AC 2008-309: USING THE NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS' (NSPE) ETHICS EXAMINATION AS AN ASSESSMENT TOOL IN THE ENGINEERING TECHNOLOGY CURRICULUM

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Abstract

In an effort to better assess our students' understanding of professional ethics, our engineering and technology department has been utilizing materials from the National Society of Professional Engineers (NSPE). Specifically, we provide each student with a copy of the NSPE Code of Ethics and use an examination on this code, also provided by NSPE. These materials are available on the NSPE website. A solution to the exam with cross-references to the applicable NSPE Code of Ethics is also available. Our department uses this exam in the senior capstone course in order to get an overall picture of the depth of professional ethics understanding among our senior class of students. The capstone course combines students from multiple disciplines, including: Mechanical Engineering Technology, Computer Engineering Technology, Technology-Design, Technology-Manufacturing, and Technology-Construction Management. The use of the exam accomplishes a few objectives. First, it provides an assessment on student understanding of professional ethics for students that are nearing graduation. As such, it provides feedback as to the efficacy and depth of coverage of ethics principles that students have been taught throughout their four year academic career. Second, it creates a springboard for additional discussion of ethics. These capstone students are seniors and most have recently completed internships out in the 'real world' and this brings more depth and insight to these discussions than often happens in lower-level courses. And third, it provides the students with some motivation and resources for life-long learning in the area of professional ethics. This paper will discuss how the exam is used in the course as well as some results and observations from its use.

Introduction

Engineering Technology students spend a substantial amount of time studying mathematics, physics, and engineering sciences. However, precious little of their time is actually spent learning about the possible social, moral, political, and economic ramifications of their future work. It is also interesting to note that some of the greatest thrusts by professional societies are in codes, safety, and professional ethics; topics that often get very little coverage in a technical program of study. In order to strengthen the educational process, these important engineering aspects are commonly combined into the general topic of professional ethics.

As the complexity of the products engineers design increases so does the need for further study into both the theoretical and realistic awareness and application of professional ethics. During their careers all engineers will be challenged by situations requiring design tradeoffs involving cost, schedule, and quality issues. Some of the solutions will be straightforward while others will be difficult forcing the engineer to utilize their best judgment. Unfortunately, in many cases these decisions are made without the benefit of adequate training and have resulted in negative or unanticipated results.

Since the engineer's work impacts all of society in many ways it is imperative that they function with honesty and integrity. Over time the engineering profession has created a positive level of confidence and trust from society and new graduates must live up to this lofty image. The safety of all the people using the products designed by engineers must be insured. By introducing engineering and professional ethics as a significant part of the curriculum students realize and understand their obligations to society, their company, and their career. This foundation provides new engineers with a valuable and practical background for ethical professional behavior.

The organization responsible for accrediting American undergraduate Engineering and Engineering Technology programs has recognized this need. As a result the Accreditation Board for Engineering and Technology[1] (ABET) has mandated that undergraduate engineering curricula include the study of ethics. Even though many engineering students begin college with a general understanding of ethical principles, further classroom exposure is required for them to fully comprehend the engineers' professional responsibility. This aspect of their education is essential in order to adequately prepare them for the real world engineering problems and ethical dilemmas that they will encounter during their career.

It is interesting to note that most students develop their understanding of professional ethics by extrapolating from their experience with their university's Academic Integrity Policy. This became very obvious from the results of a survey conducted within our department. During a previous semester a survey was conducted in the Engineering Graphics course. This is a course that is required of all students studying in any of the engineering technology and technology programs at this institution. It is also a course that is taken very early in a student's major program and is usually the first class taken within the department. Consequently students in this class are generally freshmen or sophomores. This class was chosen for these reasons so that an overall understanding of professional ethics from students just entering the department programs could be assessed. It was difficult to derive percentages from the survey since the questions used were open-ended and required a short paragraph to answer. However, the results of that survey indicated that students had an overly simplified understanding of professional ethics. The most telling question on the survey had students defining ethics as: not stealing another person's work, not misrepresenting another's work as your own, not telling lies, not plagiarizing, not falsifying work, acting with integrity, not misleading coworkers or supervisors, etc. A couple of students emphasized the "if you get caught" aspect of violating ethical behavior. The most common response was "Do not copy someone else's work" and a couple of honest individuals stated that they had "no clue" what constituted an official definition of professional ethics. One other student took a stance that professional ethics wasn't really part of the academic program needed for preparing for the workplace. It's also interesting to note that most students focused on the negative aspect, as in listing the things not to do, as opposed to having an overall philosophy of what is entailed in behaving ethically. They all seemed to understand that a violation of ethical behavior would cause you to lose your job. One of the more insightful answers given by a student was that having a code of ethics gives the individual the benefit of the doubt; that it served as a protection. In other words, having a code of ethics puts an individual in a position that they are presumed innocent and trustworthy until proven in violation of the code.

