TEACHING ENGINEERING ETHICS: A NEW APPROACH

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Abstract *— Engineering programs across the country are experimenting with new ways to integrate engineering ethics into the curriculum. In a large part, this is motivated by criterion three of ABET's Engineering Criteria 2000 that requires that engineering programs demonstrate that their graduates have an understanding of professional and ethical responsibility. Faculty are challenged to find an appropriate place to integrate this material into their curricula. The Electrical and Computer Engineering Department at California State University, Northridge has been experimenting with the use of "The Ethics Challenge", a board game that has been developed and used by the Lockheed Martin Corporation for its in-house annual ethics awareness training. This approach allows ethics to be integrated into the curriculum in many places and at levels from freshman to senior. This paper describes "The Ethics Challenge" and how it can be used to teach engineering ethics in any engineering program.*

Index Terms — Engineering Ethics, teaching ethics

I. INTRODUCTION

Many universities across the country are experimenting with new programs in applied ethics. In a large part, this is motivated by criterion three of ABET's Engineering Criteria 2000 that requires that engineering programs demonstrate that their graduates have an understanding of professional and ethical responsibility. Faculty are challenged to find an appropriate place to integrate this material into their curricula.

At Purdue University [1], a research institute with a large engineering school faculty, has focused on research ethics and bio-ethics. They put together a plan to establish a center for applied ethics. The philosophy department hired an endowed chair in applied ethics.

Since 1991, Illinois Institute of Technology has been experimenting with integrating engineering ethics into technical courses, from calculus to thermodynamics, from first-year introductory courses through senior design courses [2]. This was done recently through the offering of a 7 day tailored workshop to faculty in different institutions on how to integrate ethics into their technical courses. These workshops are supported by NSF grants and offered during the summer so that faculty can integrate ethics into their technical courses the following fall.

At Georgia Institute of Technology [3], a professor of mechanical engineering teaches an engineering design course that introduces students to concepts, processes and methods of engineering design while asking students to consider, among other things, what the ethical demands of engineering will be in 2020.

Along with other engineering faculty across the country, the electrical engineering faculty at California State University, Northridge (CSUN) are struggling to find a way to add one more requirement to an already bulging curriculum. What is needed is an effective methodology for ethics training that takes little or no time, requires no homework or grading, but engages the students in a manner that sticks with them. If such a methodology could be found, how effective could it really be? We think it does exist, and one example of it takes the form of a board game based on the cartoon character Dilbert.

In this paper, we present this method for teaching engineering ethics as it has been used successfully at CSUN. In section II, we describe the engineering ethics program at CSUN prior to Fall 2000 and our assessment of that program. In section III, we describe "The Ethics Challenge", a board game created by the Lockheed Martin Corporation. Section IV describes how we integrated this game into our curriculum and our assessment of this new program. Section V presents conclusions and ideas for future work.

II. ENGINEERING ETHICS AT CALIFORNIA STATE UNIVERSITY NORTHRIDGE - BEFORE FALL 2000

During the first three years, the electrical and computer engineering (ECE) curriculum at CSUN consists of math, science and engineering courses in electrical as well as other engineering and computer science disciplines. During these

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years many college faculty introduce students to various issues in engineering ethics such as risk, loyalty, conflict of interest, integrity, etc. This is done in courses such as MSE101, Introduction to Engineering, EE 240/L, Electrical Engineering Fundamentals and Lab, CE 240, Engineering Mechanics I, and, MSE304, Engineering Economics. In the senior year, which consists of mostly upper division elective courses emphasizing the design aspects of different areas of Electrical and Computer Engineering most ECE faculty address various ethical issues in their teaching.

In Spring 2000, the ECE department started to look at different methods to assess our student's learning of ethics. An ethics test was prepared and administered in the senior design class in Spring 2000. This test consisted of questions similar to those given in the Fundamentals of Engineering exam. Student responses were random with uninformative results about student knowledge. After the test, our students commented that the questions were too abstract and vague for them to answer. They suggested that more practical, real life questions, would be a better way to check their knowledge in ethics.

By the end of Spring 2000, the ECE department had met with its industrial advisory board and raised the issue of how we ensure that our students have learned ethics during their program. One member of the advisory board, Dr. Vaughn Cable, then working at Lockheed Martin, proposed introducing an ethics awareness-training module " The Ethics Challenge" to our senior classes. The Ethics Challenge [4] is a board game based on the cartoonist Scott Adams' famous Dilbert character. It was created for the sole purpose of providing ethics training once a year for every employee of the Lockheed Martin Corporation (approximately 140,000 employees). It was created in 1997 and consists of 50 hypothetical ethics case files to give the trainees a practical experience for using an ethical decision making while reinforcing Lockheed Martin's guiding ethical principles and values of honesty, integrity, respect, trust, responsibility, and citizenship.

Lockheed Martin sent this game to our school and encourages other companies and organizations to exchange their best practice in creating and enhancing an ethical business environment.

III. Description of The Ethics Challenge[4]

The Ethics Challenge is a board game in which teams compete to get the most tokens. Each team takes on the role of one of the Dilbert characters; e.g., Dilbert, Alice, Ratbert, and the "pointee haired" Boss. Each of these characters has a matching boards piece which will be moved around the board on each turn in an attempt to acquire tokens (see figure 1). The team with the most tokens wins the game.

