One key to the future: engaging with globally recognised ethical norms

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***Abstract**: This paper reports a study of the ethical development over a teaching session of 135 students (out of 367 enrolled) formally studying professional ethics while undertaking their final year study of a BE. The methodology used a test similar to Rest's Defining Issues Test in a voluntary on-line student survey. The main findings are that both female students and international students showed more ethical development than the overall average. As the students came from 3 different courses, comparing the respective courses and outcomes provides further evidence that aligning learning objectives, assessment and activities enhances learning.*

Introduction

The key to any future is action, specifically taking good actions. In particular, in identifying better actions, ethical considerations play a critical role and this is why Engineers Australia's (EA) insists that an awareness of professional ethics be a core element of an engineer's competency and makes it a specifically nominated graduate outcome (Engineers Australia, 2006, p 10). Ethics is, then, an important part of any student's education.

EA has a *Code of Ethics* (EA, 2000) which necessarily forms the reference point for the ethics education of the profession in Australia. Many students, though, in Australian universities are not Australians. It is important, therefore, to learn something of how these students respond to the study of ethics anchored in the local Australian code.

Engineering ethics is a global idea. Although the exact wording of codes of ethics varies considerably around the world, the underlying values remain essentially – some would say surprisingly – the same (e.g. see Cohen, 2008). Initially this may seem a contentious claim, but the reader is reminded that codes operate at a very general level; disputes about ethics arise about ranking the relative importance of these high level principles or how they should be demonstrated. Indeed, there is enough commonality that the World Federation can provide a sample such professional code (WFEO, 2001). It is beyond the scope of this paper to join the long argued debate over whether there are fundamental ethical values behind human behaviour (e.g. see Franken, 1973) or the possible differences between personal and professional ethics (e.g. see Martin & Schinzinger, 1996). Suffice to note that, in engineering at least, it seems the successful practise of the profession requires acceptance of some basic values by almost everyone. For example, honesty is needed when reporting experimentally

measured outcomes, that these results become useful. Note also that suggestive evidence is appearing that ethical values may be defined by our common human biology (e.g. see Young et al, 2010).

Interestingly, some jurisdictions (e.g. parts of China) have no formally articulated professional code of ethics for engineers. This makes the contribution of Australian education very important, in a perhaps unexpected way, to some of the students' futures. Engineering is a global profession. All students, not just Australians, need an understanding of the ethical principles that support professional practice, even if these principles are only tacit where they will be working. For this reason, too, specific knowledge of how international students engage with learning about ethics featuring EA's code is important.

The past couple of decades has seen ethics incorporated into the BE syllabus in many parts of the world. It is surprising, though, that we, as engineers, have not yet systematically measured how effective has been the associated students' learning of the profession's expectations about behaviour. The survey by Colby et al (2008) emphasised this gap in our knowledge.

This paper reports a study of the development of ethical awareness amongst a cohort of 4th year undergraduate BE students engaged in the formal study of ethics using the methodology of the Defining Issues Test (DIT) (Rest et al, 1999). Perhaps our most interesting result is that international students can and do engage in ethical development while here, including developing an awareness and understanding of EA's *Code of Ethics*. Also, we found that female students showed greater ethical engagement with this code than did their male counterparts. Findings about precisely the best way to teach ethics are consistent with the existing educational literature (e.g. Ramsden, 2003), namely that students are more likely to learn and so improve their ethics awareness in a course with a diversity of related learning activities and assessment tasks specifically aligned with explicit learning objectives related to ethics.

Methodology

Students in three different course cohorts – CEIC4000, ELEC4122, and MMAN4000 – were asked to complete one survey at the start of their formal study of ethics and another at the end of their studies. As a control, students of CEIC3006 were asked to participate, too. This last-named is a third year course about Chemical Engineering Design. These surveys were not part of the respective formal courses; they were entirely voluntary, completed on-line in the students' own time. Some lucky draw prizes were awarded to thank students for their participation.

The numbers of students who participated in the surveys are given in Table 1. The demographic profile of the participating students is shown in Table 2. Both the male:female and international:local ratios are consistent with those of the Faculty as a whole. There is no official faculty profile of the students' work-experience.

Table 1: Response rates for the experiment (surveys)

	CEIC3006	CEIC4000	ELEC4122	MMAN4000	**total**
students enrolled	77	82	104	176	439
'before' test responses	24	50	67	99	240
'before' test %	*31*	*61*	*64*	*56*	*55*
'after' test responses	24	43	46	65	178
'after' test %	*31*	*52*	*44*	*37*	*41*
matched-pair responses	18	37	42	56	153
rejected surveys*	4	7	5	7	23
usable pairs	**14**	**30**	**37**	**49**	**130**
response rate (%)	*17*	*35*	*35*	*28*	*30*

* Note that surveys were rejected based on internal inconsistencies to avoid including random results.