Background

Unfortunately, a single uniform system or standard across the entire engineering profession for ethical conduct doesn't exist. The accepted practices tend to vary to some extent by discipline or jurisdiction. They are also highly influenced by the type of organization the engineer is working for; such as consulting, governmental, or a private corporation. As a result, a number of American professional engineering societies have created their own codes of ethics. Each of these codes provides a framework for judgment and functions as a guide to aid in resolving ethical issues while maintaining proper engineering conduct. These codes should be considered as a starting point that requires additional sound judgment in order to reach an ethical decision. After all, no code could possibly cover all of the potential scenarios that could be encountered by practicing engineers. They are not a cookbook outlining steps to resolve every ethical situation, but rather they are principles and standards to follow.

A comprehensive engineering society that represents engineers from all disciplines is the National Society of Professional Engineers (NSPE). The NSPE has developed its own code of professional ethics[5]. It is an extensive and comprehensive listing of professional obligations and rules of practice. Other professional societies have codes of ethics that are more specific to their particular discipline. Among them are the American Society of Mechanical Engineers[3] (ASME), the Institute of Electrical and Electronic Engineers[4] (IEEE), the Society of Manufacturing Engineers[7] (SME), and many others.

All of these codes of professional ethics have been incorporated into the material covered by courses in the Engineering Technology curriculum. Since our department offers programs in Computer Engineering Technology, Mechanical Engineering Technology, Manufacturing, Design, and Construction Management, a good overall view of ethics is needed. Specific aspects for ethical behavior corresponding to the course objectives and outcomes are presented. For example, a junior level course that is required for all of those majors has an entire learning module dedicated to engineering ethics where codes are examined, case studies are discussed, and essays written.

What was still needed was a way to properly assess the students understanding of ethical problems and the means that could be used to resolve them. The selected method had to be broad enough to encompass the variety of disciplines offered but yet specific enough to properly critique the students' insight, awareness, and perception of the concepts. The solution was to utilize the National Society of Professional Engineers[6] (NSPE) Ethics Exam that is readily available from their web site as an assessment tool.

Method

As previously mentioned, education in professional ethics is infused throughout the program curriculum. However, students nearing graduation enroll in the senior capstone course and this allowed an opportunity for a final discussion on professional ethics before they enter the workplace. This paper focuses on professional ethics as covered in the senior capstone course. Because this course essentially constitutes their "capstone" in ethics training, the presentation is

somewhat different than in their previous academic experiences. Since, as indicated in the Introduction most students believe they have a good understanding of professional ethics, the discussion begins with the NSPE ethics examination.

The National Society of Professional Engineers (NSPE) Ethics Exam

The NSPE Ethics Exam is available on the NSPE website[6]. The exam can be taken on the website and electronically scored, if desired. The exam consists of 25 statements that are marked True or False. Each statement corresponds to a specific section of the NSPE Code of Ethics. An answer key to the exam is available that provides the corresponding reference section in the NSPE Code of Ethics for each question. The entire NSPE Code of Ethics[5] is also available for viewing.

Class Room Experience

The students in the senior capstone class are each given a copy of the NSPE Ethics Examination without any previous discussion and are allowed to complete the exam. Once all students have completed their answers the exams are graded in class. The average student performance on the exam over the past two years has been a score of 49%. Additionally, no student has ever achieved a perfect score on the exam. When the students receive what constitutes a failing grade on a topic they think they already understand, it creates a springboard for some very interesting discussion.

