Globalization of Engineering Ethics Education

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Abstract

Borderless ethics and the attempt to develop a global engineering code of ethics have formulated significant driving forces behind trends in engineering ethics education. This is because engineering is no longer limited by borders and therefore the differences in culture and values from one country to another become a significant factor in the outcome of an engineering project, product, or undertaking. There are many sides to the issue of ethics globalization. As educators in this field continuous attempts are made to look at these issues systematically and assess the required modifications for our ethics education to produce engineers that are globally successful.

Endeavors by the authors to "internationalize" instruction in engineering ethics include the solicitation of input from engineering and technology students at Lake Superior State University with regard to changes in the ethics component of the engineering curriculum. This past year third-year students were given a survey soliciting their views on what ethical values are "universal" and what values are specific to a given national and/or cultural setting. Additionally, students were asked to suggest contributions that the American engineering professional community can make to the development of a comprehensive international engineering ethics code, and what Americans in turn can learn about ethics and values from their foreign counterparts.

This paper includes a discussion of the results of this survey; views differed widely from student to student, as expected, but certain common threads of thought were found throughout the entire surveyed group. The discussion is carried out in light of professional level surveys' results that were published recently by professional societies of engineers.

Introduction

Society and technology today seem so intertwined that it is almost impossible to ignore the influences exchanged between them. In addition, both society and technology have a dynamic nature, which adds another level of complexity to their relation. Since technology is the heart of the engineering profession, engineers' interaction with the society, through their profession, becomes of paramount importance. Therefore, educational resources have been allocated towards educating engineers about the societal impact of their practice of the engineering profession. To support bringing these concepts into the engineering classroom, with a level of enforcement, the Accreditation Board for Engineering and Technology (ABET) most recent criteria included emphases

on educational outcomes like ethical awareness, societal responsibility, and the public role of engineers [1]. Moreover, engineering professional organizations have produced their own self regulatory code of ethics as the part of the profession that deals with the societal implications and engineers' responsibility.

However, as engineering educators try continuously to produce engineering professionals who are technically competent and ethically sensitive, another challenge climbs to the top of the list of priorities in engineering ethics education, which is the global dimension of engineering endeavors. The international dimension in engineering practice has become increasingly evident in the recent years resulting in serious attempts towards establishing an international set of codes of ethics. Globalization adds significantly to the inherited challenges involved in teaching engineering ethics. These challenges include logistic and pedagogical problems as well as engineering ethics implications and applicability problems. Particular to the problems related to engineering ethics teaching and practice implications on society, and the applicability of the material, is the continuous production of challenges due mainly to the changing nature of technology and society [2].

There are many sides to the issue of ethics globalization. From the engineering educators' point of view, continuous attempts are made to investigate these issues systematically and assess the required modifications of the ethics education material and goals to produce engineers that are globally aware and successful. This paper presents some of the experiences and endeavors by the authors to incorporate an international dimension into the ethics component of the engineering curriculum, at Lake Superior State University (LSSU). LSSU-Engineering has a significant contingent of Canadian students, as well as Native American students and other minorities, due to its geographical location. This gives the authors a unique opportunity to work with a class of more than one national and ethnic background, providing some insights that are of interest and benefit to engineering educators and students, towards proper modifications to the ethics component in the curriculum. Two major issues that have emerged and are discussed in particular are consensus and interaction. The resulting modifications and their effects will be surveyed and discussed in a following publication.

Globalizing Engineering Ethics Education "Consensus"

Global engineering teams produce more and better products everyday. Many factors have contributed to the elimination of geographical barriers, like information technology highways, manufacturing and services outsourcing, and international industrial partnerships, to name a few. Consequently, engineering education now is becoming global and that implies the need for a set of engineering ethics that has a global base and vision. Moreover, a variety of ideologies and cultural practices have to be understood and incorporated in engineering ethics education forcing academia to adapt to these changes. Success in an environment of multiculturalism requires a good education in handling many factors including societal and ethical considerations. Incorporating this idea of "Consensus" among our newly graduating engineers will make them effective and successful in such an environment. Therefore, identifying these challenges and opportunities will help take engineering ethics education a step closer towards a global context. The recent ABET accreditation criteria (2004-2005) for engineering programs

outcomes and assessment helps in this identification process. The criteria emphasize issues like the ability to function on multi-disciplinary teams and the understanding of professional and ethical responsibility as well as the broad education necessary to understand the impact of engineering solutions in a global and societal context [1]. Unfortunately, these issues are not well emphasized in the engineering curricula in the US. Part of the problem is because industry and faculty do not actually agree on the important issues in engineering education, especially ethics education [3]. In fact, faculty has succeeded in producing engineers that know more about number crunching than anything else…!

