theory, ethical dilemmas, and ethics in professional practice. Contributions from faculty are featured on the home page of the website. Information on how to submit an article can be found at http://ReflectiveChoices.ttu.edu .

Acknowledgement

References

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