AC 2008-2589: DESIGN OF WEB-BASED PROFESSIONAL ETHICS MODULES TO ALLEVIATE ACCULTURATION BARRIERS FOR INTERNATIONAL GRADUATE STUDENTS IN ENGINEERING

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Design of Web-based Professional Ethics Modules to Alleviate Acculturation Barriers for International Graduate Students in Engineering

Abstract

This paper reports on an ongoing National Science Foundation (NSF)-sponsored research and education project.[1] In recent years, engineering programs in the United States have sought to develop a larger role for professional ethics education in the curriculum. Accreditation requirements have helped facilitate this shift. These requirements have themselves been developed to help ensure that engineering graduates have the knowledge and skills—non-technical as well as technical—needed in today's engineering profession. With this in mind, it is worth noting that almost half of all engineering graduate students in the U.S. are international students. And about forty percent of these remain in the United States and are employed in some facet of engineering research and practice. It therefore seems prudent for the profession that these students, coming from diverse backgrounds, receive some systematic exposure to engineering ethics as it is conceived and practiced in the United States. International students face challenges that domestic students do not encounter—cultural competency, language proficiency, and acculturation stress—making them a natural audience for an educational intervention. This project aims to develop instructional materials that help international engineering graduate students in acclimating to engineering ethics standards and expectations in this country. The details of the materials and the research design to test their efficacy will be discussed.

Introduction

In the last two or three decades there has been growing recognition within the engineering profession in the United States of the importance of professional ethics education for engineers.[2,3] This is reflected in current ABET accreditation standards that require "an understanding of professional and ethical responsibility" as well as other competencies related to understanding engineering's role and impact in the wider world. This has by no means guaranteed that ethics education for U.S. engineering undergraduates is of a uniform content, quality, or depth.[4] Nonetheless the movement appears to be clearly in the direction of more coverage, whether in the form of stand-alone ethics courses or ethics modules embedded in existing courses; at the very least, engineering programs must show that their graduates have been exposed to ethics content to a level adequate to satisfy evaluators.

The underlying presumption of such ethics education requirements is that they contribute to the professionalism of engineers and hence to the welfare of the public. The vast majority of undergraduate engineering students will directly enter the engineering workplace. The desire is for them to possess an understanding of the "application of moral principles and professional standards to situations encountered by professionals in the practice of engineering."[5] But the specific expectations placed upon engineers in the United States for professionalism and ethical conduct are based upon the particular conception of engineering and engineering ethics that exists in this country. That conception of engineering and engineering ethics is a product of the historical interplay of U.S. engineering professional organizations, U.S. engineering educational

institutions, and the wider U.S. culture and ethos. But as Luegenbiehl and others have pointed out, conceptions of engineering, and of engineers' professional responsibilities, have evolved differently in different countries and cultures.[5-11]

For example, in the U.S., professional engineers are conceived as having autonomy and individual decision-making authority as professionals independent of their particular employment. But this view of engineers' role and authority within society is not necessarily common to all countries. Nor have formal codes of ethics been as central to the engineering professional societies of many other countries as they have in the U.S. over the last century. In addition, accreditation requirements for engineering education, along with licensing requirements and other legal constraints for the practice of engineering, vary widely from country to country, ranging from the non-existent to the strict. The point is not to suggest that engineers are more or less ethical in one country compared to another; rather, it is to establish that there are significant cultural variations in the ways in which the standards and expectations for professional and ethical conduct by engineers are developed, expressed, assigned, inculcated, interpreted, and enforced. As a result, an engineer raised and educated in one country cannot be expected to immediately and intuitively apprehend another country's general framework and specific conventions for professional obligations. It is in light of this observation that the current work proceeds.

Graduate Education

While there has been quite a lot of activity in recent years to incorporate professional ethics instruction into the undergraduate engineering curriculum in the U.S., the same is not true for graduate education in engineering.[3, 12] Engineering graduate students in this country are not systematically exposed to professional ethics instruction. For those that do receive some ethics instruction, it is most likely to be focused more narrowly on research ethics rather than more broadly on professional practice ethics. Of course U.S. graduate students now and in the future will have encountered some form of professional ethics instruction at the undergraduate level because of current ABET requirements. But for graduate students coming from undergraduate institutions in other countries, we can neither be sure that they have received any professional ethics instruction at the undergraduate level, nor that they are familiar with the particular conceptions of the engineering profession and of professional ethics in this country.