Ethics is the side of engineering that has to deal simultaneously with both a changing profession and a human and societal aspect, which is also changing. The important conclusion is that engineering education has to respond to these changes, with at least a similar speed, to avoid becoming obsolete.

Borderless Ethics Attempts "Interaction"

As a result of engineering globalization, attempts have been reported towards the establishment of an international set of standards for engineering ethics. These attempts are advancing significantly. If our engineers are to contribute positively and have a leading edge in these attempts, engineering ethics education has to respond by incorporating this issue of "interaction." Most engineering ethics education in the US is still national in character, with some international flavor superimposed on it. However, some significant contributions can be realized from the American experience in this field towards the formation of an international context. Examples of this experience include the strong emphasis on public safety, engineers' competency and objectivity, emphasis on making fair and meritorious decisions, avoidance of conflicts of interest, honesty, and confidentiality of the work [4]. However, for many reasons, some important topics have not been well handled by the American experience. Examples of these are the emphasis of respect to human rights, since it's a concept taken for granted in the US. Other examples include ensuring the rights of engineers, public role of engineers, intellectual property, natural resources and environment wise use and preservation, and concern for the implications of technology. Accordingly, contributions by other international experiences will prove to be of great value as an international context is attempted.

Different cultures have different bases for decisions and actions. In comparison to the professional ethics bases in the western hemisphere, many societies around the world do not emphasize the individual or common ethical theories similar to those used in the US for example. In fact, some societies have their own basis for moral and ethical norms, regardless of the profession of the individual, deeply rooted in their beliefs [5, 6]. Unfortunately, most engineering ethics educational resources in the US do not consider these facts and limit the students to the western ethical theories. This is an area of engineering ethics education that needs a significant amount of work.

The LSSU-Engineering Ethics Globalization Experience

In light of the previous ideas, and in a continuous attempt to assess and modify engineering ethics education at LSSU, coverage of two major issues emerges in the

globalization of ethics education. Both issues are widely discussed among students during the ethics modules, both in introduction to engineering (EG101), the first-year engineering orientation course, and in the Senior Sequence. The Senior Sequence for students completing their engineering degrees can be an industrial project, usually with an external customer, a research project with a faculty member in his/her field of expertise, or a cooperative educational experience similar to an internship in other professions such as teaching and nursing. All of these options, however, include a three-credit, capstone course (EG491 Engineering Design Project I) of which the teaching of ethics and, more generally, engineering professionalism is a major component.

The first major issue that the students were surveyed on is one of "Consensus," as embedded in the questions: "What ethical standards are "universal" (i.e. across all nations and cultures) in engineering? What standards should be relative to a national and/or cultural setting?"

The advent of a global marketplace makes inevitable the sale and use of products involving engineering design in one nation that were produced in a completely different national and cultural setting. To buy a product from a faraway location involves trust that somehow the prevailing ethos at that location precludes the possibility that said product would be unsafe or unfit for use. Thus, the mere existence of commercial activity between nations and cultures implies a mutual trust, founded on the assumption that some universal set of ethical values does exist. Admittedly, this is not an unbridled trust, in that global mechanisms do exist for the recovery of damages in the event that products or services prove defective and/or cause harm. But would it be possible to codify this unwritten set of values? What are the essential components of these values? This, indeed, is the heart of the matter of ethics for a young engineering student preparing to enter an increasingly globalized engineering environment.

The second major issue is one of "interaction," as embedded in the questions: "What insights do those in the engineering professions, as practiced in the US, have to offer the international community? What practices can serve as models for other nations? And, just as important, what can the US engineering community learn from other nations with regard to engineering ethics?"

Certainly, consensus cannot be built without a significant amount of interaction. In addition to discussions at international conferences, and other forums of a formal nature, the university itself can serve as a valuable facilitator in encouraging discussion between future engineers from a wide variety of national and ethnic backgrounds. At LSSU, native American students and others born and raised in Michigan find themselves discussing ethical principles with students from India, China, Canada, and a number of European and African nations, as well as many other states in the United States.

The authors have made an attempt to capitalize on this interaction by conducting a survey of students nearing graduation with regard to their views on the two issues above.

Survey Results on Consensus

In this survey, students were asked the previous questions. In answer to the first set of questions, only two major "universals" were cited by a majority of the students, (interestingly, an identical number of students cited each one). These are:

1. honesty and integrity, and
2. safety and concern for the public welfare.

