

Professional ethics education in engineering

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***Abstract:** There is much debate surrounding professional ethics education, in particular surrounding the question of whether professional ethics can be taught at all (Steneck, 1999; Bauer and Adams, 2005). Professional ethics instruction in engineering is commonly conducted by examining case studies in light of the code of conduct of a suitable professional body. Although graphical presentations of spectacular failures, sobering stories of the repercussions and the solid framework provided by the tenets of a code of ethics may leave a lasting impression, students generally gain their professional identity from relatives and colleagues (Loui, 2005). Their professional ethics tend to be mostly an extension of their personal ethics. Instruction on ethics generally serves only to reinforce students' inclination to act ethically and provides encouragement to act on these beliefs. In this study a survey was conducted (n=576), based on the work by O'Clock and Okleshen (1993), examining the personal ethical perceptions of engineering students. The survey measured how engineering students perceive their own ethical beliefs and how they perceive the ethical beliefs and actions of their peers. As a learning exercise, students were then challenged by examining their personal ethical beliefs in light of the professional ethics requirements of the IEAust code of conduct. After familiarisation with the Engineers Australia code of ethics, students were also invited to comment regarding their beliefs regarding adherence to this code.*

Introduction

Professional engineers have a personal and professional obligation to society to act in an ethical manner (Passino, 1998). Although psychologists have long studied the development of moral identity (e.g. Flanagan and Rorty, 1990; Kohlberg, 1984), there has been little investigation into the effect of professional engineering ethics education on students' moral growth (Self and Ellison, 1998; Sindelar, Shuman and Wolfe, 2003). Steneck (1999) and Bauer and Adams (2005) suggest that ethics cannot be taught and that only ethical reasoning can. This viewpoint leads to ethics education that focuses predominantly on abstract ethical frameworks and moral justification. Lynch (1997) cautioned that such a theoretical approach needs to be contextualised in engineering activities to act as an effective mode of instruction for engineering students.

The traditional approach to teaching professional engineering ethics is to use a series of case studies, typically detailing breaches of professional codes of conduct with subsequent dire consequences. Adopting this educational approach introduces the risk of turning an ethics course of instruction into one on engineering disasters. Generally this results in entertaining lectures and associated student activities but has little impact on students' ethical development (Bauer and Adams, 2005). Graphical presentations of spectacular failures, sobering stories of the repercussions and the solid framework provided by the tenets of a code of ethics may leave a lasting impression; however students generally gain their professional identity from relatives and colleagues (Loui, 2005). Students' professional ethics tend to be mostly an extension of their personal ethics.

The ethical and moral development study conducted by Loui (2005) revealed that the greatest benefit of professional engineering ethics education is to reinforce students' inclination to act ethically. The instruction on moral reasoning frameworks and professional codes of conduct providing encouragement to act on the personal ethical and moral convictions already held. Naturally then, the question arise regarding how ethical our engineering students are and what can be done to promote and encourage further personal ethical development.

The study by O’Clock and Okleshen (1993), examining the personal ethical beliefs of engineering and business undergraduate and postgraduate students, provides some interesting insights to these questions. Business students generally display a self selection bias toward less ethical behaviour and less developed ethical values relative to students from a range of other disciplines (e.g. Arlow and Ulrich, 1980; O’Clock and Okleshen, 1993). The investigation by O’Clock and Okleshen (1993) reported no significant statistical difference between business and engineering students’ ethical perceptions and behaviour, indicating that the ethical values of engineering students are perhaps also less developed than their peers in disciplines other than business.

Notably however, the study also reported a marked difference between engineering and business students returning to postgraduate studies to pursue a MBA. The postgraduate engineering students demonstrated a significantly higher level of ethical values and behaviour compared to the undergraduate engineering students. Postgraduate business students displayed the opposite trend, indicating a lower level of ethical values and behaviours. From this study it would appear that the engineering profession has a positive influence in promoting and encouraging further personal and professional ethical development.

The present study assessed the current state of engineering students’ personal ethical values and their beliefs about others, including practising professional engineers. As a learning exercise, students were also challenged by examining their personal ethical beliefs in light of the professional ethics requirements of the IEAust code of conduct.

