Work In Progress - Incorporating Ethics and Social Responsibility in Undergraduate Engineering Education

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Abstract - One tactic that has not been effectively evaluated to increase the involvement of women and underrepresented minorities in engineering is the incorporation of a socially and ethically relevant framework in the teaching of engineering at the undergraduate level. In this research, we are characterizing the efforts currently utilized in universities to integrate social relevance and engineering in the curriculum. We are conducting a pilot study to evaluate the effects of these efforts on overall student interest in the field and retention, women and minority student interest and retention, and students’ awareness of the overlap between society and technology. This study involves a pre-and post-semester survey of students in engineering courses that incorporate ethics and social responsibility to a greater or lesser degree. We plan to make suggestions for the most effective strategies currently used and to recommend new strategies to incorporate these issues in the engineering curriculum, with a focus on the attitudes of women and underrepresented minorities.

Index Terms – diversity, engineering ethics, social responsibility, evaluation of ethical curricula

INTRODUCTION

There has been much discussion in recent years about expanding the ethical training of engineers, and numerous departments focused on the intersection of technology and society have developed in response. Within some engineering departments themselves, a greater emphasis on the incorporation of social elements of technology into technical coursework has been encouraged by the Accreditation Board on Engineering and Technology [1]. The long-term goal of our proposed research is to determine whether the incorporation of ethical and social issues into the engineering curricula affects the way engineering is both practiced in the outside world and/or attracts students from underrepresented populations. Though one goal of the current research is to determine whether the number of women and underrepresented minorities interested in engineering increases when issues of ethics and social justice are incorporated in the curriculum, we urge that the sheer increase of students in these groups is not the only goal of this research. Ultimately, we hope that by increasing the representation of any students who value social responsibility, engineering itself will become a more socially-aware field.

Our assertion is that underrepresented minorities and women may be drawn to an engineering curriculum that integrates social and ethical dimensions of engineering. There is evidence to suggest that, in general, women and underrepresented minorities are more likely to pursue careers that emphasize helping others and social concern [2, 3]. Elaine Seymour attributes this difference in career motivation to varying socialization of boys and girls in Western society [3]. Based on this precedent, we have reason to believe that by incorporating such elements, attraction and retention of females and underrepresented minorities to engineering could improve.

Attempts to incorporate ethical or social dimensions into the science and engineering curriculum are abundant, but few of these have shown clear data that supports their effectiveness in terms of student retention overall, attraction and retention of underrepresented minorities, and the way students view their career choices. Engineering professors interested in incorporating these issues in their classes often do not have the time, training, or resources to effectively evaluate the effectiveness of these efforts. There are a few researchers who have attempted to analyze these efforts, and in [5], the impacts of two different types of ethical interventions in the classroom were evaluated [4, 5].

We have expanded on this prior research by developing a new analytical tool to gauge the effectiveness of ethical interventions in the classroom. We have also applied this new tool to a greater variety of ethical curricular approaches than has been done in previous research.

METHODS

I. Current Ethics Efforts in Undergraduate Courses

The first portion of this research involves categorizing efforts currently undertaken to introduce ethics and social responsibility into the undergraduate curriculum. Some engineering departments choose to largely keep the ethical/social component separate from the technical component through separate courses or distribution requirements. Some schools choose to introduce short ethics modules that take up one or two course periods in a single class that is otherwise purely technical in nature. Other efforts

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may include introducing socially relevant technical problems within individual classes (for example, by incorporating the environment at large in models used to evaluate the products of a chemical reactor or an engine) [6]. Still others may choose to change the way engineering is traditionally taught altogether and have ethical and social issues inherently imbedded throughout the curriculum, rather than simply in individual courses. One could conceive these as four different methods of introducing ethics or social responsibility within the engineering curriculum. We argue that, from more to less “integrative,” these methods would be: (I) separate humanities and technical courses, (II) ethics modules in one or two technical courses, (III) interdisciplinary courses integrating technical and ethical/socially-relevant material, and (IV) entire curricula that integrate technical and ethical/socially-relevant material. We hope to either group our results loosely by these categories or to develop a rubric that “ranks” the ethical treatment in the courses we have studied based on course content and pedagogy. Because many of the courses we included in this study fell in Category II (which is perhaps the most common method of the four), a rubric may delineate the differences between the courses in this study more effectively.

II. Survey Development

The broad concept of “effects” of this ethical coursework can be broken into a variety of different questions. What impact does such coursework have on enrollment numbers in technical disciplines, in general, and those from underrepresented minorities, in particular? Do we retain those from diverse backgrounds in the field? Do certain tactics to incorporate these issues into coursework work better than others? Our study attempts to address these issues using a survey technique. The survey we have developed serves as an analytical tool to evaluate students’ ethical sensitivity, generally, and in an engineering context, specifically. This survey also gauges whether the students’ desires to remain in the engineering field have changed as a result of the introduction to social responsibility in engineering through their coursework.

The survey consists of three primary question sections: (I) demographic data, (II) general interest in social issues, and (III) specific awareness of ethical and social issues in an engineering context. Some questions in Part II were based on work done by Schwartz in his work on human values, and a brief case study in Part III was adapted from the Online Ethics Center [7, 8]. The survey will be administered in a “pre-” and “post-” test fashion during the winter/spring semester, in order to evaluate the impact of the class on student attitudes and ethical awareness. So far, the “pre-test” survey has been administered (responses were received within three weeks of the first day of class), and we anticipate administering the post-test within the last two weeks of classes. We anticipate that all data taken during this semester will be analyzed and ready for presentation in time for FIE 2007. The invitation to participate in the survey was given to approximately 850 students at nine different universities in a total of 16 separate classes. Four universities are major public institutions, and five colleges are smaller private schools. Some surveys were administered via pen and paper, but most surveys were administered online. We anticipate that all the post-tests will be administered online. For the pre-test administration, 200-250 responses were received. Students who complete both sections will be entered into a lottery for one of two I-Pod Nanos.

CONCLUSION AND FUTURE DIRECTIONS

We hope that the research presented here will fill a void in the current literature in engineering ethics. The novel survey analysis tool and its application to a wide variety of courses at nine separate universities is one of the most extensive evaluative studies of engineering ethics coursework to date. Though this WIP is a pilot study, we hope it will provide valuable preliminary information about how effectively such courses impact students’ desires to remain engineers and their awareness of ethical and social issues in engineering and technology. In particular, we anticipate some interesting results about how these courses impact the attitudes of women and underrepresented minorities.

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REFERENCES