

Embedding Online Research Integrity and AI Training in Final Year Engineering Honours Projects

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ABSTRACT

CONTEXT

UNSW Canberra provides undergraduate education to trainee officers of the Australian Defence Force Academy, including Engineers Australia (EA) accredited engineering degrees. In line with an EA requirement to include more engineering ethics in the curriculum, the School of Engineering and Technology at UNSW Canberra has developed four ethics modules, one for each year of the degrees. The final year online module covers research integrity and the ethical use of AI, which students must complete early in their final year project.

PURPOSE OR GOAL

This study aims to evaluate the final year module's performance in learning and engagement of the students through student surveys and peer-review of the module. The questions answered through this study will be: (1) How well do students engage with the module? (2) How effective was the module in achieving the learning outcomes? (3) What features of the module are most important for its effectiveness?

APPROACH OR METHODOLOGY/METHODS

The module is online, asynchronous and self-paced. Pre- and post-module student surveys were designed to evaluate the effectiveness of, and student engagement with, the module. Peer review of the module is being done by educational designers to evaluate module design, and research integrity officers to evaluate module content.

ACTUAL OR ANTICIPATED OUTCOMES

The implementation of the module itself was one of the outcomes of this project. The module introduces students to the requirements of research integrity that they will be applying in their research projects. As the module is delivered online and requires no monitoring by academics beyond checking completions, it reduces the effort required by supervisors to introduce students to research integrity and ensures consistent research integrity training. The evaluation of the module demonstrates that the module was a success in improving students' knowledge about research integrity and where to seek guidance regarding the same. Recommendations were suggested based on the quantitative data and the raw comments from students and peer-reviewers.

CONCLUSIONS/RECOMMENDATIONS/SUMMARY

It is hoped that the module will prove to be an effective way to support research integrity training and the ethical use of AI by engineering students in their final year project, and their professional workplace moving forward.

KEYWORDS

Ethics and Integrity, Artificial Intelligence (AI)

Introduction

'Immoral behaviours prevalent in the professional scene have been partly attributed to the failure of university education to integrate ethical and moral development of students in their undergraduate programs' (Alleyne & Phillips, 2011; Lewellyn & Rodriguez, 2015; Lynch *et al.*, 2022). To tackle this problem, Engineers Australia has placed an emphasis on integrating engineering ethics in the undergraduate engineering curriculum.

Last year we presented a standalone module that covered Engineering Ethics and Research Integrity combined for final year engineering students (Pawar *et al.*, 2024). This module was developed in response to Engineers Australia recommendation to include more engineering ethics into the program. Since then, this module has been expanded and divided into 'Workplace ethics' for third year students before their work placement and 'Research Integrity and ethical use of AI' for final year students as a part of their honours' thesis project.

James Rachels' consensus that unless people in a society follow a set of rules of behaviour, there will be a loss in trust among the members of the society and this, in turn, will destroy the social fabric prevalent in the society (Rachels, 2003). Applying this to a university, and specifically to a research context, research integrity defines these set of rules that underpin the foundation of the field of research. Lynch *et al.* (2022) define the importance of academic integrity for nursing students. Expanding this to the field of research, research integrity is integral to the development of knowledge, research skills, and professional skills of students, and provides an inextricable link to the standards for professional practice. Serious forms of misconduct appear often in research in the forms of falsification and fabrication of data, plagiarism, etc. (Ana *et al.*, 2013; Anderson *et al.*, 2007; Bakker & Wicherts, 2011, Hoffmann & Holm, 2019). This, in turn, raises concerns about confidence in research and researchers (Hoffmann & Holm, 2019), thus shaking the very grounds of research and its importance.

Hoffmann & Holm (2019) point out that research (scientific) dishonesty has two major reasons – individual attitudes and environmental factors. The environmental factor becomes a driving factor in further studies (research degrees) and professional lives. However, individual attitudes remain a fundamental factor throughout the research journey from undergraduate studies to professional research. Tackling environmental factors can only be achieved if the individual attitudes towards research conduct are aligned with honesty and morality. Research integrity education and training can foster responsible conduct of research (van den Hoven *et al.*, 2023).