The ethics training comes in the form of a series of ethical dilemmas and each dilemma is a standalone module.

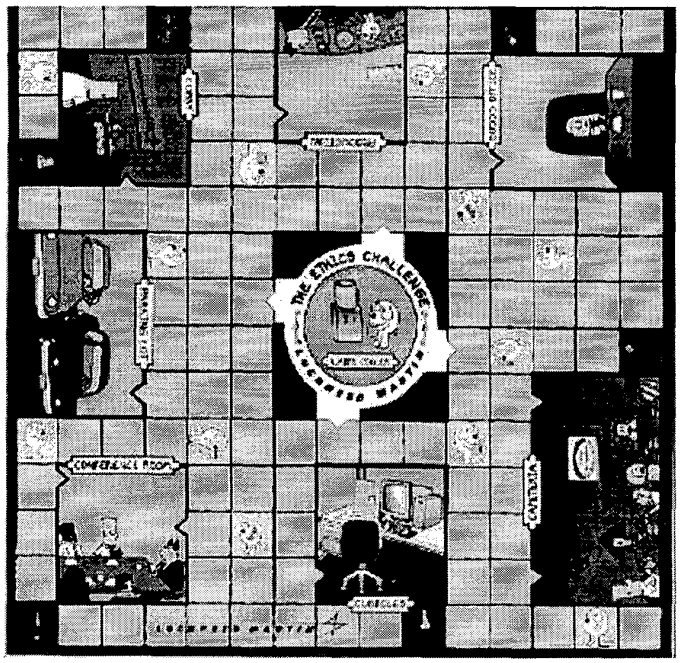

FIGURE 1.
THE ETHICS CHALLENGE GAME BOARD

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Within a module, one dilemma scenario and five potential solutions are read aloud by the game master (usually the teacher). Each team then huddles for five minutes to come up with the "best" answer. Each team then announces its answer and states why they chose that particular answer. The answers are then "graded" by the teacher and points are awarded that determine the number of squares each teams may move their game piece.

For example, one of the cases in the guide reads as follows:

Case: One of your co-workers is copying software at work and taking it home. You need the same software for your personal use and are having problems raising the money to buy it. What do you do?

A. Tell your co-work it's unfair that you have to save in order to buy the software, when he didn't.
B. Report the matter to your supervisor, and ask whether you can copy the software for personal use.
C. Copy the software yourself; your co-worker hasn't been caught.
D. Contact your Software Support representative for guidance.

In this case, answer "B" was worth 5 points, "D" was worth 4 points, "A" was worth 1 point, and "C" was worth zero points.

The board contains eight locations each with three tokens to begin with. The team may only pick up one token per entry and only one entry per location is allowed per game. Just to make things interesting, the board also contains a number of "chance" squares where the player selects a card and must follow the directions on the card. For example, the directions may say go to a particular token location and collect one taken. Other possibilities include cards that direct that team to collect (or give up) one token from (or to) the team on their left.

For a four team class, a series of five dilemmas requires about 1.5 hours to complete. The game is fun for all and the discussions that arise are stimulating. The scenarios are selected beforehand to cover such topics as conflict of interest, harassment, misuse of company assets, honesty, responsibility, integrity, lying, cheating, proprietary information, and many others.

When the game is over, the team that ends up with the most tokens is declared the winner. For each team, their immediate objective is to win the most tokens, but in truth, the real objective of this Ethics Game is to stimulate thought, discussion, and analysis of specific ethical issues.

IV. Integration and Assessment of the Ethics Challenge at CSUN

This Ethics Challenge Game has been used in our Senior Design class during the Fall 2000 and Spring 2001 semesters. During the Spring 2001 semester the Ethics Challenge was played in a single class period (2 hours) in a senior design class with 16 students. The sessions were run by Dr. Vaughn Cable, of the Lockheed Martin Corporation. The two sessions have been attended by several faculty members in the ECE department in order to learn more about the ethics exercise and gain the experience so that they can implement the exercise in their other classes. The two sessions were also video taped for documentation and future review by the other faculty. Both videos show students being very enthusiastic and having fun while involved in group discussions and making group decisions, and each student had a chance to orally express their group's opinion. In Spring 2001, a survey was given at the end of the session in order to allow the students to self assess their ethical knowledge before and after the seminar. In addition, students were asked to comment on how important the ethics issue was to them and what they thought of the Ethics Challenge.

Our survey showed that 80% of the students realized the importance of ethics before they took the Ethics Challenge, but 50% of the students said that the Ethics Challenge changed the way they think about personal and professional ethics. Also, 70% said that they would volunteer to take it again with new scenarios.

V. Conclusions

During the past academic year, the electrical and computer engineering program at California State University, Northridge has experimented with a new method for teaching ethics to its students. Students in senior design played The Ethics Challenge, a board game created by the Lockheed Martin Corporation. The use of the Ethics Challenge game allowed ethics training to be inserted into the curriculum in very little time and with very little effort. More importantly, the students who participated enjoyed the experience and learned from it. In the future, the faculty at CSUN plan to introduce the Ethics Challenge game to our freshman, sophomore, and junior students also.

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