

How Good Is Engineering Students' Moral Reasoning?

By A. Francois, K. Mehrabi Kochenbyoki, K. Mopari & E. Zare Eelanjeh

Project supervised by R. Tormey, Centre d'appui à l'enseignement (CAPE)

Ecole polytechnique fédérale de Lausanne (EPFL), Switzerland

Rationale

The influence of engineers on our day-to-day life is getting larger and larger over the years. It is therefore important to see the development of moral reasoning of engineering students who would eventually grow into professionals with power to influence various aspects of the life. The significance of the education in developing ethical behaviour is widely acknowledged and hence been widely studied quantitatively using Defining Issues Test (DIT). DIT is concerned with how one defines the issues in moral dilemmas and is based on Kohlberg's cognitive theory for moral development. There are various measures to evaluate the performance in DIT. P score and N2 score are mostly used. We present a systematic review of studies subjected to engineering students using DIT.

Kohlberg's cognitive theory: stages of moral development

Pre-conventional	<ul style="list-style-type: none"> ▪ Obedience and punishment orientation ▪ Self-interest orientation
Conventional	<ul style="list-style-type: none"> ▪ Interpersonal accord and conformity ▪ Authority and social-order maintaining orientation
Post-conventional	<ul style="list-style-type: none"> ▪ Social contract orientation ▪ Universal ethical principles

Method

For this meta-analysis, we focused on the studies that used revised version DIT2. In order to collect as much data as possible, we searched rigorously on the electronic data-bases such as 'Web of Science', 'Google Scholar' etc. After pruning out the set of all the studies we found, we were left with 27 studies fulfilling our criteria. We aggregated the results of all these studies to present more precise estimate for average DIT2 scores for engineering students. Furthermore, various trends and the effect of educational interventions were identified.

Do ethics course make engineering students more ethical?

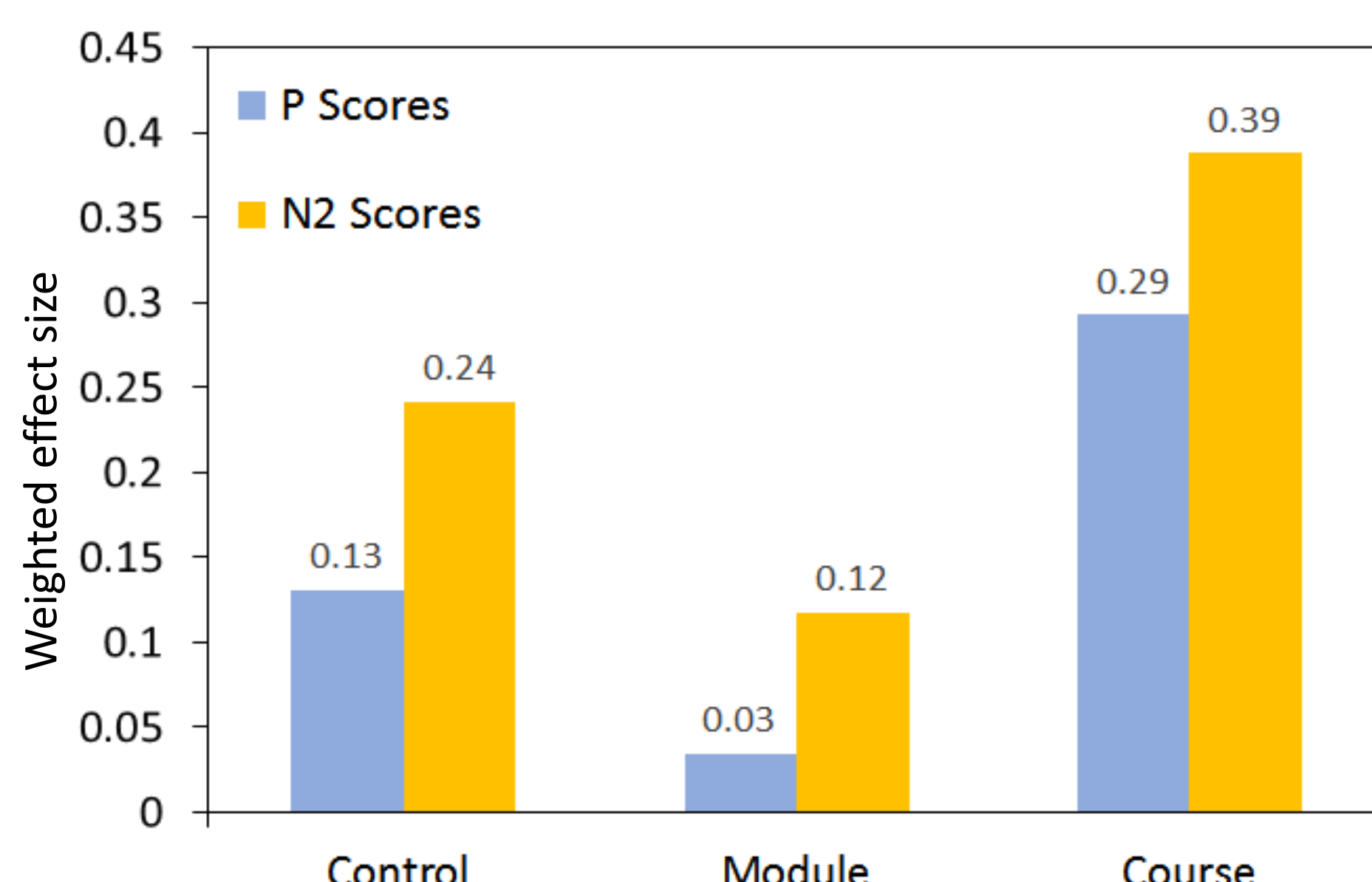
Yes, ethics can be taught. But the educational interventions must be designed properly in terms of the duration and the contents. N2 score is a better instrument to measure the effect of intervention as it not only considers post-conventional stages (like P-score), but also distinguishes between low and high stages.