This is not of great concern for those graduate students who return to their countries of origin to pursue their careers. But 45% of the approximately 140,000 engineering graduate students in the U.S. are international students, and up to two thirds of those have plans to stay in the United States to work.[13, 14] The National Science Foundation estimates that there are close to a million immigrant scientists and engineers in the United States who initially came here to pursue an education.[14] If the engineering profession in the United States believes in the importance of engineering professionals being conversant with professional ethics, then there is a need to make sure that these international students—and future U.S. engineers—receive some introduction to that subject. Many of these graduate students will enter the U.S. engineering workplace and will need to acclimate themselves to the professional obligations and expectations they encounter. Just as, if not more importantly, many others will remain in academia where they will need to contribute to the professional ethics educational requirements for undergraduate students. Thus,

an engineering ethics educational intervention for international graduate students is proposed in this work.

Approach: Web-Based Modules

There are two issues confronting the project of promoting widespread professional ethics education for international graduate students: delivery mode and acculturation. First is the issue of delivery mode. The prevalence of offering graduate level ethics courses to engineers will likely increase with time if, for no other reason, as a side-effect of the current interest and activity with respect to ethics at the undergraduate level. But in the absence of some impetus equivalent to the ABET accreditation requirement at the undergraduate level, this trend will not necessarily be swift or uniform. Thus we have chosen to develop web-based ethics modules that institutions can offer to graduate students either external to degree program credit requirements, or embedded as a modular component of an existing course or seminar. The goal is to provide and educational resource that institutions can easily adopt, which will provide a solid, introductory educational experience, and which will provide a credential of value to the student.

In developing the module format, we wanted a series of modules that identify broad themes that underlie engineering ethics, and then provide detailed information about how those themes relate to standards and practices in the U.S. engineering profession. A series of eight hour-long modules have been developed on the following themes:

1. Codes of Ethics
2. Protecting Human Life and Welfare
3. Competence
4. Honesty
5. Fairness
6. Conflicts of Interest
7. Intellectual Property & Plagiarism
8. Data Integrity

Heinz Luegenbiehl has argued for the development of an international code of ethics that addresses themes that are common across national and cultural borders regardless of the specific ways in which the details of those themes manifest themselves in a particular locale.[5] Some globally appropriate themes he extracts from a U.S. view of engineering ethics include the "safety, health, and welfare of the public, engineers' competence, the qualities of honesty and objectivity, avoidance of conflicts of interest…and making decision[s] which are fair and based on merit." These themes are also consistent with the themes of the NAFTA Code of Ethics, specific to Canada, the US and Mexico, and designed expressly to be equivalently worded in French, English and Spanish.[15] These themes match well to our module themes 2-6. We have also included the more specific themes of modules 1, 7, & 8 because engineers and researchers who will be working in the U.S. should be conversant with the specific laws, rules, and expectations concerning ethics codes, intellectual property, data integrity, and research practices.

Each module is intended to require one hour (nominally) to complete, and consists of the primary textual and graphic information, secondary "enhanced" content that provides more in-depth

information on specific topics, and tertiary content that can be accessed through links to external sources of information if students care to pursue a topic further. Figure 1 shows a portion of a page from the Competence module. The blue hyperlink "Catching mistakes" takes the reader to a page with enhanced content—in this case, a more in-depth discussion of engineering mistakes and how they can be avoided. Each hour-long module is broken in to three (approximately) 20-minute sub-modules. Each sub-module has practice questions/exercises requiring student responses to facilitate active learning. At the end of each module there is a mastery quiz to test student comprehension of the material. To complete the ethics short course, students must pass the mastery quizzes for all eight modules.