The module

The research integrity module was delivered online and asynchronous. The idea was this module would be a supplementary addition to the final year honours' thesis project, in line with constructive alignment of the module (Biggs & Tang, 2022). The completion of the module was mandatory to pass their honours' project course. The students were given the whole year to complete the course. However, it was expected that they complete the module within the first semester of their project. In next iterations of the course, the deadline might be reduced from the whole year to the first semester only so that they can apply these principles in their honours' project.

Module Aims

The module aimed at –

- Introducing Research Integrity to improve knowledge of research integrity (Level 2, Table 1).
- Recognising and addressing potential issues in research integrity to improve decision-making (Level 2, Table 1).
- Familiarising students with protocols and support systems for research integrity breaches at UNSW Canberra.
- Introducing ethical use of AI as per UNSW policy.

Van den Hoven *et al.* (2023) emphasise the importance of taxonomical description to design and redesign research integrity training. The authors describe four levels of research integrity training based on Kirkpatrick’s four levels of evaluation (2016, 1998). The module aims at developing the first and second levels and the third level to a certain degree.

Table 1 – Evaluation levels for the module based on Kirkpatrick’s model for evaluation (2016, 1998)

Fourth level	Responsible conduct of research and no research misconduct
Third level	Research integrity related decision-making, reasoning, interaction outside classroom
Second level	Research integrity related knowledge, decision-making, interaction in the classroom
First level	sensitivity, motivation, commitment towards research integrity

Module content

The module was divided into two parts. One regarding research integrity and the other regarding ethical use of AI. This section gives a brief overview of the module content.

Research Integrity section

The research integrity section was developed heavily based on the Australian Code for the Responsible Conduct of Research (2018) developed by National Health and Medical Research Council’s (NHMRC), Australian Research Council (ARC) and Universities Australia. This was augmented by additional context and content based on UNSW Code of Conduct and Values for Research. The principles of research integrity in the module are shown in Figure 1.

Let’s take a look at the **Principles of Research Integrity** in this Code in more depth.

Honesty	+
Rigour	+
Transparency	+
Fairness	+
Respect	+
Recognition	+
Accountability	+
Promotion	+

Figure 1 – Research Integrity principles covered in the module

Each principle of research integrity was then expanded upon in this section in an accordion format (Figure 1) where the students are free to expand and read each section any number of times.

However, the students must expand each section at least once to proceed. Since this module had to be of the form that could be completed without the students spending significant amount of time on it, the explanations were brief and to the point. For example, Figure 2 shows the principle of recognition and its content.

Recognition

We, as researchers, should recognise, value, and respect the cultural heritage, diversity, knowledge, and property of indigenous people. Indigenous peoples (Aboriginal and Torres Strait Islander peoples in Australia) have the freedom to decide about their involvement in research and we need to engage with them before starting a particular research project that might affect them or is significant to them.

Participating Aboriginal and Torres Strait Islander people have a right to know the outcomes of the research.

For more details on the lessons learned from mistakes regarding intercultural research, please read the following article:

Vanette McLennan & Glenn Woods (2018) Learning from mistakes and moving forward in intercultural research with Aboriginal and Torres Strait Islander peoples, Higher Education Research & Development, 37:1, 88-100, [DOI: 10.1080/07294360.2017.1343806](https://doi.org/10.1080/07294360.2017.1343806)

*** This subsection on Recognition is based on the following references -**

* UNSW Code of Conduct and Values

* Vanette McLennan & Glenn Woods (2018) Learning from mistakes and moving forward in intercultural research with Aboriginal and Torres Strait Islander peoples, Higher Education Research & Development, 37:1, 88-100, DOI: 10.1080/07294360.2017.1343806



Figure 2 – An example of the content in the Research Integrity section

Artificial Intelligence section

The second section of the module consisted of an introduction of how to use AI ethically in research. This was based on the ethical use of AI strategy at UNSW. This section consisted of the expectations of students in using AI specifically for research and good practices for the same. A few examples of how AI should and should not be used were included in the section. Ultimately, students were also shown the limitations of AI through an example. This section is being extended significantly for the second iteration of the module.

