121st ASEE Annual Conference & Exposition
Indianapolis, IN
June 15-18, 2014
Paper ID #9395

Ethics for the "Me" Generation - How "Millennial" Engineering Students View Ethical Responsibility in the Engineering Profession

Mrs. Natalie CT Van Tyne P.E., Colorado School of Mines

Natalie Van Tyne is a Teaching Associate Professor and Director of the Design EPICS Program at Colorado School of Mines. Her background is in chemical and environmental engineering, and she is a registered professional engineer in Colorado. She has been teaching first year and second year fundamental engineering design courses since 2002, and her research interests are in service learning, reflective learning, and assessment of effective teaching and learning at the university level.

Dr. Maria Brunhart-Lupo, Colorado School of Mines

Maria Brunhart-Lupo is an adjunct faculty member in both the Design EPICS Program and the Department of Geology and Geological Engineering at the Colorado School of Mines. Her background is in geotechnical engineering, applied geology and geoscience/engineering education. Her research in STEM education currently centers around undergraduate and graduate course development and how to best teach STEM based materials to students of all levels.

Title: Ethics for the "Me" Generation – How "Millennial" Engineering Students View Ethical Responsibility in the Engineering Profession

Abstract

Common observations about the "millennial generation" include a tendency to be self-centered, a sense of entitlement, a fondness for networking in a variety of forms, and a demand that value be articulated in ways that make sense to them, and without any ambiguity. This generation is also noted for its open-mindedness, inclusivity, enthusiasm and optimism for work, adaptability and a desire to act in an ethical manner. Knowing that our current population of undergraduate engineering students is part of the "millennial generation", we wondered whether the social and cultural values ascribed to this generation would be reflected in their understanding of professional responsibility and ethics in the practice of engineering.

As a part of a one-semester engineering design course at our public university in the western United States, we conduct a workshop in engineering ethics with a discussion of the ABET Code of Ethics for Engineers, followed by a case study of an ethical dilemma in an industrial workplace. During the Fall 2012 and Spring 2013 semesters we included an assessment survey of the workshop content and delivery, between one week and two weeks later, to determine how well the students understood the meaning of ethical responsibility and could identify appropriate ways to respond when ethically difficult decisions need to be made in the workplace.

The focus of this study is on student responses to an open-ended question in the survey which asked students to list two primary behaviors or actions that engineers must follow when performing their professional duties. Across the two samples, the most popular responses related to integrity, safety, honesty, and improving human welfare/society. While the workshop leaders emphasized that the study of ethics involves personal values or morals as applied to dealing with other people, it is notable that responses involving society were not the most frequent answers given during either semester. This might indicate that these students, as members of the millennial generation, either view morals or values on a primarily personal level, or just do not have the experience, yet, to realize that interpersonal relations and actions are influenced by fundamental values and knowledge of how to do the "right" thing in a situation where multiple solutions or actions are possible, and where two or more ethical principles may be in conflict.

Introduction

Sooner or later, all engineers will encounter problems in their workplace for which there may be a variety of solutions available, but that the choice of any one of them may involve one or more conflicts in the areas of personal values or ethics. For this reason, students need an early exposure to situations where the solution is not obvious, and may entail undesirable consequences for a society, an employer or even the engineer or technical manager making the decision. Fledderman [1] points out that the resolution of this type of problem involves the same type of reasoning present in engineering design. For example, the recognition that there is no one "right" answer, and that not everyone involved may agree on one answer, especially at the outset of the process, is common, along with the presence of quantitative and qualitative specifications, which may involve both site-specific conditions (e.g., weather, terrain, accessibility, size of local population), and societal parameters such as the local economy and cultural preferences. [2]

Engineering involves not only knowledge of a subject area but how to use it.[3] For this reason, our first year engineering design course contains a one-session workshop in engineering ethics, featuring an introduction to the ABET Code of Ethics of Engineers [4] and a viewing with discussion of the video case study, "Gilbane Gold" .[5] We chose this case study in part because it illustrates a number of easily recognizable issues and behaviors leading to the central character's "ethical dilemma" and because its length was compatible with the time available for its viewing and discussion.

