

Ethics in Engineering Education

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Abstract

How are core ethical values within students developed so graduates are prepared to make ethically sound decisions? Some ethicists believe humanity is entering an era referred to as the *Morally Deficient Society*. Yet almost a century ago, Teddy Roosevelt stated “We draw the line against misconduct, not against wealth. The capitalist who, alone or in conjunction with his fellows, performs some great industrial feat by which he wins money is a well doer, not a wrong doer, provided he works in the proper and legitimate lines.”¹

As educators, how can professors conduct an ethics needs assessment in order to identify breaches in ethical thinking, then direct the students’ learned abilities to develop sound ethical decision making? Today, most corporations and organizations have developed a code of ethics. From an employer’s perspective, most people know and understand what is expected from an ethical point of view. Are engineering students able to translate the right versus wrong literal teaching of ethics to case-by-case application? Objectives of this document are:

- Provide a brief overview of Ethics
- Apply ethical principles to Engineering Education through case studies
- Identify breaches in ethics within the student population
- Present ethics statements of leading transnational organizations

Thinking beyond the University, how can students become better prepared to work ethically and effectively in the corporate world? Social responsibility includes participating in the communities in which people work. Yet, perhaps even more important, is how to work within ethical parameters yet achieve adequate profitability of the firm for its stakeholders (employees, stockholders, investors).

Ethics: An Overview

Students have learned the literal definition of ethics: the study of morals – good versus bad, right versus wrong, acceptable versus unacceptable. Applied ethics suggests foundational principles must be integrated into engineering curriculum. A case study approach develops graduates who are able to formulate exemplary ethical choices once they leave the university and enter corporate America or academia. Thus, engineering educators have an exciting opportunity to impact the application of ethical theory.

As an academic community, ethical values must be practiced, believed, and upheld. There can be no excuses: instructors' houses must be in order before the same can be expected from students. University professors are well-regarded leaders that must realize the *fish bowl affect*: People are watching. When students, parents and the public look at a professor, what do they see? Professors are entrusted with the intellectual and moral development of future leaders. Thus, they must lead by example.

The majority of educators and students are ethical. However, as an academic population, universities represent a subset of the population at large. If a person has ever worked with a colleague for years to later discover he/she has fallen into a dramatic breach of ethics, one wonders why...how could this happen? As a subset of the population, some people bring poor ethical values with them and do not change. Others become unethical. In academia, educators have an opportunity to develop sound cognitive ethical reasoning ability in students.

The Application of Ethical Principles to Engineering Education

Ethical decision making is not instinctive². Before establishing an instructional approach for engineering students, consider the four developmental stages in ethics training: ethical Awareness, Reasoning, Action, and Leadership.

A strong foundation of ethical awareness will be established when students understand the four core elements of making an ethical decision: Actions, Beliefs, Conduct, and Discipline. (The ABCD Model)³:

Actions –

Simply stated, this is the way people act. These are actions taken day-to-day. Examples are:

- Eat well, exercise, don't smoke, drink only in moderation, manage stress...and these actions should keep a person healthy and functional
- Work hard, don't lie, cheat or steal...these actions should keep someone from termination, expulsion, or incarceration

Beliefs –

- Belief in self, profession, family, religion, and friends
- Belief in policies and the good of the cause
- Believe the good guys (and gals) prevail

Conduct –

- Conduct oneself as if everyone were watching: Mom, Dad, Wife, Uncle, Supervisor, Son, Daughter, and Higher Power
- Will people view a student as honorable, trustworthy, and dedicated?
- Conduct should make people proud of higher education

Discipline –

- If tempted, enticed, or intrigued by the possible benefits that immediate gratification may bring, people are human
- If one is weak in character and unable to resist temptation, they should seek help

The next two stages of ethics training; Reasoning and Action, should be developed through case study analyses. Applied ethicists declare: *Ethical Values are CAUGHT... not taught.* Students should be able to reflect on ethical issues and discuss them. Through case study analyses, students become better equipped to recognize ethical dilemmas and develop decision-making abilities.

Sample Ethical Dilemmas to Consider Solving with Students:

Case 1: The Foreign Engineering Training Opportunity

As a lead engineer in a fortune 200 company division, Whirlwind International has functioned globally for years. In recent years, however, more production has left the US to newly constructed plants abroad. Whirlwind International asks you to train a lead division engineer in a sister plant located in Canton, China. You strongly suspect you are “training your replacement” and that your job is on-the-line. What should you do?

Case 2: Safety and Throughput

As a corporate throughput expert, you have the opportunity to travel to various production locations. Your job: study current workflow and make recommendations that can improve throughput. As you tour this facility, you notice a worker who is sweeping. Good housekeeping is your first impression. Upon further observation, you notice this worker is circumventing a safety door under a palletizer: “sneaking in” to clean around the moving equipment. What should you do?

