Can Engineering Students Enjoy Learning Ethics? Using Student-led Seminars to Teach Professional Responsibility

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ABSTRACT

CONTEXT

Developing professional skills is an essential but challenging part of engineering education, with industry, government, and professional bodies still indicating a deficiency among graduates. This paper presents an innovative approach to teaching ethics, occupational health and safety, and information management, which we have grouped under the term Professional Responsibility. The approach has taken the form of a series of student-led seminars conducted within an internship subject.

GOAL

In 2021, the Faculty of Engineering and IT at the University of Melbourne undertook a study to better understand the student experience, resulting in a comprehensive review of the faculty's internship subject. This review led to the creation of a new assessment to support the development of Professional Responsibility. The assessment has been designed to engage students by using student-led learning and situating the content in the students' own experiences.

APPROACH

This paper reports on the design and development of a new student-led seminar presentation, including the justifications underlying the design decisions made. Refinements are also presented based on the experiences, observations and anecdotal evidence of academics involved in developing and facilitating the seminar presentations. It reports on the initial insights gained in implementing this innovative student-led teaching method and provides scope for future research and implementation.

OUTCOMES

Initial outcomes and observations over three semesters suggest a good level of student engagement with the assessment and an acceptable level of development of Professional Responsibility amongst the students. Additional benefits include an enhanced cohort experience and the opportunity to practice communication skills.

CONCLUSIONS

Experiences from three iterations suggest that the student-led seminar presentation format, particularly when combined with Work Integrated Learning, is an effective model for developing Professional Responsibility and sets the foundation for more comprehensive research.

KEYWORDS

Student-led learning; work integrated learning; professional skills; ethics; occupational health and safety; information management.

Introduction

Professional skills are part of the core competencies required of engineers (Engineers Australia, 2017) but can be difficult to teach (Carew & Therese, 2007; Freedman et al., 1994; Henderson et al., 2019). While there are many challenges, one significant concern is the ability to embed the teaching of professional skills within the discipline (Barrie, 2006). This paper presents a model for teaching ethics, information management, and occupational health and safety that situates the learning within the student experience, places the responsibility for learning on the students, and enables communication skill development in an authentic environment.

The presented model uses a student-led seminar, a novel approach within engineering education although more common in other disciplines. This seminar is implemented within the Engineering and IT Internship subject (ENGR90033) at the University of Melbourne, which requires students to complete 320 hours of industry placement and consists of Engineering, Information Technology and Information Systems postgraduate coursework students.

Recognising the requirements of both industry and students, the subject is offered as part-time or full-time and may be paid or unpaid. It is offered in semesters 1 and 2 and over the summer with local and international placements. The subject's focus is the internship experience, with the subject learning and assessment tasks designed to maximise the benefits students gain from completing their placement. Each student is allocated an industry supervisor for the technical components of their placement and an academic mentor to support their well-being and assist them in their academic and professional skill development. Upon completing the subject, students receive a pass or fail without a mark, recognising that the primary learning and time commitment (80%) of the subject occurs while on placement. This allows students to focus on maximising their learning without the pressure of maximising their marks.

The subject is structured to support students to (1) navigate their placement (well-being), (2) plan, reflect, and develop their professional skills, and (3) prepare for future employment using their placement experiences. **Figure 1** illustrates how each assessment task builds on previous ones to meet these three key aims. In the Initial Reflection, Students are guided on the key elements of reflective writing, the use of literature and theory, and professional competency. They then apply this learning periodically across three engagement reports and are then supported to build upon it to inform their presentations and their final report.
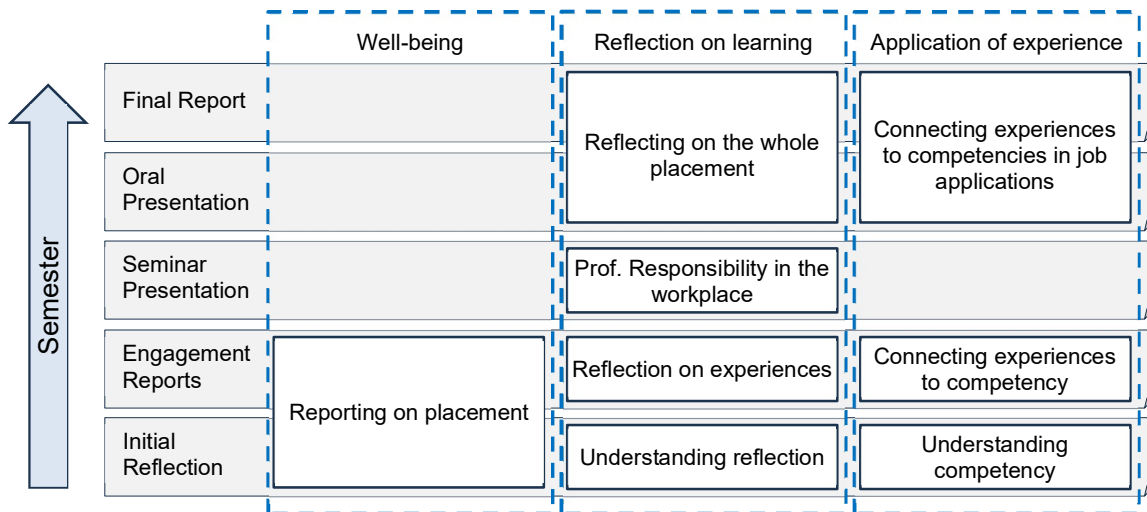