Once the students have completed and scored their NSPE Ethics Exam, they are each given a copy of the corresponding NSPE Code of Ethics[5]. The discussion begins by looking up the reference for each of the questions on the exam and getting student's to discuss what aspect of the question had led them to an incorrect answer. After this discussion, each student is given copies of other codes of ethics developed by other professional societies, including ones from ASME[3], SME[7], and IEEE[4]. Students are informed that these professional societies also offer training in professional ethics on their websites (see, for example, the ASME Ethics Center[2]). A discussion ensues as to the reasons that each society might form their own code of ethics and the students are allowed to compare and contrast the different codes.

During all of this classroom discussion, actual work experiences are solicited from the students. Many of the students have previous or current job experiences and most of the students have, by this point in their academic program, completed an internship. Experiences that the students have had in these working environments provide a wealth of material for discussion. Additionally, the instructor provides a few examples of his own, and also includes some of the classic examples used to discuss ethical failures within the technology and engineering professions. This entire lesson is also a subset of a lifelong learning project each student in the capstone course must complete. In this project the students create a ten-year career plan that involves researching professional societies and what benefits membership might have for their career. This lesson helps them see the ethics training benefits of professional society membership.

Lessons Learned

The NSPE Ethics Examination[6] is a great lead-in to often very in-depth discussion. It shows the students that professional ethics is not as simple as they might have previously thought. Additionally, when the students essentially "fail" an exam on a topic that they think they understand, it gets their adrenaline going and they are very prone to expressing their opinions, justifying their answers and sharing their experiences.

The National Society of Professional Engineers (NSPE) Ethics Exam[6] proved useful as an assessment tool. It gave a metric for depth of understanding of professional ethics. One of the most significant results of using the exam was the creation of additional opportunities for discussion leading to additional depth and insight into professional ethics. It also provided motivation and encouragement for life-long learning in the area of professional ethics and the role of professional societies in their chosen field of engineering.

It is noted, however, that the value of the assessment comes in comparing graduating seniors from year to year. In other words, it provides a good program assessment. With the consistently poor scores on the exam it was difficult to use the score to assess an individual student's understanding of professional ethics. One avenue that is being implemented to obtain even more useful information is to conduct a cohort study. As mentioned earlier a survey was given to students in our engineering graphics course to get an assessment of their level of understanding of professional ethics as they enter the program. In the future the NSPE Ethics Exam will be substituted for this generic survey. Then when these same students re-take the NSPE Ethics Exam a few years later in their senior capstone course as they are completing their program of study their results can be compared with how they scored as freshmen or sophomores.

Another observation that is being discussed relates to student attitudes towards the NSPE Ethics Exam. When the NSPE exam is passed out in the senior capstone class the students are told to do their best, but they know that the exam isn't part of their grade. This opens the possibility that students may not take as much care in completing the exam as they otherwise might and perhaps the exam scores reflect this.

Finally, the use of this exam has proven to be a great addition to our academic program in professional ethics. It has also been a great opportunity to re-address the importance of professional societies and the benefits that they can offer.

Conclusions, Recommendations and the Future

Students in the various Engineering Technology programs are now better prepared to handle the ethical challenges that will be presented to them during their engineering career. They were exposed to codes of ethics dictating professional behavior, case studies, discussion groups, and other avenues familiarizing them with some situations they may encounter. They are also aware that by now many organizations have instituted some type of ethics code or program of their own. Unfortunately the training only covered the fundamentals, but the experience and their judgment should be able to guide them through the problems and confrontations that lay ahead.

The future includes further improvements in engineering ethics education and the process will be expanded. Today ethical behavior is expected from all engineers, managers, and professionals. As a result of all the problems from the recent past, this trend will continue and intensify in the future. In order to remain competitive, organizations of all types and sizes are trying to foster an ethical culture with employees that will notice and resolve ethical problems early before they become an issue.

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