Case 3: Two Countries, Two Engineers

As a transnational corporation, engineers you oversee are located around the globe. You need a recommendation on how to best implement a solution to an engineering problem. You have two project engineers in mind. One is based in the Middle East and is very strong in theory. The second is based in the United States and is very strong in application. The Middle Eastern engineer may be able to derive a solution more quickly than his/her US counterpart due to a strong theoretical understanding. The US engineer may be able to derive a less expensive alternative due to a strong applications understanding. Corporate pressure is on... What do you do?

Case 4: A Computer Glitch One Would Not Expect

As the Computer Programming Technology expert at your firm, many people seek your advice. At times it is to rid them of spyware or viruses. Sometimes it is a systems issue and you refer them on to your technical staff. Today was a surprise. A loyal, 30-year employee came to you because his computer totally locked up and would not boot up. When you evaluated the system, you found child pornography website links and images. What should you do?

Case 5: New Software Tools

Your corporation has asked you to determine the next best software tools for your department and make a recommendation to the purchasing department. Several global, well-qualified vendors are under consideration. The CEO's son works for a firm who brokers IT goods for one of the companies you are considering. The CEO would like to see "his boy" benefit from the firm's purchase. Who will you choose?

Suggested outcomes and points of consideration are noted in *Appendix 1* following the formal text of this article.

Department heads should consider authoring and implementing scenarios for staff. This is an exceptional mechanism to cultivate desired behaviors in new faculty as well as address issues that could have had a more appropriate response or resolution. Suggested ethical scenarios for instructors of higher education are listed in *Appendix 2*.

Breaches in Ethics: the Student Population

Professors may have many hypotheses regarding *why* students experience breaches in ethics or choose poorly. Academic pressures, trouble at home, lack of moral basis... the best way to assess a student population is to involve them in the process. A fun method to accomplish this goal is to develop a "Top Ten" ethics list.

The text, "Enforcing Ethics" was written to support ethical behavior in law enforcement professionals. When previous officers who turned into offenders became incarcerated,

the author interviewed this population. This “Top Ten” list was derived for reasons why law enforcement officers *crossed the line*:

10. Marital trouble/divorce
9. Others’ bad examples
8. Not enough pay
7. Bad relationship with supervisor
6. Sex
5. Need to fit in
4. No consequences
3. Money
2. Pressure
1. Easy to get away with

When academic leaders engage students and illicit input, educators will be able to uncover the “Top Ten” for the campus climate in which they are teaching. What would the “Top Ten” list read? Ask, network with students, and the list will write itself. Once weakest areas (or biggest ethical temptations) are established, dedicate written policy to address lapses. When authoring ethical cases to analyze, one should address issues listed in the “Top Ten” list. These might include lying, violating procedures, and encouragement or support for those who report ethical breaches (ethical whistle blowing). Whatever discovered, students will require professors’ time and support to develop analytical skills for ethical decision-making.

In reviewing recent works on ethics in engineering, the January, 2005 edition of the *Science and Engineering Ethics*⁴ (United Kingdom) offered three articles:

1. The Ethics of Intellectual Property in Biomedicine and Biotechnology
2. International Policy in Intellectual Property
3. Patents and Ethics

In contrast, the *International Journal of Engineering Education* hosted only one article on engineering ethics in the past two years⁵. The Journal of Engineering Education⁶ (ASEE) has had contributions in the area of ethics in engineering. However, when this author reviewed the past 10 years, only one article remained in the on-line publication that hosted ethics in engineering in its title. Perhaps this supports the author’s call to educators to renew enthusiasm for teaching the *application* of ethical theory in the classroom, utilizing case scenarios, to develop critical thinking skills.

Ethics Statements in Transnational Corporations

In corporate America, most global leaders have drafted and adopted ethics statements. Ethical standards may be cited in a variety of company documents including corporate governance, policies and procedures, core values or recruitment tools.

Fortune 2: ExxonMobil

The Code of Ethics⁷ in Exxon Mobile includes their Ethics Policy, Conflict of Interest Policy, Corporate Assets Policy, Directorships Policy, and a section entitled “Procedures and Open Door Communication”

Fortune 5: General Electric (GE)

GE understands the importance of integrity and has established a set of policies and a code of ethics that cover all GE employees. This code of conduct is called *The Spirit & the Letter*⁸. This details GE’s main core value – *integrity*, and conveys ethical expectations to every GE employee. In addition to a 35 page pdf guidebook, GE hosts a dedicated ethics website: integrity.ge.com. Ethical standards are outlined in three sections: When You Have an Integrity Concern, Working with Governments, and Conflicts of Interest.

Fortune 11: Hewlett-Packard

Business ethics are guided by enduring values.

“At HP, we are guided by enduring values that stretch back to our roots—values that reflect basic, fundamental ideas about who we are”⁹

Values include:

- there is no substitute for personal and professional integrity;
- doing well and doing good can go hand in hand, and
- trust and respect have always been the cornerstones of HP success.