Figure 1: How the assessment tasks meet the subject's key purposes

In 2021, the Faculty of Engineering and IT at the University of Melbourne conducted a project to improve the student experience within the faculty, with one recommendation being a comprehensive review of the subject ENGR90033: Internship. The recommended review's scope included the subject's design, assessments, stakeholder management, and the overall student experience. Some of the key outcomes were:

1. That the subject teaches ethics, information management, and occupational health and safety (OHS).
2. That the subject provides a greater opportunity for students to connect with their cohort.
3. That students should share their experiences with each other.

To achieve these outcomes, a new assessment was introduced in the form of a seminar presentation on Professional Responsibility, a term used to recognise the professional role of ethics, occupational health and safety and information management. The seminar presentation aims to allow students to learn about an aspect of Professional Responsibility and then share this learning with their peers, potentially incorporating their own placement experiences.

Background: Developing Professional Skills

Despite the importance of professional skills for engineers, many problems are associated with developing them within engineering education. Some common issues are that they are often viewed as separate from the core discipline skills (Barrie, 2006), they can be resource-intensive to teach and assess compared to traditional technical skills (Carew & Therese, 2007), program implementation is often performed in isolation (Carew & Therese, 2007), there are limitations on the effectiveness of classroom activities to teach professional skills (Freedman et al., 1994), and there can be a lack of expertise in teaching professional skills among faculty (Henderson et al., 2019).

These problems can have direct implications on the learning experience. For example, viewing professional skills as complementary to the core knowledge (Barrie, 2006) can colour students' perceptions, reducing their willingness to engage with the materials and activities generally. Further, the increased time and effort needed to teach and assess professional skills, the reliance on individuals for implementation, and the general lack of specialised expertise can result in a lack of support for students and superficial teaching methods.

To help address these problems, literature suggests several practices. To counter the view that professional skills are complementary, it is recommended that they be developed within the discipline content (Falkner, 2012). Another recommendation is that both students and staff need resources dedicated to support them (Goldsmith & Willey, 2018). An important concept when developing professional skills is "authenticity", which is aligning student learning tasks with industry practice (Hollis-Turner & Scholtz, 2010). This can take several forms, such as "text authenticity", which uses activities and artifacts from industry (MacDonald et al., 2000), and "task authenticity", which aligns the purpose of completing a task with that of an industry setting (Badger & MacDonald, 2010). Work Integrated Learning (WIL) focuses on adding authenticity to learning and is widely recognised as an effective method of developing professional skills (Patrick et al., 2008). WIL is also considered to motivate students to engage with their learning and to help them link the theory they learn with practice (Patrick et al., 2008).

Student-led learning, a style that emphasises a student's self-direction and creativity (as opposed to the more traditional lecture/tutorial approach to education) is another practice for developing professional skills (Adler et al., 2004; Purkarthofer & Mantysalo, 2022) and extends the concept of student-centred learning which is based on the premise that students have an underlying foundation of understanding. Student-led learning provides the opportunity for students to direct how the learning will occur through a combination of content material, exploration, questioning, lived experience and other engagement activities. In student-led learning, students will typically take greater responsibility for the learning that happens (Purkarthofer & Mantysalo, 2022). A significant perceived benefit of student-led learning is that it can transform students from passive

learners to self-directed ones. For example, a study by Adler et al. (2004) into case studies concludes that it is not the type of activity that drives the learning but the approach to learning. That is, 'how' the case study is used and, more importantly, 'who' is responsible for leading the case.