Methodology

A survey was conducted over two years (n=576) examining the personal ethical perceptions of first year engineering students. The students were all enrolled in a subject where ethics was taught. Approximately 14.9% of these were international students and 85.1% Australian. The sample group had a female to male ratio of 0.21. The survey measured how engineering students perceive their own ethical beliefs and how they perceive the ethical beliefs and actions of their peers.

A list of unethical acts or behaviours was developed by adapting the set of twelve from the study by O’Clock and Okleshen (1993). These are presented below. The acts were carefully selected so that they could later be discussed in light of the IEAust code of conduct during class activities. Although most are not overtly unethical, many of these seemingly minor unethical breaches in the set can be shown to potentially lead to the sorts of catastrophic engineering failure case studies commonly discussed in professional engineering ethics education.

1. Accepting gifts/favours in exchange for preferential treatment
2. Undertaking work in an area you know little about
3. Passing blame for errors to an innocent co-worker
4. Not supporting a colleague who is trying to do the right thing
5. Giving gifts/favours in exchange for preferential treatment
6. Claiming credit for someone else’s work
7. Not reporting others’ violations of organisation policies
8. Divulging confidential information
9. Withholding relevant information from a colleague or client
10. Calling in sick to take a day off
11. Pilfering organisation material and supplies
12. Doing personal business on organisation time
13. Not keeping up to date with the latest developments in your area
14. Concealing one’s errors

15. Taking extra personal time (lunch hours, breaks, early departure)

16. Using organisation services for personal use

The survey administered, instructed students to rank the sixteen unethical acts according to the following ratings. They were asked to rate both their personal beliefs and what they believe their colleagues believe.

1. Very unethical
2. Basically unethical
3. Somewhat unethical
4. Not particularly unethical
5. Not at all unethical

Following the survey, students received instruction regarding the IEAust code of ethics, several case studies were discussed and formal ethics education, covering utilitarianism, Kant's theory and virtue ethics frameworks and moral justification was provided. To allow students to form the conceptual link between personal and professional ethics, the survey, dealing with students' personal ethical beliefs, was discussed in light of the IEAust code of conduct. Following this discussion, the succeeding questions were posed to students:

1. Do you believe you always act in accordance with the tenets of the IEAust code of conduct?
2. Do you believe that most practicing engineers always abide by the IEAust code of conduct?
3. Do you believe that professional engineers can realistically be expected to abide at all times by the IEAust code of conduct?

Results and discussion

The results of the survey are presented in Table 1. The mean ratings indicate that students generally understood all acts or behaviours listed in the survey to be unethical to some degree. Students rated items 3, 'passing blame for errors to an innocent co-worker' and 6, 'claiming credit for someone else's work' as the most unethical. This was closely followed by item 8, 'divulging confidential information'.

Table 1 – Engineering students' personal and their perception of colleagues' beliefs regarding unethical behaviour