Table 2: Participants' demographic data

demographic detail	CEIC3006	CEIC4000	ELEC4122	MMAN4000	**total**
female	5	7	8	3	23
male	9	23	29	46	107
local*	9	18	24	32	83
International	5	12	13	17	47
work experience					
<6 weeks	9	11	8	20	48
6-12 weeks	1	7	5	7	20
3-6 months	2	6	10	13	31
6-12 months	0	1	6	4	11
>1 yr	2	5	8	5	20

* Aust citizens or permanent residents; not necessarily "Australians."

The surveys were structured using a variation of the original DIT. This test is designed to reveal where a respondent sits on Kohlberg's (1984) 6-point scale of ethical development. It confronts the student with a set of scenarios and measures the student's moral reasoning in working through what each scenario's protagonist should or should not do. Although the DIT does ask what the student actually thinks about a specific issue, the student's choice (moral or otherwise) is not scored and is irrelevant in the analysis of the test. What the test actually assesses is how people rate the importance of certain specified issues, which may or may not be related to the scenario. Insofar as some issues are considered to be components of ethical thinking, then the premise is that identification of such issues is related directly to the student's ethical thinking in some assessable way.

Analysis of the DIT has resolved that its so-called N2-score measures the ethical development of the respondent along Kohlberg's 6-pt scale, i.e. movement towards level 6 thinking. In other words, N2 is seen to be a "measure" of the moral autonomy of the individual. On the other hand, the so-called P4-score shows the respondent's preference for thinking within codified behavioural norms, such as, for example, a professional code of ethics, which in our case is that of EA. This corresponds to Kohlberg's level 4 thinking. P4, then, "measures" the individual's preference to make decisions conforming to the expectations of others, notably the profession.

It is worth posing the question: "Is this the correct tool to assess the learning aims of a university course? And a course on specifically professional ethics at that?" Kohlberg's levels of ethical development are premised on the idea that people demonstrate full moral autonomy at the highest level, having proceeded through rules and 'expectations' at earlier levels. This premise about ethical development has been criticised. Notably, his student Gilligan (e.g., Donleavy, 2008) made the specific claim that individual autonomy, being focussed on "I," is not the pinnacle so much as awareness of collective requirements, expressed by "we." In terms of a hierarchy of development of ethical thought, Gilligan swapped Kohlberg's levels 3 and 4 with his levels 5 and 6.

Recently Borenstein et al (2010) introduced a new tool: the Engineering and Science Issues Test. This, too, is premised on Kohlberg's levels but is designed to assess the development of professional rather than general ethical thinking, with the issues used being more directly connected to working with a variety of technologies.

Furthermore, universities are not concerned with how students actually behave and engineering education concentrates on developing an awareness of the expectations – both social and professional – placed on the individual. In some sense this is counter to the ethical theorists' notion of full autonomy. An additional observation is that modern engineering is as much a "we" profession as

an "I" profession. Its greatest successes are a consequence of co-operation, and co-operation of a level rarely seen in other spheres of human endeavour. For example, the International Telecommunications Union is the oldest and arguably amongst the most successful of international institutions.

Nevertheless, Kohlberg's test is widely accepted and comparative studies are possible with previous research if it is used.

Findings

The N2-score revealed that, of the three ethics based courses being examined, none developed students' moral reasoning more than did the control course. There was a slight improvement by the CEIC3006 cohort and this is interpreted as showing the students gaining practice with the test. Comparisons, then, of the change in N2-score between each of the ethics-based courses and the control group yielded non-significant results within the respective 95 % confidence level. The low confidence intervals required to produce significant results are due to the combination of a large spread of scores found by the surveys and the small sample sizes. This null result was disappointing as the three courses took very distinctive approaches to the material. However, this very lack of correlation with the respective courses' approaches is consistent with a previous finding (Drake et al, 2005) although their more recent work (Borenstein et al, 2010) did find some variations between courses.