While we have been using this particular case for a number of years, our results of recent assessments of student learning have led us to wonder whether our current students' responses are related to commonly identified observations about the social and cultural values of the "millennial generation", to which these students belong. Most were born during the 1993-1995 time frame, which is either near the end of this era or in the middle of it, depending on how it is specified.[6-14] Nevertheless, this generation appears to influence both educational and workplace environments in more profound ways than ever before. [15-17] In turn, this generation can also be influenced by an increasing awareness of social responsibility, encouraged by readily available information about emerging social issues and community-based learning experiences as an example of "engineering in action" , which will undoubtedly influence the continuing formation of students' own systems of values.[2]

How is the Millennial Generation Different?

While any generation can be recognized for its apparent brilliance, one major societal aspect that sets Millennials apart is their population demographic: they were estimated to comprise approximately 25% of the voting public in 2012, and this percentage is expected to rise to 36% by 2020.[15] Winograd and Hais assert that any group of this size will have a significant influence on nearly every aspect of life in America, from presidential elections to public policy.[15] Even the engineering profession is taking notice: *Engineering News-Record*, a voice of the construction industry, identifies the priorities of millennial generation engineers as sustainability, high ethical standards, and career fulfillment.[18] What they mean by career fulfillment, at least in the construction industry, was described in terms of a "new" approach to work-life balance, and a recognition that the "transition to power" would come quickly, requiring these engineers to be ready for it.[18] The identification of high ethical standards is encouraging to us, as we believe that our students are receptive to the idea of fulfilling their expected role in society, through an adherence to these standards.

Meanwhile, the National Society of Professional Engineers (NSPE) recognizes that Millennials are not a homogenous group.[13] On the positive side, these engineers have a great deal of enthusiasm and optimism for their work,[13] as well as more of a willingness to be open-minded, energetic and adaptable.[13] Their strong sense of collaboration and interdisciplinary acceptance has been attributed to an intrinsic familiarity with network computing and other group-oriented aspects of the Information Age, such as social networking.[6,11, 13] However, not all Millennials are being welcomed to the workplace with open arms: job-hopping is more common and acceptable, [18] possibly due to a sense of entitlement.[8, 9, 13, 19]In the classroom, they expect their education to be customized for them,[20] such that career-related information and insights are articulated in ways that make sense to their particular way of thinking[12] and without any ambiguity [20]. A fear of ambiguity might lead them to choose a "wrong" answer leading to negative consequences for them, such as punishment or reprimand, or it might be a sign of entitlement.

This introduces another dilemma: should the millennial engineering student take responsibility and decide what to do, or wait for someone to state the "right" answer? [21] This dilemma is made worse by the fact that ethical issues must often be resolved in view of insufficient time and information, without the opportunity for someone else to come up with the "right" answer.

If Millennial college students are self-centered[7], yet ethnically and socially diverse [13]and collaborative, what does this mean in terms of ethics and professional responsibility? Millennial generation engineers understand the strength of their own numbers (and therefore a lack of willingness to accept established values per se,[10] but also recognize the value of positive relationships with older engineers, managers and other sources of knowledge,[18] looking for structure and mentorship, as they experienced with their parents, teachers and other role models.[18, 19] These role models exhibited their own values in the workplace and in everyday life, causing millennial generation students and engineers to accept that they can and should make meaningful contributions to human welfare, but strictly on their own terms.[7, 10, 13, 18] As the case with every other generation we have observed in recent history, Millennials want to do it "their way, "which may actually turn out to be better for their society than for those of previous generations.

Objectives for This Study

Since we know that engineers are obligated, through the ABET Code of Ethics and similar engineering-based codes, to work for the benefit of public welfare,[4] and that future engineers will not escape this responsibility, we conducted this study to address the following questions:

1. How well do first year students develop a basic understanding of ethical responsibility in the engineering profession, given the cultural orientation of the millennial generation?