Intervention's Duration:

Short time ethical instruction (on average two ethical lectures among other engineering topics during one semester length course) does not seem to be effective. They may function as a starting point for further development, but the DIT measures long-term development. In order to produce significant acceleration in moral development, the teaching programme should be around 4 to 12 weeks long.

Intervention's content:

A general engineering ethical course produces larger impact on the development of moral judgement than introducing discipline-specific content including relevant case studies as a module during an engineering course.



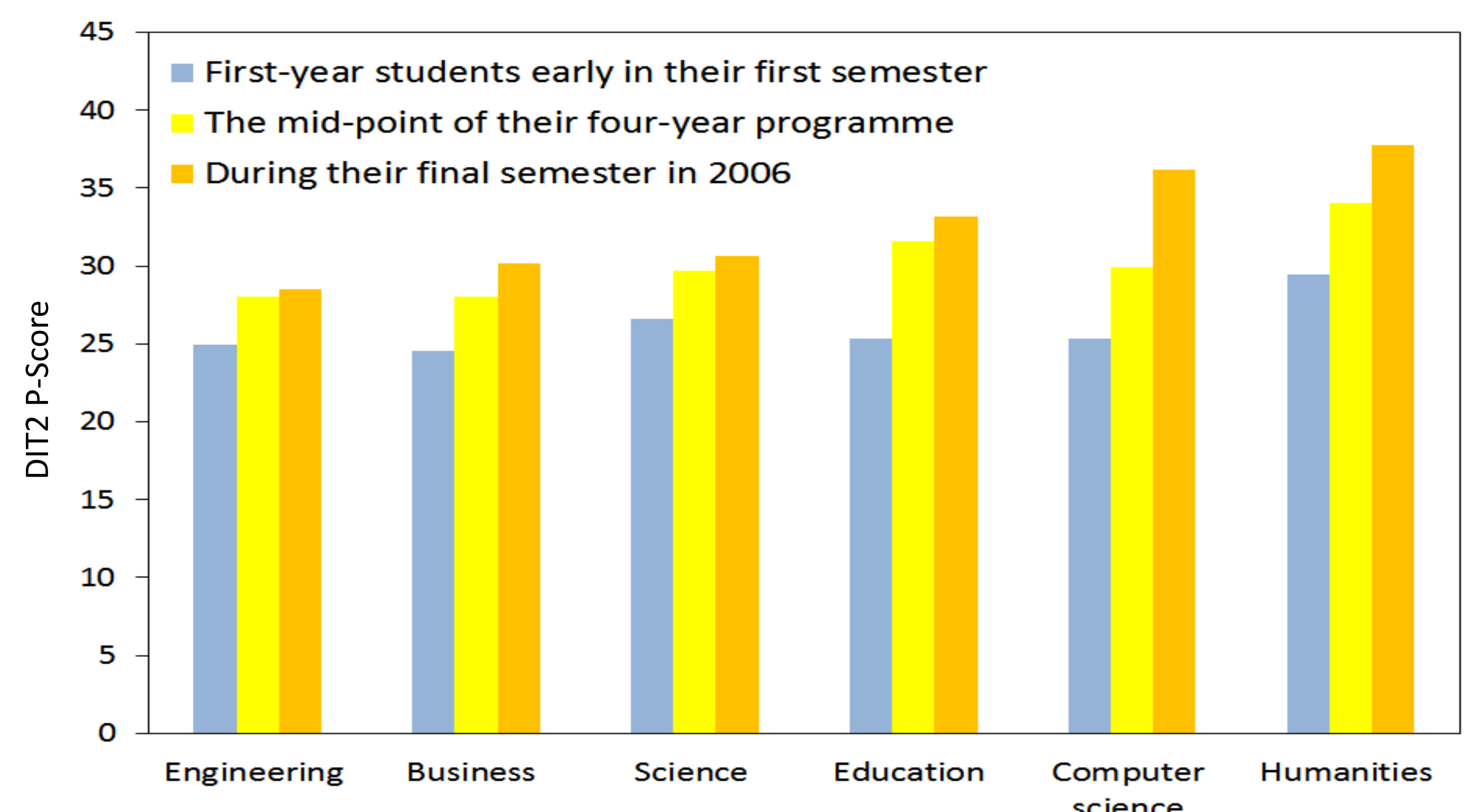
The mean values of weighted effect size of "Post-pre" DIT2 P/N2 Scores of Engineering Students, after different ethical interventions

i) Control group: usual engineering course
ii) Experimental groups: Module (< 4 weeks)
Course (> 4 weeks)

References

O'Flaherty, J. & Gleeson, J. (2014). Longitudinal study of levels of moral reasoning of undergraduate students in an Irish university: the influence of contextual factors, *Irish Educational Studies*, 33:1, 57-74.
Finelli, C. J., Carpenter, D. D., Harding, T. S. (2012). An Exploratory Investigation of the Ethical Behavior of Engineering Undergraduates. *Journal of Engineering Education*. Vol. 101, No. 2, pp. 346-374.
Loui, M.C. (2006). Assessment of an engineering ethics video: Incident at morals. *Journal of Engineering Education* Volume 95, Issue 1, pages 85-91.

Does engineering education improve moral reasoning?



Longitudinal mean DIT2 P score by academic discipline

Longitudinal evolution

Aggregating the results of the three longitudinal studies, we can conclude that the level of engineering education is a strong predictor of increase in DIT2 scores as the average P and N2 scores increase significantly over the course of undergraduate engineering programmes. There is also a significant correlation between the DIT scores and academic achievements.

Comparison with other disciplines:

If we compare the progress of engineering students with other disciplines, over the span of undergraduate education, engineering students have scored consistently lower than most other disciplines like humanities and business. This difference could be due to the nature of engineering discipline, which focuses on strict laws and formulas which suggest more conventional reasoning, as opposed to post-conventional moral reasoning for which one has to go beyond the established framework and think what could be a better answer for the society.

IMPLICATIONS

- Average N2 score for Engineering students is 32.59 and average P score is 32.53.
- The average moral reasoning of students increases significantly over the course of undergraduate engineering programmes.
- The progress of engineering students is lesser when compared to other disciplines.
- Including an ethics course in the curriculum is useful if it is carefully crafted and longer than 4 weeks
- Differences in educational system play an important role in the moral development of students.

More about this study

This study was completed by EPFL Master students as part of a Social and Human Science course called *How People Learn II*.

For further details contact roland.tormey@epfl.ch