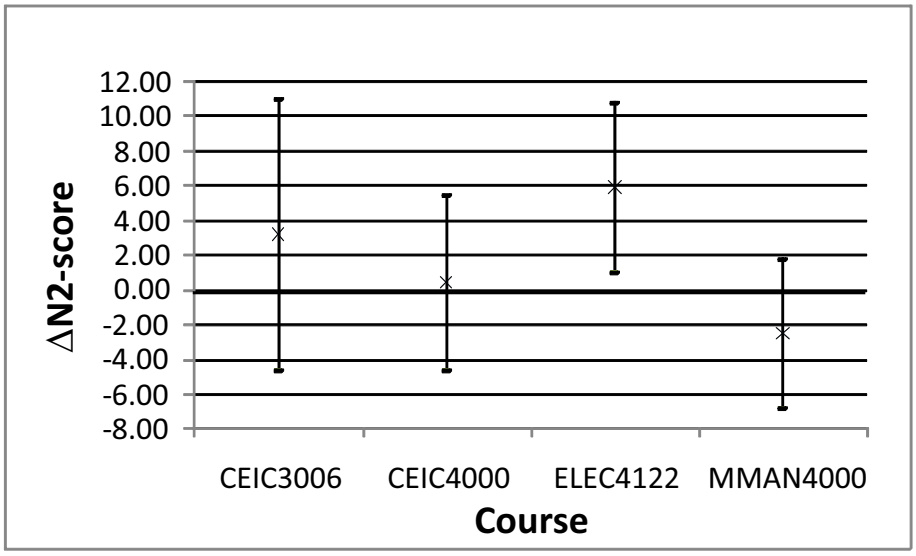

Figure 1: The change of Kohlberg level-6 thinking by course cohorts
Crosses indicate the change in the respective cohort's mean; bars show 95 % confidence intervals.

However, one can argue that the apparent shift by the control group is a random result. Two measurements of the same students on different days would not be expected to give identical results. Take, then, the baseline to be not this control course but, instead, 'zero', i.e. any evidence of ethical development is ascribed to the course, and not simply perhaps to a growing 'maturity' of the students. As shown in Figure 1, the population of ELEC4122 now does show a small, but statistically significant, improvement in ethical development. It is notable that this is the only course of the three in which there was significant alignment of the learning objectives, classroom activities, and assessment tasks. Specifically, students of ELEC4122 received lectures introducing ethics early in the teaching session and then engaged in weekly student led seminars and on-line discussions. These diverse activities were complemented by a variety of assessment tasks, including half the open-ended questions on the final exam, which was open-book. MMAN4000, too, provided an early introduction to ethics with lectures, but then nothing until the final exam whereon some multiple-choice questions addressed ethics, but with little contribution to the overall mark. In CEIC4000, lectures introducing

ethics occurred late in the session and were followed by a major assignment, representing half the student's marks. This involved both exploration of an ethical problem and peer-review of other students' ethical analyses. The educational value of such constructive alignment is well-attested to by all major educational theories.

Use of the P4-score resulted in evidence to suggest that none of the students changed their preference for stage four reasoning, at least within a 95 % level of significance. Once again, there was a slight increase shown by the students in ELEC4122 when the more conventional baseline of zero was used, instead of that of the very small control cohort (CEIC3006). The P4-score, as it is used in the DIT, only measures preference for using the code and not knowledge or awareness of its principles. For instance, a student with a very detailed knowledge of the EA's *Code of Ethics* may not necessarily wish to use its principles in resolving ethical dilemmas and, hence, produce a low P4-score. This characteristic of the P4-score is a notable limitation for its use in investigation of engineering ethics education.

Comparing changes to the N2-scores of the local and international students revealed no significant difference between them, but examination of their respective P4-scores yielded a novel, surprising result, shown in Figure 2. In terms of Kohlberg theory, this implies that the international students' preference for level-4 reasoning increased much more than did that of local students. Furthermore, due to the engineering nature of these courses, this implies international students increased their preference for using EA's *Code of Ethics*. This may seem counter-intuitive but could also be interpreted as consistent with Confucian thinking, notably a stress on the primacy of society's welfare and a respect for authority structures.