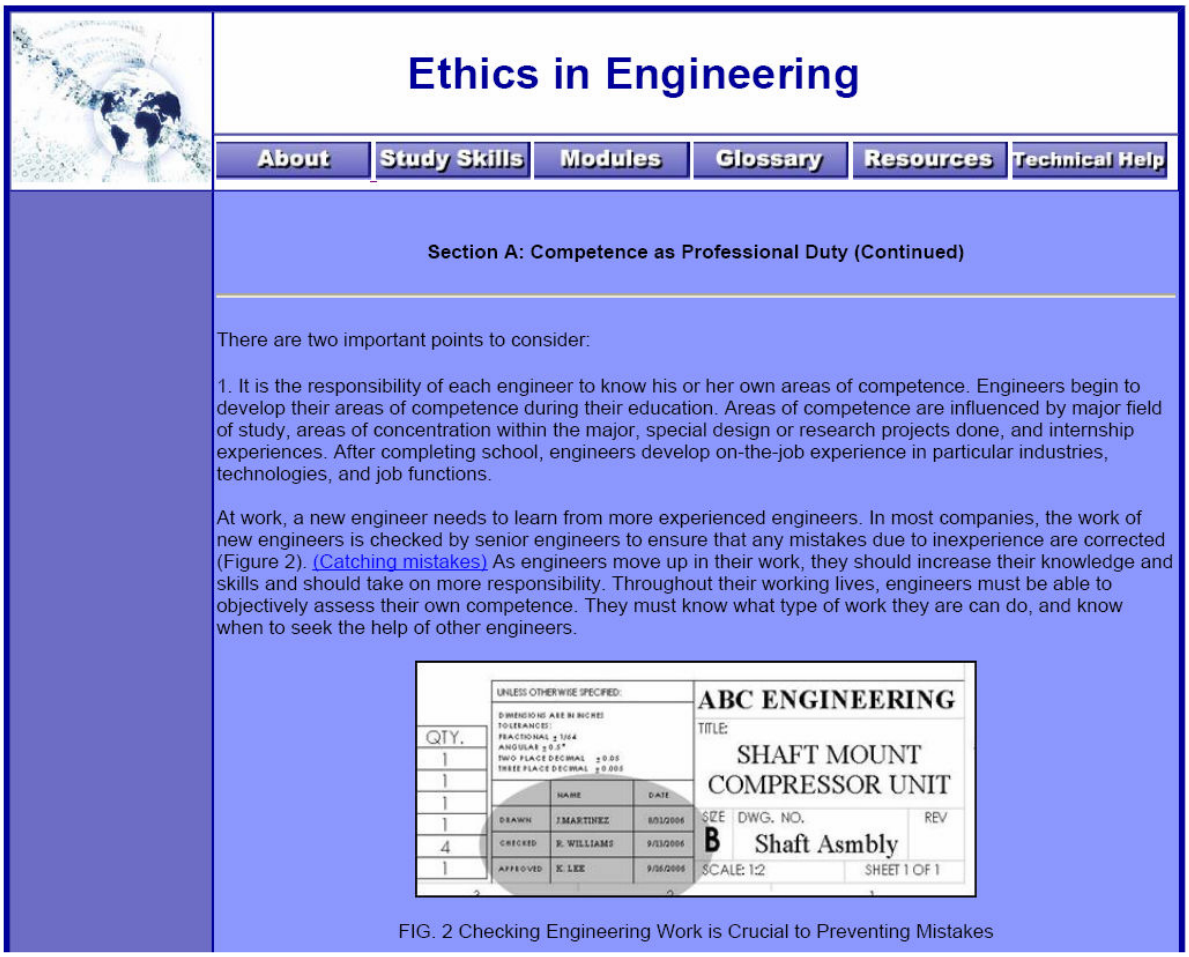

Figure 1. Screen Shot from Web-Based "Competence" Module

Acculturation

Acculturation is the assimilation into mainstream culture of the host society and integration of native country culture and traditions. Acculturation issues create barriers for international students who need to know and accept what is/would be ethically required of them were they to remain in the United States to practice engineering, teach engineering, or do engineering research. These barriers are above and beyond the challenges faced by domestic engineering graduate students.[16] As discussed below, factors that strongly predict successful acculturation are cultural competency, language proficiency, and specific acculturation stress indicators.

- Cultural Competency: American culture is centered around a normative value system based on future orientation, mastery of environment, individualism, "doing", and good/bad dimensions of humanity.[17] In evaluating the cultural competency of international graduate students, Rahman and Rollock found that cultural competency strongly predicts successful acculturation.[18] Their research delineated four components of cultural competency: intercultural attitudes, work (career and academic) productivity, personal/social efficacy, and intergroup comfort. In a similar study, Wilton and Constantine concluded that increased familiarity with cultural and professional norms leads to better adjustment and quicker acculturation.[19] Huntley[16] and Poyrazali, Kavanaugh, Baker, and Al-Timimi[20] noted that Asian international students struggle the most with cultural competency, as Asian culture is grounded in principles of dependency and conformity, which are divergent from the individualism of American culture.