Hewlett Packard is committed to uncompromising integrity:

- Honesty
- Excellence
- Responsibility
- Compassion
- Citizenship
- Fairness
- Respect

Fortune 21: Boeing

Ethics and business conduct programs include an ethics executive and ethics advisors at each Boeing business unit who are assigned to provide guidance and answer questions regarding proper behavior in the workplace, business ethics issues, and Boeing values¹⁰.

Fortune 28: Proctor and Gamble

In March 2001, Business Ethics magazine ranked P&G first in its list of 100 best corporate citizens. Proctor and Gamble's dedication to business ethics has taken them from the development of corporate governance guidelines to delivering speeches and mentoring corporate ethics in Western Europe. "*We are a unique company based on the principles of ethics*"

Engineering instructors are proud when students are hired and excel in Fortune 500 companies. If ethical values are a core component of corporate governance and an expectation of leading Fortune 500 employers, educators have a duty and a privilege to prepare students to embrace, align, and lead in the ethical corporate world.

Conclusion

Integrating ethical case analyses into the classroom on a consistent basis requires additional time and commitment from the professor. Developing students' cognitive ethical awareness and decision-making abilities is a challenge all educators need to accept. This investment in students will assure ethical Awareness, Reasoning and Action. The result will be Leadership, provided by students who are well prepared to address ethical dilemmas in their future.

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Appendix 1

Student Case Studies: Suggested Outcomes and Points of Consideration

Case 1

This engineer must take many issues into consideration. Does he have a family? If so, would they accompany him or remain in the US? Is this a permanent job move or a temporary expatriate assignment? The average US expatriate can manage two years on assignment abroad. After that time, turnover is extremely high. If his family will accompany him, will there be adequate expatriate family training? Many assignments fail because the expatriate's family, who does not have the benefit of a consistent work environment nor people surrounding them who likely speak English, lobbies to return home.

Case 2

Although the throughput expert is on-site for a task aside from safety, most corporations believe safety is everyone's job. The throughput expert should report the unsafe behavior and, if in a position to do so, watch the worker to see if the worker's behavior has changed for the better. This is based on a true story. This worker was observed by colleagues as he circumvented the safety mechanisms to sweep. One day his timing was off and he was crushed. He left behind a family with 10 children.

Case 3

Assign the task to both engineers with a timeline for completion. Or, team up both engineers to work together toward a best solution within a given timeframe. Considerations: Could these two work together electronically or, would collaboration rely upon sending one to the other's country to work together physically? If electronic collaboration is chosen, how would time changes between the two countries be addressed?

Case 4

Pornography and child pornography are two totally different cases. If indeed pornography links were found without the child porn, corporate policy on computer and Internet usage should be followed. If child pornography links were found, this is a felony charge. If this information is protected rather than reported, you could be charged as impeding an investigation or harboring a felon. Turn this over to the authorities and let them do their job. The case could worsen as law enforcement uses their special software to evaluate the computer system. One example: if child pornography is sent via e mail (which is considered interstate communication), additional and more severe penalties may likely be charged against the employee. This is true story. A preventive approach to

ensure people understand the corporate Internet policy and especially the harsh ramifications of viewing and sending child pornography images is prudent.

Case 5

The firm with the best tool for the tasks at a fair price should be selected, regardless of who the CEO's son works for. Frankly, it is rather unethical for a CEO to suggest this type of behavior. He/she could put in a good word for the son, then should let your process work and determine the best software fit for the organization and tasks at hand. Frankly, if the son's firm is the top selection, super. If the son's company is not, you could communicate to the CEO the decision reached and explain why the other software firm was chosen. If you work for a CEO who would base your own employment status on this type of scenario, do you really want to work there in the future anyway?

Appendix 2

Suggested Scenarios for Instructors in Higher Education

- A professor authors a new exam for a traditional course as the textbook is new this semester. The high score is a 70% and the mean is a 42. Should this exam be curved or adhere to a straight scale?
- A colleague's syllabus explicitly states late work is subject to a 10% reduction per day. Once this professor becomes better acquainted with the students, he discovers that several are day workers, rushing to class, who have families and other extenuating situations. One-third of the students turn in late first assignments. What should this professor do?
- Although the syllabus provides for participation/attendance points and strictly encourages the same, many students repeatedly miss class. As a professor who is teaching at a regional campus with small class size –you notice when students are absent. How should this attendance issue be addressed?
- A colleague is granting students more liberties in his/her courses of study than anyone else in the department. He/she has the authority and is signing off on these decisions. You are uneasy with this approach. What should you do?
- A well-regarded tenured full professor comments that he is an “easy grader” to a new professor in a tenure-track position. He states that this is how he achieves high student evaluations. Should the new professor reexamine his/her grading approach?
- As a professor on a large well-regarded campus you encourage attendance in class, even at lecture. Pop quizzes are one way you confirm attendance. One student misses five lectures and each time states that she has lost a grandparent. This occurs over the course of the semester. When she reports her fifth lost grandparent at semester's end, how should you handle this situation?