Act/ Behaviour	Personal belief (rating 1 to 5)						Perception of colleagues (rating 1 to 5)					
	1	2	3	4	5	Mean	1	2	3	4	5	Mean
1	41.0%	34.2%	18.1%	5.8%	0.9%	1.91	39.5%	35.1%	18.7%	6.1%	0.5%	1.93
2	7.7%	17.1%	31.9%	33.6%	9.7%	3.20	9.2%	23.5%	33.5%	25.0%	8.9%	3.01
3	79.2%	14.8%	4.2%	1.1%	0.7%	1.30	66.1%	21.7%	8.7%	3.4%	0.2%	1.50
4	27.6%	39.1%	23.9%	7.4%	1.9%	2.17	27.1%	38.0%	24.6%	8.3%	2.0%	2.20
5	41.6%	31.5%	18.8%	7.3%	0.9%	1.94	41.3%	30.8%	19.6%	7.6%	0.7%	1.96
6	76.6%	16.8%	3.7%	2.5%	0.4%	1.37	67.8%	22.3%	7.4%	1.8%	0.7%	1.45
7	16.2%	33.7%	36.7%	10.8%	2.6%	2.50	18.4%	34.2%	33.8%	12.0%	1.6%	2.48
8	54.9%	31.0%	10.9%	2.6%	0.5%	1.63	49.8%	32.4%	14.7%	2.7%	0.4%	1.71
9	25.1%	47.2%	19.1%	7.6%	1.1%	2.12	25.2%	41.3%	26.6%	4.7%	2.2%	2.17
10	15.8%	19.5%	33.8%	21.0%	9.9%	2.89	16.1%	22.3%	30.5%	20.1%	11.1%	2.88
11	29.3%	33.2%	26.7%	8.1%	2.7%	2.22	27.2%	33.7%	26.1%	9.6%	3.4%	2.28
12	10.2%	31.6%	38.6%	15.9%	3.7%	2.71	14.3%	32.1%	34.5%	14.5%	4.5%	2.63
13	6.7%	19.6%	32.6%	28.6%	12.5%	3.21	9.8%	20.7%	35.0%	22.5%	12.1%	3.07
14	13.9%	33.5%	34.0%	14.1%	4.4%	2.62	17.6%	30.9%	32.8%	15.1%	3.6%	2.56
15	11.1%	30.5%	33.0%	19.6%	5.8%	2.78	13.5%	26.8%	37.3%	16.9%	5.5%	2.74
16	10.8%	32.5%	33.4%	18.2%	5.1%	2.74	15.6%	26.9%	38.1%	14.5%	4.9%	2.66

The least unethical acts as rated by the students were items 2 and 13, respectively, ‘undertaking work in an area you know little about’ and ‘not keeping up to date with the latest developments in your area’. In light of the Australian cultural traditions, this was predictably followed closely by item 10, ‘calling in sick to take a day off’.

The rating of items 2 and 13 as least unethical is somewhat alarming. The response to item 2 was justified by students as a necessary requirement at their current stage of development as an engineer. They were all in the first year of their studies and continually being forced to work (in an educational context) in areas they had little understanding. The rating of item 13 by students as one of the least unethical behaviours points strongly to the need to reinforce the relevant lifelong learning related graduate competencies in the engineering curriculum.

The personal ethical belief responses to the overlapping items in the present study with that conducted by O’Clock and Okleshen (1993) showed reasonable agreement. From Table 1 and Figure 1 however it is evident that in the present investigation, the self-versus-other disparity referred to in the American study by O’Clock and Okleshen (1993), is not consistent. Students tended to rate themselves as more ethical than their peers when the act was perceived more strongly unethical. When the act was not perceived as strongly unethical, students tended to rate their peers as more ethical. This is in disagreement with the study by O’Clock and Okleshen (1993) where a pronounced ‘halo’ effect was evident with students rating themselves consistently and significantly more ethical than their peers. This result may reflect a fundamental cultural difference between Australia and America.