- Language Proficiency: Mastery of the English language poses a major challenge for most international graduate students. In addition to typical writing skills, Gorsuch discussed language competency in terms of sociolinguistic mastery (speaker ability to use appropriate language in various contexts), and textual proficiency (the organization of language in accordance with normative rhetoric guidelines).[21] Huntley noted that the development and requirement of the TOEFL – Test of English as a Foreign Language – is a testament to the barrier that English language proficiency poses to international graduate students.[15] The TOEFL is now required, as the language barrier is extremely common for international students. In terms of Asian international students, Jiali[22] and Poyrazli, Kavanaugh, Baker and Al-Timimi[20] found that language barriers are one of the most prominent obstacles to successful acculturation.

- Acculturation Stress: Acculturation stress is a psychological manifestation of maladaption to the host culture. Poyrazali, Kavanaugh, Baker, and Al-Timimi identified ethnicity as the major predictor of acculturative stress and noted that Asian international students suffer higher levels of acculturative stress, compared to other ethnicities.[20] Further, Jiali identified four measurable variables that diagnose acculturative stress: fear, perceived hatred, perceived discrimination, and cultural shock.[22] Rahman and Rollock concluded that acculturative stress was predictive of perceived cultural competency and successful functioning for international engineering students.[18]

The educational process – for our purposes, ethics instruction – will be effective only to the extent that acculturation factors permit learning to occur. This is in contrast to domestic students, where learning is more directly linked to instruction. Our instructional strategy is directed

specifically at alleviating the acculturation barriers, thereby improving ethics education for international graduate students. That is, acculturation barriers for international graduate students can be mitigated by an education intervention (web-based ethics learning modules) designed with appropriate regard to distance learning pedagogy and the unique needs of international student populations. The timing of the educational intervention is paramount to aiding students with acculturation with respect to engineering ethics. Huntley delineates four stages of acculturation: (1) anticipatory (before leaving native country); (2) passive spectator (first few months in the US); (3) disenchantment (follows passive spectator and varies in duration based on psychological and cognitive individual differences); and (4) adaptation.[16] Research indicates that all students who stay reach a point of "adaptation" that may include poor language skills, cultural misconceptions, and a misunderstanding of normative values. Once a student reaches this point of "maladaptation," they are less malleable and less willing to re-learn information about the host country.[19,23]

As such, we seek to expose students to the learning modules during the passive spectator stage of their acculturation, in an attempt to maximize the benefit of our educational intervention. The most efficacious intervention strategies include the following pedagogical components: education about specific expectations and demands; education concerning specific skills required for success in the field; and decision-making strategies.[18] With regard to normative ethical instruction for engineering students, our educational materials focus on both declarative knowledge (definitions of ethical guidelines, rules, and regulations) and procedural skills (application exercises, decision-making exercises, and recognizing ethical dilemmas). In terms of delivery modality, international students are typically proficient with Internet-based technologies, as they use these technologies for socialization and communication with their families at home.[17] Furthermore, web-delivered modules support an educational paradigm and environment that international students, especially Asian students, are comfortable using. The role of both the student and teacher in Asian culture is very formal and non-interactive, much like traditional American education in the 1950s.[23] Web-based environments allow students to actively learn through the interface without the stress of public-speaking and face-to-face interactions. For example, Huntley[16] and Gorsuch[21] indicated that the international educational cultures are often dramatically different from American educational culture.

As the modules are being developed, the baseline content on professional ethics is edited to make the language as accessible as possible to foreign-born readers. This includes eliminating unnecessary jargon, explicitly defining important terminology, and avoiding unnecessary cultural references, metaphors, and allusions that would be unknown to the average non-U.S. citizen. Each module has undergone a think-aloud protocol whereby one of the authors observed international graduate students reading the modules and providing feedback about what aspects of them they found difficult to understand and interpret. We also have a Cultural Advisory Panel of foreign-born engineering faculty to oversee and provide input to module development.

Conclusion

The modules are currently undergoing continued development and testing. Over the course of this project, we will to administer versions of the ethics modules to incoming international and domestic graduate students. Students will complete an assessment prior to participating in the

educational intervention (pre-test) and upon finishing the online instructional material (post-test). This normative value assessment instrument administered prior to training and upon completion will include question sets linked to specific pedagogical approaches contained in the educational modules, such as interactive exercises, multimedia, and trial/error quizzes. This design will allow us to measure the efficacy of the pedagogies and strategies deployed in each module version. After each year, item-level data will be analyzed to determine the validity of the instructional technique.

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