2. Is a one-session workshop sufficient to develop a basic understanding of engineering ethics?

Research Methodology

During each of the Fall 2012 and Spring 2013 semesters, a total of approximately 500 students took the first year engineering design course; they were divided into 10 classes of 50 students each. We realized, in part from the work of Felder and Silverman,[22] that the content and delivery of our workshop should account for typical student learning mechanisms and employ specific teaching methods that would appeal to these styles. These investigators revealed that students learn through a variety of mechanisms: visual, auditory, reflecting, acting, reasoning logically and intuitively, memorizing, visualizing, drawing analogies and building models [23]. They concluded that engineering students are more "active" than "reflective" learners, and advised educators to encourage visual, sensing, inductive and active ways for their students to gather data and information, infer one or more patterns, and then proceed to generalities and the formation of concepts, rather than the other way around, i.e., lecturing for the memorization of concepts that students are then expected to apply to specific situations [22].

Each of the ten 50-minute workshops began with an information sheet containingthe ABET Code of Ethics of Engineers, [4] and a description of the Gilbane Gold case [5]. Students were first asked to read the Code of Ethics of Engineers, after which the workshop leader explained the organization of the Code into Principles and Canons, emphasized how one or more Canons support each Principle, and gave examples of how these Canons would apply in the engineering workplace. Using this information as background, the students then read the description of the case study and were assigned to follow specific characters throughout the case as they viewed the film. An open discussion was then moderated by the workshop leader to identify what each character's major concerns, motives and biases were, and whether or not, in the students' view, these characters were acting in an ethical manner. The workshop was concluded with the leader's statement that someday these students might face a similar "ethical dilemma" in the workplace, and prior knowledge of a code of ethics and the chance to consider what they would do in such a situation would be beneficial, even at this early stage in their careers.

It was not the intent of this workshop to prescribe a particular way to act when faced with an ethical dilemma, but, rather, to encourage students to identify what it means to act in an ethical manner, by recognizing unique and often conflicting professional positions, points of view and motives before making a decision. This approach reflected our design course's emphasis on a decision-making "process", which then leads to the identification of one or more specific outcomes.

We conducted an assessment survey of the workshop content and delivery, between one week and two weeks later, to determine how well the students understood the meaning of ethical responsibility and could identify appropriate ways to respond when ethically difficult decisions need to be made in the engineering workplace.

The survey contained one open-ended question and three statements regarding satisfaction with the workshop content and the overall effectiveness of the workshop leader. The open-ended question was written in short-answer format as follows:

According to the *ABET Code of Ethics of Engineers*, what are two primary behaviors or actions that engineers must follow when performing their professional duties?

Data Collection

Students wrote their answers to the open-ended question in the blank spaces provided on the survey form. Survey data were returned to the workshop leaders for ten workshop sessions held in each of the spring and fall semesters, respectively. We waited 1-2 weeks between the workshop and administering the survey to avoid students simply parroting back what they might have just memorized. This was done in an attempt to assess what the students had internalized and remembered from the workshop.

Data Analysis

Responses to the open-ended survey question were compiled for each of the 10 sessions during each semester, respectively. The data for all sessions within one semester were then combined to detect overall trends and variations each cohort. Results from the Ethics Workshop survey were compiled manually, with each answer logged, either as a unique entry, or as a repeated term. Unique entries were used when no similar term, or similarly phrased term, had been stated previously. For example "public health" and "health of the public" were counted as the same answer. "Safety of the public" and "health of the public" would be an example of where the terms are similar, but not similar enough that they were counted as the same, because the key words of the answers were non-inclusive of the same meaning. An effort was made to not consolidate the terms too much and to be generous with the idea of what a "similar" term meant. The idea was to gather the full range of possible answers, in students' own words, with as little repetition as possible.

These terms were then tabulated under the following categories:

- Safety
- Honesty
- Integrity
- Observe/follow a code of ethics
- Improve human welfare/society
- Miscellaneous

The total numbers of responses for these categories were then compared for each cohort, as well as their relative frequency of response as percentages of the total number of responses.