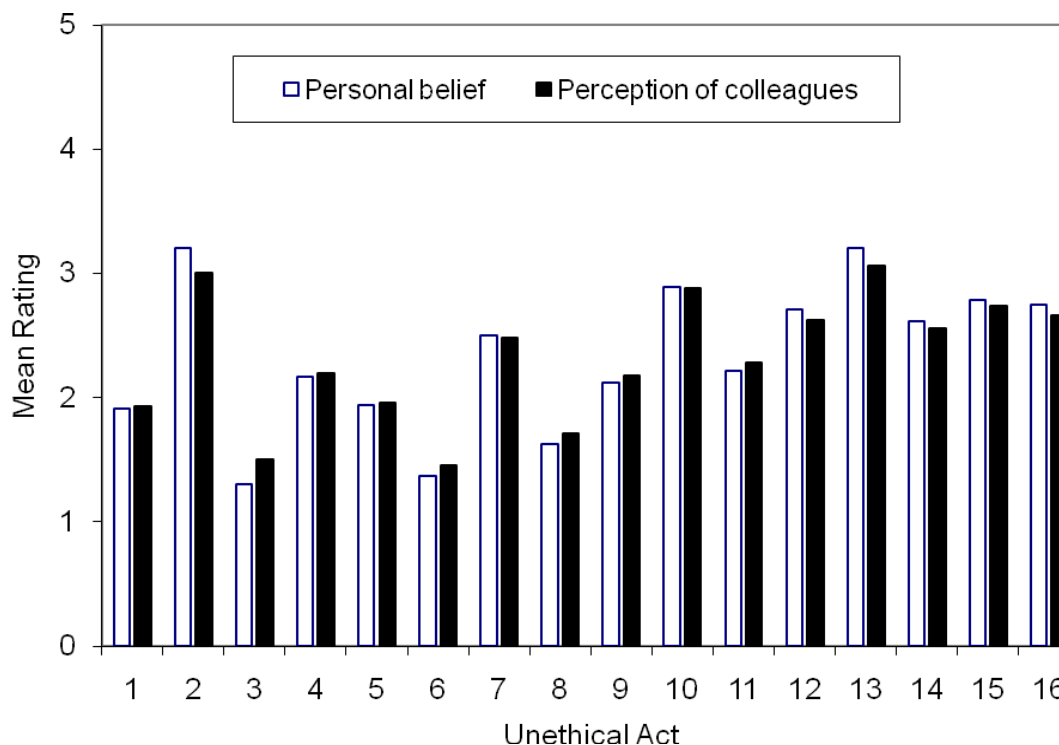


Figure 1 – Mean ratings of Engineering students’ personal and their perception of colleagues’ beliefs regarding unethical behaviour

The post IEAust code of conduct instruction and discussion question responses, regarding adherence to the code, are presented in Table 2. The breakdown of responses to the first question is consistent with the personal ethical beliefs reported by students. The large number of students who were unsure whether they were behaving in line with the tenets of the code does suggest however that more work is required to translate students’ personal ethics to their emerging professional identity.

The number of students that do not believe practicing professional engineers act ethically is concerning. Over a quarter of the students surveyed also stated that they do not believe that professional engineers can realistically be expected to abide by the code at all times. Part of the solution to addressing this concerning result may be to place more emphasis on ethical engineering practice in ethics education to balance the case studies where breaches of the code of conduct are examined. Modelling ethical behaviour and providing outstanding engineering role models for students would appear to be a more positive approach to ethics instruction.

Table 2 – Engineering students’ perception regarding adherence to the IEAust code of conduct

Question	Yes	No	Unsure
Do you believe you always act in accordance with the tenets of the IEAust code of conduct?	54.0%	19.9%	26.2%
Do you believe that most practicing engineers always abide by the IEAust code of conduct?	48.2%	28.3%	23.5%
Do you believe that professional engineers can realistically be expected to abide at all times by the IEAust code of conduct?	54.5%	26.9%	18.6%

Conclusion

The present study has provided a snapshot of the current personal ethical beliefs of engineering students. Although generally, engineering students in the sample group agreed that the acts listed were unethical, there were several items that raised concern. In particular, the item concerning ‘not keeping up to date with the latest developments in your area’ was rated by students as one of the least unethical behaviours. This result points strongly to the need to further reinforce the relevant lifelong learning related graduate competencies in the engineering curriculum. The most alarming results of the present study were that 28% of students do not believe current practicing professional engineers act ethically and almost 27% believe that it is unrealistic to expect this ethical behaviour. This suggests that significantly more work is required in engineering ethics education and in shaping our students’ emerging professional identities.

As discussed previously, it has been argued in previous studies that ethics cannot be taught. Regardless, personal ethical change will take place in our students. While these students are under our guidance it is imperative that we engender and enable positive development. Rather than a standalone module of ethics instruction a move toward a more holistic, integrated approach to teaching ethics would appear a more suitable mode of instruction (Jimenez, O’Neill-Carrillo and Marrero, 2005; Cruz, Frey and Sanchez, 2004). Since personal ethics has previously been shown to be the basis of professional ethics, this ethical instruction embedded across the curriculum does not need to be entirely engineering oriented. Exposure to an ethical academic culture may be as much if not more beneficial in positively influencing personal ethical development than targeted efforts to explicitly teach professional engineering ethics. Students need to be exposed to as many ethical professional engineering role models as possible. This may be in the form of formalised lecture and tutorial type exposure but may be much more beneficial if received in the form of engineering mentors and the modelling of ethical behaviour by academic engineering staff.

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