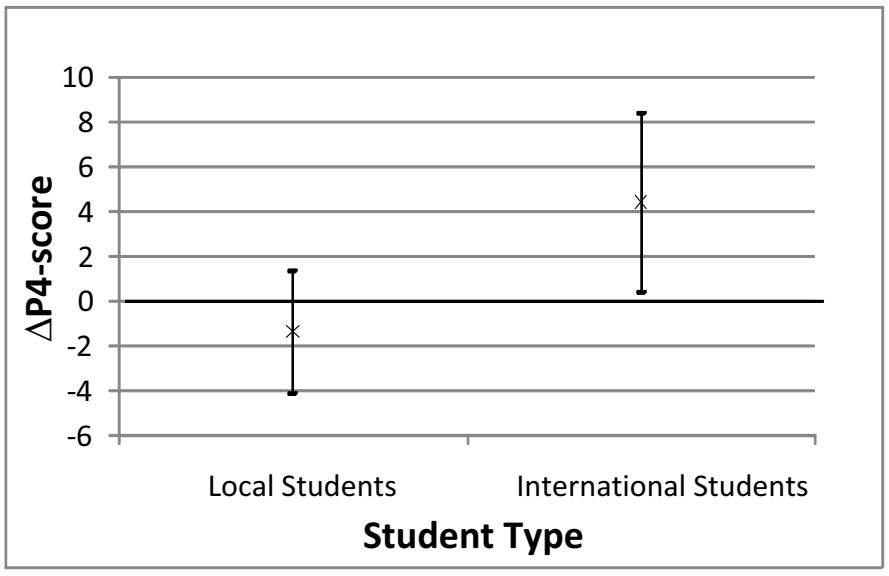

Figure 2: The change of Kohlberg level-4 thinking by local and international cohorts
Crosses indicate the change in the respective cohort's mean; bars show 95 % confidence intervals.

No significant difference was observed in the general moral reasoning between females and males. However, females showed more significant development of level4 reasoning than did males, as shown in Figure 3. Considering the above-mentioned finding about the development of international student P4-scores, the results were calculated using appropriate controls for the international:local populations. This produced an even stronger result. Such a male-female discrepancy has not been reported previously. On face-value it points to female students being more engaged with their engineering ethics education than are males and their identifying more strongly with the values espoused by EA's *Code of Ethics*. Drew (2009) has explored some possible explanations but none is particularly compelling. Significantly, Gilligan's criticism of Kohlberg's thesis claimed that women naturally think more at level 4 and men more at his level 6.

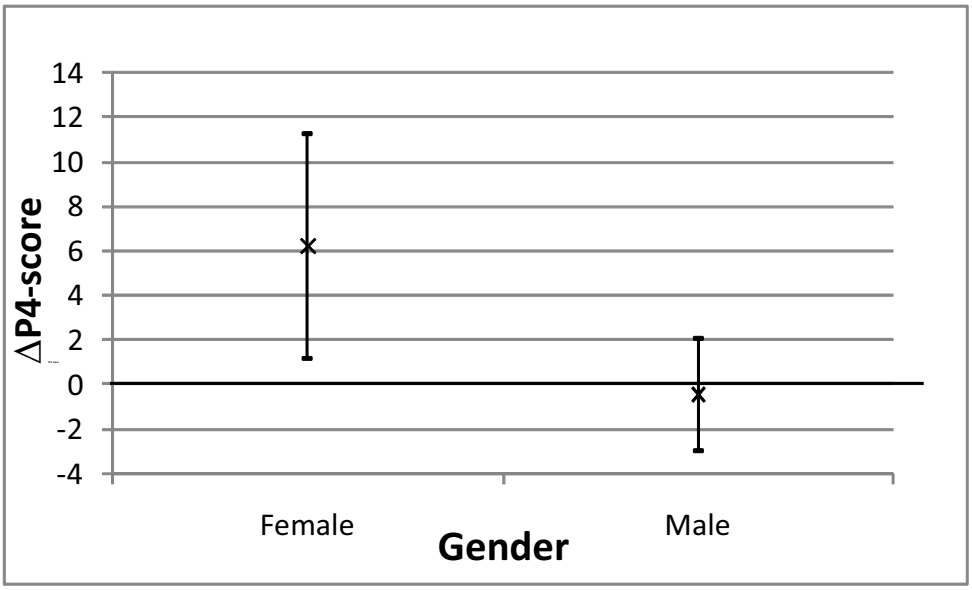

Figure 3: The change of Kohlberg level-4 thinking by female and male cohorts
Crosses indicate the change in the respective cohort's mean; bars show 95 % confidence intervals.

Conclusions

Some students show significant ethical development over the duration of their study of the material. Specifically, the ethics courses in this study appear to enhance the awareness of both the female and the international sub-sets of the student population. Both these cohorts showed a marked preference to employ the professional code as a guide when making decisions about ethics.

Greater development was shown by students when the relevant course had a variety of classroom activities and the assessment tasks specifically aligned with a stated learning objective to enhance ethical awareness.

Improved reliability in the findings will require much larger numbers of students to participate and this is a continuing interest of the authors.

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Acknowledgements

The authors thank the students who participated in these studies.

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