Although student-led learning is not a novel concept in education, being used in disciplines such as the arts, communication and accounting, it is atypical in engineering education, particularly in this form. Where student-led learning is used in engineering education, it generally takes the form of student-led problem-solving classes in which students support other students to complete engineering problems set by staff. These activities appear under names such as Peer-Led Team Learning (Mottley & Roth, 2013), Student-Led Tutorials (Serra et al., 2023) and Peer Assisted Study Sessions (Beaumont et al., 2012). The seminar presentation model presented in this paper is novel as it is combined with WIL, the focus is professional skills, students are provided almost complete control over the design and execution of the learning activity, and they are able to centre the activity on their own experiences. This creates an environment where students can engage in the development of their professional skills with agency, responsibility and authenticity.

Objectives: Design Considerations

The primary recommendation of the subject review was that students be taught Professional Responsibility; ethics, information management and occupational health and safety. As discussed, the literature indicates that professional skills are best developed by:

- Teaching them within the discipline content,
- Incorporating task authenticity,
- Providing students with agency,
- Allowing students to incorporate their own experience, and
- Managing the potential lack of specialised expertise in students and staff with support.

In consideration of this guidance, while the review had three key recommendations, in practice, the recommendations of helping students connect more with their peers and share their experiences can naturally be incorporated into achieving the first recommendation by developing an interactive student-led group activity.

The practical implementation of the literature's guidance is shaped by the context of students completing internships. Teaching Professional Responsibility within the discipline content in an internship subject means linking the activity to events that occur during the students' placements. This also relates to allowing students to incorporate their own experience, and if students choose how to incorporate this experience, it can provide them with agency within their learning. Task authenticity means providing students with practical goals such that they do not just repeat what has happened within their placement but use the experience as a basis for achieving an outcome. Supporting students and staff means providing scaffolding that will cover the basics of Professional Responsibility and form a foundation on which further learning can be built. In addition to this, it means creating a safe environment where students can share their experiences. To manage the different levels of student expertise requires some redundancy and repetition to ensure that, when students lack capability in leading learning, other opportunities will be available.

Based on these considerations, the following requirements guided the activity's design:

1. Cohort: The activity should bring students together to interact with each other.
2. Repetition: Students should have multiple opportunities to hear from others.
3. Relevance: The activity should allow students to incorporate their internship experiences.
4. Agency: Students should have control over and responsibility for the activity.

5. Authenticity: The activity should have a real purpose and require meaningful interactions.
6. Supported: Students should feel supported and safe in exploring and sharing their ideas.

Two other requirements were needed for administrative purposes:

7. Workload: As students could be working full-time at their internship, the activity time commitment needs to be modest.
8. Format: Students may be based internationally, so it should be possible to conduct the activity both in-person and online.

The outcome was that, at its core, the assessment is a presentation followed by a group activity, a format conceptually familiar to students but significantly different in execution.

Method: Implementation

The implementation of the assessment is effectively a 4-hour seminar covering all three topics of Professional Responsibility. To accommodate all the students enrolled in the subject, it is repeated multiple times although each student only attends a single seminar in which they both present and participate. Each seminar has one to three streams of approximately 12 students to ensure small group sizes.

The seminars use a student-led approach that places the responsibility for learning on the students; they research the topic, develop the presentation and then design the activity for their peers. The activity is a practical application of the theory being learnt. This structure brings students together to meet the Cohort requirement while requiring students to conduct the teaching and design the activity, provides them with Agency. As students need to teach their topic to a level such that their peers can successfully complete an associated activity, their presentation has a practical purpose that introduces Task Authenticity.

The presentation and subsequent activity are limited to 10 minutes and 15 minutes, respectively, and repeated with different presenters so that a seminar stream typically consists of 6 cycles of presentations and activities, two for each topic. This format addresses the need for Repetition ensuring that students have the opportunity to hear from several peers as well as other participants. To build a safe and supportive environment, students present and run the activity as part of a pair. Students sign up for their seminar and subtopic, automatically being partnered with whoever signs up for the same subtopic and seminar, although they can choose their own partner by coordinating the session they sign up for.

Combining the small group size, the use of paired presenters, and the consistency of having the same group of students throughout the seminar (all of whom are presenting and participating) helps to meet the requirement of a Supported activity. Preparation modules are provided to further help meet this need and are also used by staff to ensure a consistent basis of understanding.

The seminar consists of four sessions, each of which is approximately 50 minutes to allow for breaks. The first session is a brief introduction to the seminar followed by 45 minutes for students to finalise their presentations. The remaining three sessions are devoted to a single Professional Responsibility topic, each consisting of two sets of presentations and activities. Online seminars are split into two 2-hour sessions in consideration of the mental load of online interactions. The seminar format is illustrated in **Figure 2**.

| Finalise presentations | → | Topic 1 OHS | → | Topic 2 Ethics | → | Topic 3 Info. Man. |

Figure 2: Presentation Seminar format

The three main topics are split into two subtopics, allowing for some breadth and Repetition without excessive redundancy. The activities are prescribed for each subtopic in recognition of

the possible inexperience of students in Professional Responsibility, as well as in designing and conducting activities. Even so, there is flexibility within the prescribed activity so that students can incorporate their own placement experience, meeting the requirement of Relevance.