Evaluation methodology

The module was evaluated based on student surveys and peer review. The student survey data was both qualitative and quantitative in nature, while the peer-review was purely qualitative. Please note that since AI and its use in the education sector is developing at an incredible pace, the university guidelines are also evolving accordingly. Hence, the AI section was not included in the feedback survey. However, we plan to add questions regarding AI in the next iteration of the module.

Student surveys

Two surveys were produced and delivered online – one before taking the module and one after completing the module. The questions in the pre-module survey were used to gauge the students' prior knowledge regarding research integrity and their knowledge about support available at UNSW (Figure 3). These questions were framed in a 6-point Likert scale format with no neutral response.

⋮

1. You are not required to complete this survey, but your participation will help us improve the mandatory research module. If you do not wish to participate, simply leave the survey blank.

For each question below, please indicate whether you agree or disagree with the statement.

	Strongly disagree	Disagree	Moderately disagree	Moderately agree	Agree	Strongly agree
I am familiar with the principles of Research Integrity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am familiar with the UNSW Code of Conduct and Values	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am confident that I could identify a breach of research integrity	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am confident in my ability to act with integrity in my research	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I believe research integrity is an important aspect of engineering research.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I know where to find information about research integrity at UNSW	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I know who to talk to if I have a concern about research integrity at UNSW	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A knowledge of research integrity is relevant to my future career	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Figure 3 – Pre-module survey questionnaire

The post-module survey questionnaire expanded upon the pre-module survey by adding some questions (the same 6-point Likert scale) regarding the quality and engagement of the module itself and standard descriptive questions such as what was the best part of the module, how can the module be improved and any other comments.

Peer-review

The module was peer-reviewed internally by an integrity advisor and an educational designer; and externally by two integrity advisors. The peer-review process feedback questions were strictly qualitative and were used to assess the quality of content, engagement, and the presentation.

Results and Discussion

This section discusses the results of the qualitative and quantitative analysis of student survey data and peer review.

Student feedback

The pre-module and post-module surveys were supplied to students online, which reduced the number of respondents. The number of respondents for the pre-module survey were N = 32 and post-module survey were N = 28. The percentage average and standard deviation of the Likert questions asked in both the pre- and post-module surveys is shown in Figure 4 (6-point average converted to a percentage value with 6 being 100%). Each question shows an overall improvement. However, a significant improvement was observed in two areas – knowledge about resources regarding research integrity and people to approach regarding research integrity. This was encouraging as students conducting research as a part of the university should know where to find the resources they need to ensure good research.