Results

The Fall 2012 cohort gave these types of responses most frequently, as shown in Table 1:

Table 1: Fall 2012 Responses

Category	**Number**	**% Total**
Integrity	190	27.6
Improve human welfare/society	126	18.3
Honesty	119	17.3
Safety	96	13.9
Observe and follow code of ethics	83	12.0
Miscellaneous	75	10.9
Total Responses	689	100.0

A total of 689 relevant responses were tabulated from this population of 1,000 possible responses; the "Miscellaneous" category contained 27 unique responses out of its total of 75. The non-relevant responses were random in nature, with no direct or implied relationship to the workshop content. Absences on the day of the survey accounted for 6-28% of the students in each 50-student class.

During the Spring 2013 semester, the top three sets of responses related to the following, as shown in Table 2:

Table 2: Spring 2013 Responses

Category	Number	% Total
Safety	167	28.3
Integrity	148	25.0
Honesty	103	17.4
Improve human welfare/society	93	15.7
Observe and follow code of ethics	34	5.8
Miscellaneous	46	7.8
Total Responses	591	100.0

There were a total of 591 relevant responses from this population of 1,000 possible responses, and the “Miscellaneous” category again contained 27 unique responses out of its total of 46. Absences on the day of the survey accounted for 2-32% of the students in each 50-student class.

Discussion

Results for the Fall 2012 and Spring 2013 semesters revealed some variation in the frequency of specific responses between the fall semester and spring semester cohorts, which could be attributed to a number of factors: diversity in age, gender, cultural background or prior education, influence of prior college experience (even for just one semester), or differences among students in their own understanding of ethics vs. morals. We also noted that that the Spring 2013 students gave responses that were more specifically worded than those for the Fall 2012 students, showing that they could articulate more specific examples of ethical behavior as, perhaps, an indication of slightly higher order thinking. A similar observation was made by Self and Ellison [23] in 1998, when they assessed the moral development of Generation X students as part of a course in engineering ethics. In administering the Defining Issues Test to cohorts from both the fall and spring semesters of the 1995-1996 academic year, they reported not only a significant gain between pre-test and post-test scores, but a measurable gain in mean pre-test scores from the fall to spring semesters.[23]

While the workshop leaders emphasized that the study of ethics involves personal values or morals as applied to dealing with other people, the fact that a response involving society was not among the top two responses in either list might indicate that these students, as members of the millennial generation, either view engineeringethics on a more personal level, or just do not have the experience, yet, to realize that interpersonal relations and actions are influenced by fundamental values and knowledge of how to do the “right” thing in a situation where multiple solutions or actions are possible, and where two or more ethical principles may be in conflict. The wider recognition that one’s actions may affect more than oneself could also be a function of greater developmental or emotional maturity as well as more experience in dealing with larger and diverse groups of people within industry or society.

The aspect of engineering ethics instruction which presents ethical decision making as a "process" was identified by Pfatteicher [24] soon after the promulgation of ABET's Engineering Criteria 2000, along with an observation that students need to identify with the engineering profession in order to subscribe to its values.[24] This sense of identification then leads to a commitment to act toward resolving an ethical dilemma, which goes beyond merely recognizing that one exists. At the same time, students need to develop problem-solving skills as part of an adaptive expertise learning environment, [3] which are the same skills necessary to solve technical problems.

Another example of ethical decision making as a process are the studies in moral development by Lawrence Kohlberg, leading to his theory of moral development, as described by Crain[25]. This theory was first developed in 1958 and was based on responses to a hypothetical case involving morality-based choices expressed by youth from middle and lower class families in Chicago. [25] Kohlberg organized these responses into a scale of six stages grouped into three levels. [25]These stages progressed from a totally "me-orientation" expressed as obedience for the avoidance of punishment, to a broad concern for the improvement of society as a whole. The fact that more of our students mentioned personal rather than societal values in their responses may be indicative of the fact that, when faced with a brand new topic with relatively brief exposure, their responses may have been more simplistic in nature, even when given the opportunity to think about and reflect upon what they have learned or remembered about the workshop during subsequent weeks.