Under the first universal, descriptions of this value varied widely in emphasis. Some students emphasized the importance of delivering a product according to specifications, not falsifying test data, and other considerations that insure that the customer really does receive the product advertised and expected. Others focused more on the submission on one's own work. These students were more concerned about plagiarism and the stealing and copying of proprietary designs. Among all listing this concern, a slightly larger number cited the "no lies" aspect mentioned first than those citing the "no stealing" aspect mentioned second, but many students felt that both aspects were important.

The second universal was presented by the students in a variety of different ways. Nearly all students felt that products that were safe to use, both with regard to the user and with regard to the surrounding public, were a must for the companies, and firms producing these products, even if a large additional cost was involved. Some students emphasized the value and/or sanctity of human life as a basis for this; others did not. In this area, the authors discovered an "embedded attitude" in nearly all student responses, even those that did not cite safety as a universal concern. This attitude is that companies and firms that furnish products or services need to make economic sacrifices to insure that ethical standards, whatever they may be, are followed.

A variety of other concerns were mentioned as "universals" by a minority of the students, ranging from 5-20%. These included punctuality, hard work, concern for the environment, and tolerance and acceptance of women in the workplace. Although not listed by a large number of students, each of these issues was uncontested as a universal issue, in that no student mentioned any one of them as a value that should be specific to a national or cultural setting (the punctuality issue surprised one author, who has worked in a variety of international situations where punctuality was virtually nonexistent). One student offered the interesting insight that the standardization of engineering symbols and nomenclature should actually be thought of as an ethical issue, in that readers and reviewers of technical documentation could be "deceived" by unclear communication in this area.

It was very difficult for the students to formulate ethical issues specific to nations and cultures that still relate to the furnishing of engineering products and services. This may be due in part to a limited knowledge of other cultures and values. Answers to the second question involved mostly lifestyle issues, such as consumption of alcohol, working hours, and the integration of various forms of technology into the "common way of doing things" in a given society. Two areas were cited that possibly have an impact. These were modes of technical communication and forms of deference toward supervisory officials. Some Asian student felt that a high level of deference towards monarchs, nobles, and even people of great age provided cohesiveness in societies without a long history of democratic institutions, and that this deference naturally extended to the

workplace, where a supervisor would be "lord" of his or her technical area. However, others felt that the resulting uncritical acceptance by workers of a supervisor's judgment might impair product quality and compromise the universal value of safety and the public good discussed earlier.

Survey Results on Interaction

With regard to interaction between the United States and the international community in the engineering fields, again there was a great deal of consensus. Students felt that the American educational system encouraged them to think critically about ethical values, and exposed them to a variety of different viewpoints. If somehow the American educational process could be exported to other nations, particularly developing countries, great progress could be reached toward a global consensus on major ethical issues. Despite this strength, however, primarily discussed as an answer to the first portion of the second set of questions, students answered the last part of the question by saying that Americans should not be so closed-minded, and must be more prepared to accept what engineers from other nations and cultures have to say. Apparently, in the view of the students, opportunities exist in the American educational system for exposure to a variety of viewpoints, but that American students are all too reluctant to consider them (even the American students wrote this!).

Other American strengths cited were innovation and creativity, and pride of workmanship, although it is not completely clear to the authors how these would contribute to the development of an international ethical code, except in regard to the relationship between pride of workmanship and the assurance of a quality product or service. The existence and development of affirmative action programs was also mentioned by some students. On the last question, a majority of students (over 70%) discussed a lack of concern for the environment as an American weakness, either in regard to air and water pollution or in the appropriation and use of natural resources.

Summary and Conclusions

In summary, knowledge of other ethical bases and cultural norms that influence engineering in the global dimension have been found to be lacking in the American engineering-ethics educational curriculum. This knowledge is important to demonstrate the concept of common morality, or a standard of conduct that all human beings would agree on. As a consequence, this will provide a fertile ground to start an international standards project, to which, the international engineering community can contribute. Unfortunately, our engineering ethics curricula need a lot of work to catch up to the level of significantly influencing these international activities.

Also based on the previous results, it was found that consensus does exist in the LSSU engineering community, and hence may be possible over a much broader spectrum of engineers. The majority view was that honesty, integrity, and safety and the public welfare were universal ethical values that could comprise the core of an international ethical standard. There was also major agreement on American strengths in the education of engineers, and weaknesses in the areas of closed-mindedness and a lack of concern for the environment. However, some significant modifications to the ethics education

content are needed to make our engineers effective and successful in a global environment. The good news is that our engineering students seem to have an idea of what they are lacking. In a following publication, the authors will attempt to report on modifications that have been introduced to the engineering ethics curriculum at LSSU as a result of the abovementioned findings and the results obtained.

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Biography:

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