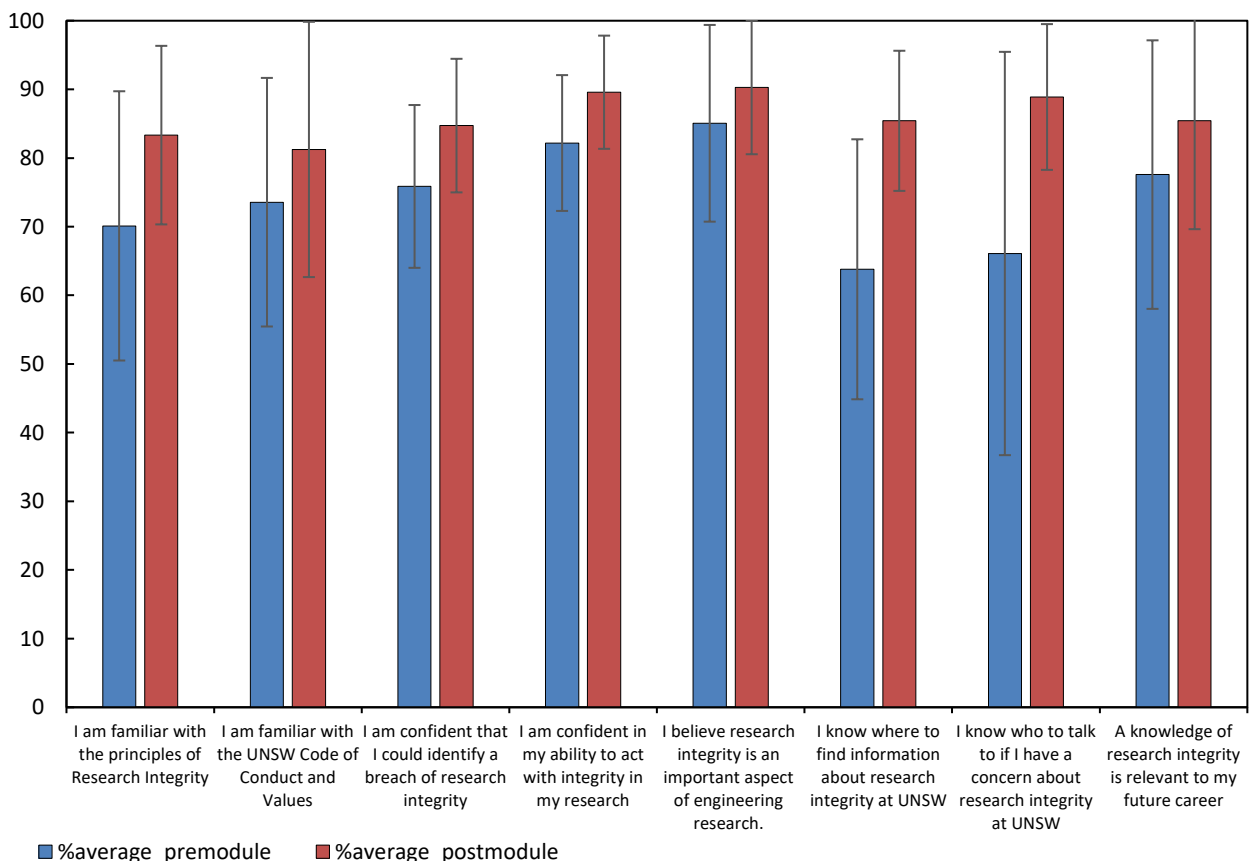


Figure 4 – Quantitative data from the pre- and post-module surveys

The data from the additional questions of the extended questionnaire is shown in Figure 5. These questions are based on the engagement and the content of the module, as to see what worked

and what did not. Students found the module informative and useful. However, the engagement factor seems to be lacking as observed from question 1. More than 80% of the respondents agreeing that the module was relevant and helpful and being satisfied could be considered a success for the module's first iteration.

To understand the improvements essential for the module, we looked at the raw comments from students. Students appreciated the brevity of the module. They also appreciated the content itself and more importantly the case studies. The raw comments showed that the module achieved the course learning outcomes of introducing research integrity to students and its application beyond this module, specifically to their research project. One of the raw comments regarding the module

“Being relevant not just to a specific course or aspect of Final year project, but a holistic approach to being conscious about research not just at UNSW but into the future.”