Many students recognized the existence of a code of ethics for engineers, but relatively few mentioned it as a "primary behavior or action that engineers must follow." However, several keywords or key phrases from the ABET Code of Ethics of Engineers were named as frequent responses: "safety", "welfare of the public", "honest" and "impartial." Once again, most of these can be considered to be "individual" rather than "group" or "societal" values, with the exception of "welfare of the public."

The answer to our research question regarding how well first year students develop a basic understanding of ethical responsibility in the engineering profession is: moderately well. The self-centered nature of many of these Millennial Generation students is reflected in the higher frequency with which they identified individual-based values, such as integrity, honesty and safety (not differentiating between personal and public safety), rather than societal values, such as improving human welfare and following a code of ethics prescribed by others. However, it is important to note that the fall semester cohort mentioned, "welfare of the public/society" as one of its top two responses.

On this basis, a one-session workshop in engineering ethics is not sufficient to develop enough of a basic understanding to enable new engineers to fully understand their responsibilities for professional conduct as it relates to ethical dilemmas in the engineering workplace. Our workshop, however, is a start, as this early exposure to open-ended problem solving is highly beneficial to first year students, and appeals to their desire to form concepts based on data and information through a process of active learning.

Conclusions and Recommendations

We suggest that the best way to introduce millennial generation engineering students to the concept of professional responsibility in the engineering workplace is to use real-world examples which clearly and dramatically illustrate the importance of ethical behavior through the consequences of inappropriate action, so that we are articulating value in terms that make sense to our students.This also appeals to their tendency to observe what is going on and form inferences about it through inductive reasoning, gathering data and forming their own conclusions based on what they observe, not merely what they are told.

Since students seem to understand these concepts best when presented in context, a comparison of several different codes of ethics would be appropriate, including the "honor code" or "code of conduct" for one's own institution. Instructors could then guide a discussion comparing these codes, and the real-world consequences for violating them. In addition, a code of ethics is a set of guidelines, not laws, although many first year students seem to view them as inviolate, showing once again their distaste for ambiguity and the possibility of multiple solutions to an ethical problem. It would also be useful to follow a student cohort as they progress through their engineering curriculum, both by asking the same questions as in our first-year workshop survey, and by a request that they describe their own concept of engineering ethics as a reflection of higher order thinking and reasoning skills which may now exist. Finally, an assessment instrument such as the Defining Issues Test [23], administered both before and after this one-session workshop, as well as later in a student cohort's curriculum, may reveal how well they have developed the skills of moral reasoning. [23]

By teaching the development of professional responsibility as a process rather than as a set of rules not subject to interpretation or applicability, engineering faculty can better enable their students to analyze and resolve nearly any type of ethical dilemma in the engineering workplace by considering all views, motives and consequences before choosing the most mutually beneficial course of action.

References

1. Fledderman, C., Engineering Ethics, 4th Edition. Upper Saddle River, NJ: Prentice Hall.

2. Lathem, S., M. Neumann, and N. Hayden. 2011. The Socially Responsible Engineer: Assessing Student Attitudes of Roles and Responsibilities. *Journal of Engineering Education,* 100(3):p. 444-474.

3. Redish, E., Smith, K., Looking Beyond Content; Skill Development for Engineers. *Journal of Engineering Education.* 97(3):p. 295-307.

4. Accreditation Board for Engineering and Technology. 1997.*ABET Code of Ethics of Engineers*.http://wadsworth.cengage.com/philosophy_d/templates/student_resources/0534605796_harris/cases/Codes/abet.htm (accessed January 3, 2014).