The subtopics and activities are:

1. Occupational Health and Safety (OHS)
   1. **Risk and Control**. Students analyse and discuss a work task.
   2. **Safety Culture**. Students discuss safety culture within their workplaces.
2. Ethics
   1. **Ethical Decision Making**. Students apply an ethical framework to a case study.
   2. **Codes of Ethics**. Students apply an ethical framework to a case study in the context of a professional Code of Ethics.
3. Information Management
   1. **Data Quality**. Students analyse an article using the dimensions of data quality.
   2. **Information Lifecycle**. Students discuss the information lifecycle practices they have experienced.

A range of styles of activity were chosen to help maintain interest and allow students to share their experiences in different ways. Some activities allow for a deep investigation into a single experience, while the discussions enable participants to all briefly share their own experiences. For example, for the Ethical Decision Making subtopic, students present an ethical framework for decision making, provide a case study and then guide the group in applying the framework to the case study. As students only participate in each subtopic and activity once, it is possible to provide significant scaffolding and direction without unnecessarily exposing them to the same content. Therefore, while students are encouraged to use a case study created from their own experiences, they could also be provided with a library of case studies that would help those few students who had not encountered a Professional Responsibility experience in their placement. **Figure 3** illustrates the format of a topic session.
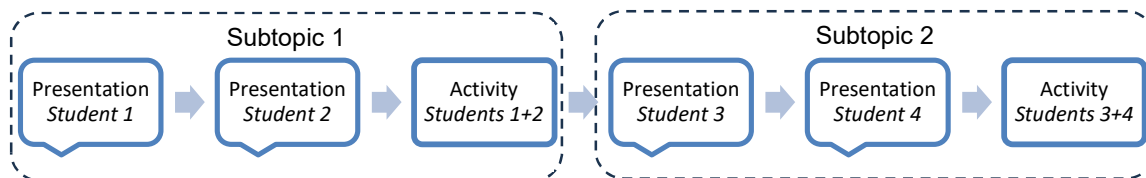

Figure 3: Single topic session format

The seminar presentations are assessed by both a staff member and the student audience. The staff assessor assesses the design (10%), delivery (10%) and content (40%) of the student's presentation, as well as the student's engagement as an audience member (20%). The student audience also assesses the student presenter (20%) on the understanding they demonstrate, the learning gained, and the presenter's effort to engage the audience. In consideration of the potential inexperience of students with both the topics and the format, and to reduce the focus on marks, the assessments were deliberately weighted to be generous, with a modest level of achievement resulting in a mark of approximately 70%.

Students are provided online preparation modules for the three main topics, which take approximately 15 minutes each to complete. These modules ensure a minimum level of depth for each topic and subtopic and a degree of consistency in the quality of information each student accesses. Students can work through the resources independently and then utilise this information to plan and prepare their presentation and engagement activity. These modules draw on various sources but have been designed with an industry focus and include resources provided by government and professional bodies. While students are expected to complete all three modules, typically, only the module of the topic that they will present is expected to be reviewed in depth.

Results: The Seminar in Practice

This section of the paper reports on the experiences, observations and anecdotal evidence of the academics involved in developing and facilitating the assessment with respect to the goals and design of the seminar presentation. In particular, how these goals were achieved and how the identified design requirements (Cohort, Repetition, Relevance, Agency, Authenticity, Supported, Workload and Format) were incorporated.

Of the eight requirements that guided the design of the activity, the first two, Cohort and Repetition, related to the inherent structure of the activity. Observation of student interest and engagement prior to (based on the level of preparation) and within the seminar sessions supports the view that students invested in connecting with their peers and appreciated the exposure to the experiences shared. In post-seminar meetings with their academic mentors, students also indicated how much they enjoyed learning from each other.

Although these observations also indicated that students perceived the seminar subtopics and activities as generally relevant to the range of disciplines represented in the student cohort, it became clear that some sessions involved more enthusiastic group discussion and debate than others. In the initial implementation, the order was OHS, ethics and then information management and, even though student engagement was high for the first two topics, it waned with the third. While it could not be definitively determined whether this was due to the nature of information management or its position as the last topic, the order was changed, and one subtopic was removed from each seminar. Ethics became the last topic to be presented for the second and later implementations, coming after information management. The subtopic removed varied between seminars such that the subtopics were represented approximately equally across all the seminars. Observations in later semesters suggest that this combination of changes has had the desired effect of helping students engage across the full seminar, with the reduction in subtopic sessions being a reasonable compromise between opportunities to hear from other students and managing the cognitive load for both students and staff.