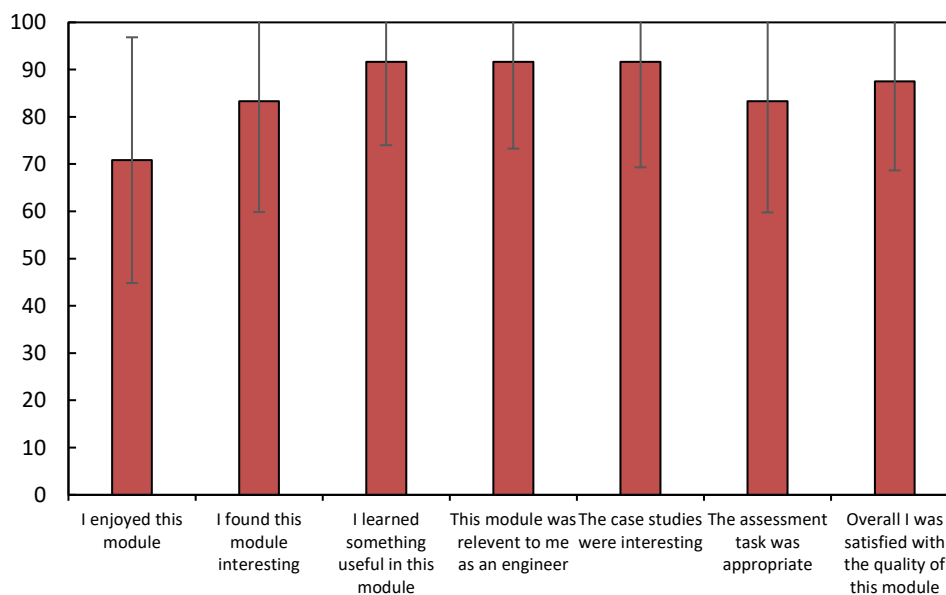


Figure 5 – Module assessment questions

Students commented on the module's improvement by suggesting engagement with staff members, especially for case studies. The comments show that they would like to discuss and engage more regarding this topic with academics and other peers. They would have also preferred a real case scenario in the module to allow practicing applications of integrity principles. Although some of the questions in the final quiz were scenario-based, perhaps including them within a scenario as knowledge check within the content would be a better way moving forward. Some students also found it frustrating to navigate through the module due to the nature of its integration in the learning management system among a few other technical difficulties.

Peer-review and evaluation

Each peer-review emphasised the importance of this initiative. The reviewers were pleased that the initiative was taken at an undergraduate level and pointed out that students would benefit from the module.

Content of the module

The reviewers' comments reveal that the content is at a proper level, however, it can be further extended to include more detail. A separation of learning tools and learning checks style questions were suggested to be separated and the use of learning tools using H5P within the content was suggested. Another point of improvement suggested was that although each tab of the accordion had to be expanded once, it was possible to go through it without actively engaging with the content. This problem could be solved using the next tab being locked behind a learning tool type question. The use of guided/structured scenarios could be helpful.

Some of the other comments around the content of the module included more detail on the AI section, and perhaps scenarios to enforce these (e.g., use of AI for experimental design?). The most important point raised was about the privacy and security of content and specifically the agreements with any specific AI that the university has.

Presentation of the module

The structure of the content was deemed to be clear, appropriate and engaging; however, the AI section could do with more structure to allow better knowledge transfer. Improvement in reflection opportunities through guided scenarios was suggested. Another improvement suggested was to ensure definitions and explanations were differentiated. The use of different media like videos and/or podcasts was suggested in the presentation of the module.

Limitations

The module was designed with a specific cohort in mind – the lack of animal ethics and human ethics for example is missing because it is not relevant to the engineering cohort at UNSW Canberra. For other schools that actually do have biomedical engineering and other research that involves human ethics, should include it in their module. The module at this point of time is designed using the current code of research integrity and needs to be updated every time the code of integrity changes as the rules for integrity can be dynamic in nature. It is also not possible to track student behaviour during their honours' project beyond reported serious breaches of integrity and in the future during their professional lives. We also suggest conducting a longitudinal study on the module and see how it is perceived by different cohorts and their attitudes. The study also does not collect or assess data on the AI component of the module.

Recommendations

Based on the student feedback and peer-review, we recommend the following points in order to integrate research integrity in the undergraduate engineering curriculum –

- a. Ensure all principles of research integrity in the Australian Code for Responsible Conduct of Research (2018) are covered, and examples for each are provided for students.
- b. Do not rely solely on the Australian Code for Responsible Conduct of Research (2018). Use the university's own code of research conduct wherever necessary as each university expands upon the Australian Code for Responsible Code of Conduct.
- c. Wherever necessary, include animal and human ethics in the module. In UNSW Canberra's case, almost no undergraduate engineering student is involved in human/animal research, hence, this content was excluded. However, at larger universities, it is essential that these points are covered. Perhaps a supplementary non-mandatory module on human/animal ethics wherever necessary. This could easily be used for other STEM degrees/disciplines that include animal/human trials.
- d. Involve research integrity advisors and AI advisors of the faculty/university, possibly academics working in ethics and other stakeholders in forming the content of the module.
- e. Use interactive elements like H5P to create guided scenarios as learning tools within the content.
- f. AI and its ethical use need to be a staple in research integrity training as AI has become a non-trivial part of research, and its importance will only keep increasing.

Conclusion

This study shows an example of embedding research integrity in the undergraduate engineering curriculum. The study demonstrates that the current module for research integrity at UNSW Canberra covers the basics of research integrity expected from graduate engineers as per the integrity pillar of the Engineers Australia Code of Ethics and Professional Conduct. While the module achieves its outcomes and is engaging, further development and improvement of the module needs to happen and will be included in its second iteration through more detailed content, better opportunities for reflection and engagement through guided scenarios using tools like H5P.

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