5. *Gilbane Gold.* 1989. 24 min. Lubbock, TX: National Institute for Engineering Ethics, Texas Tech University. (DVD)

6. Sweeney, R. 2013.*Are Engineering Students Typical Millennials?* http://library1.njit.edu/staff-folders/Sweeney. (accessed October 1, 2013) (slide presentation)

7. Hansen, L. and R. Spaeth. 2013. *Narcissistic, broke and 7 other ways to describe the Millennial generation.* http://theweek.com/article/index/228213 (accessed September 30, 2013)

8. Nazar, J. 2013. *20 Things 20-year-olds Don't Get.* http://www.forbes.com/sites/jasonnazar/2013/07/23/20-things-20-year-olds-don't-get (accessed August 2, 2013)

9. Chau, J. 2012. *Millennials are more "Generation Me" than "Generation We", Study Finds*, The Chronicle of Higher Education, Students section. http://chronicle.com/article/Millennials-Are-More/131175. (accessed July 9, 2012)

10. Martin, C. 2011. *My 'Millennials' Generation is busy reimagining a life of ethics.* Christian Science Monitor, Opinion section, http://www.csmonitor.com/Commentary/Opinion/2011/1227/My-Millennials-generation-is-busy-reimagining-a-life-of-ethics. (accessed June 10, 2013)

11. Schieffer School of Journalism, Texas Christian University. 2012. TCU 360 Image Magazine, http://www.tcu360.com/campus/2012/04/15252.millennial-generation-redefining-the-future. (accessed June 10, 2013)

12. Sloan, C. 2012. *How colleges can best connect with prospective students (essay).* Inside Higher Ed, http://www.insidehighered.com/print/views/2012/07/19/how-colleges/can-best-connect-with-prospective-students-essay. (accessed October 1, 2013)

13. Kaplan-Leiserson, E. 2008. *Mind the Gap*. National Society of Professional Engineers, http://www.nspe.org/PEmagazine/pe_0108_mind-the-gap.html (accessed September 30, 2013)

14. Knowledge@Emory. 2010. *Managing Millennials in the Workplace*. http://knowledge.emory.edu/article.cfm?articleid=1351. (accessed October 1, 2013)

15. Winograd, M, and M. Hais, 2011.*Millennial Momentum: how a new generation is remaking America.* New Brunswick, NJ: Rutgers University Press.

16. Burstein, D. 2013.*Fast Future: How the Millennial Generation is Shaping Our World*. Boston, MA: Beacon Press.

17. Alsop, R. 2008.*The Trophy Kids Grow Up.* San Francisco, CA: Jossey-Bass.

18. Abaffy, L. 2011. *Millennials Bring New Attitudes*. Engineering News-Record, http:enr.construction.com/business_management/workforce/2011/0223-newattitudes-1.asp. (accessed June 10, 2013)

19. Argen, R. 2012. *Millennial generation students will make a difference.* http://coherencefirst.com/millennial-generation-students-will-make-a-difference. (accessed September 30, 2013)

20.Knowledge@Emory. 2006. *Teaching the Millennial Generation.* http://knowledge.emory.edu/article/cfm?articleid=956. (accessed October 1, 2013)

21. Gorman, M., Turning Students into Professionals: Types of Knowledge and ABET Engineering Criteria. *Journal of Engineering Education.* 91(3): p. 327-332.

22. Felder, R.K. and L.K. Silverman. 1988. Learning and Teaching Styles in Engineering Education. *Engineering Education*, 78(7), pp. 674-681.

23. Self, D.J. and E.M. Ellison, Teaching Engineering Ethics: Assessment of Its Influence on Moral Reasoning Skills. *Journal of Engineering Education,* 87(1): pp. 29-34.

24. Pfatteicher, S. 2001. Teaching vs. Preaching: EC2000 and the Engineering Ethics Dilemma. *Journal of Engineering Education.* 90(1):p. 137-142.

25. Crain, W.C. 1985. *Theories of Development,Chapter 7: Kohlberg's Stages of Moral Development*. Englewood Cliffs, NJ: Prentice Hall, pp.118-136. http://faculty.plts.edu/gpence/html/Kohlberg.htm. Accessed March 12, 2014.