The third and fourth design requirements, Relevance and Agency, aimed to allow students to incorporate their internship experiences and allow them to do so in a way of their choosing. The student-led learning approach was used as it encourages engagement through the flexibility built into the activities, allowing students to interpret and share their own lived experiences as both activity coordinators and participants. These design requirements were incorporated by giving students the choice of which subtopic to address and by also providing students with some control over how they did so. As students only addressed a single topic, it was observed that they tended to focus on the one their experience was potentially best suited to. There was a sense that the topic students selected was often correlated with their discipline so that they could use situations from their own experience; for example, infrastructure and mechanical engineering students seemed to select OHS more often, biomedical students preferred ethics, and information management was popular among Information Technology students.

Authenticity was achieved by requiring the audience to use the information being communicated and incorporating student review in the assessment. Discussions with students indicated that they had found facilitating the activity, in particular, to be a new and challenging experience. While the length of the seminar (4 hours) was recognised as a potential risk to student engagement, the combination of information delivery followed by a learning activity was effective, with students expressing surprise to staff at how quickly the sessions went and how interesting they found each other's presentations and activities. Some students even expressed to staff that despite their low expectations going into the seminar, they had been surprised to find it to be enjoyable once it had started.

To ensure that students were Supported, they were provided with preparation modules and presented in pairs. As the online preparation modules were the primary source of information for the seminars, the successful execution of the presentations and activities combined with a lack of questions or complaints about them suggests that students found these resources to be an effective foundation for their learning and teaching. It was observed, though, that students who chose to use the sample case studies provided to them often lacked sufficient experience to moderate the content presented to their audience. After the initial implementation, students were provided extra guidance on being selective in the information they included in their session, largely resolving the issue.

Having students present in pairs was considered both a benefit and a concern. While it would provide support to students during the seminar itself, there was also the risk of an imbalance in how students allocated and completed the required work between them. To manage this risk, students were encouraged to meet before the seminar, where possible, and required to submit a draft of their presentation for validation of their contribution. In addition, the workshop was designed so that students could finalise their presentations and activities with their partners during the seminar's first session. These measures appear to have been effective, with students generally being satisfied with their partnerships. Observations and student feedback also suggest that the multi-faceted approach to marking (with both staff and student elements, as well as pair and individual marks) helped to address issues of fairness and equity between partners.

The Workload for students also seems to be reasonable, although more information needs to be collected to be confident of this. The bulk of the information required by students to complete the seminar is contained within the short online modules, leaving their main task to be the creation of the presentation and the development of the activity. This is then shared between two students with some time allocated to finalising the task during the seminar itself.

The final design requirement was the need to be able to conduct the seminar in both in-person and online Formats. The primary difference between the two modes was that the online format was conducted as two 2-hour sessions. In execution, this was considered a necessary variation for both students and staff, although lower engagement levels were apparent in the online modality. Even so, observations made by academics assessing the sessions through listening to students engage with each other during the experiential learning activities suggest that the desired learning outcomes were generally achieved in both groups.

Conclusion

The seminar presentation, as a combination of Work Integrated Learning and student-led learning, appears to have been highly successful. It has transformed learning topics that can often be viewed as an adjunct to core engineering skills into a highly enjoyable and engaging activity. In addition to an expressed level of enjoyment with the seminar, students were pleasantly surprised and buoyed by the level of participation from other students during the sharing of information and, more importantly, during the ensuing engagement activities and student-led discussions. Overall, students have engaged deeply in learning one of the areas of Professional Responsibility to the point where they can teach it to others and have been moderately engaged with the remaining two. They have had multiple opportunities to share their experiences both as a presenter and as a participant and repeatedly heard about the experiences of others in their cohort. It is these opportunities to hear from their peers that have elevated the activity in the eyes of the students. Further to these goals, the seminars have provided students with a rare opportunity to communicate authentically and engage with their audience and material in a new and interesting way. While student feedback and academic observations have provided valuable insights and helped shape the task since the first iteration, formal and more comprehensive data collection and research will be undertaken during future semesters to more robustly analyse and understand the effectiveness of the task and its impact on student outcomes. In the meantime, the student-led seminar presentation appears to be an effective and valuable tool for developing Professional Responsibility.

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