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Students as partners developing engineering professional practice learning resources in a post-COVID environment

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ABSTRACT

CONTEXT

At the university where this research is being conducted current engineering students were invited through a professional practice placement program to partner with the Industry Engagement team and industry practitioners to co-design learning experiences.

PURPOSE

The purpose of our professional practice placement program is two-fold: 1) to generate career education opportunities for students 2) to produce and integrate engaging authentic professional practice resources with input from students and industry practitioners. Our student instructional designers, employed through the university placement program, collected the perspectives of industry practitioners to distil key messages informing the development of future resources. This paper showcases this partnership and evaluates how first year students engaged with the resources produced by a Student Instructional Designer to develop an understanding of social responsibility – a key professional practice pillar promoted for graduate employability. It also captures the teaching teams perspectives on the usefulness of these resources for supporting student learning and development of practice perspectives.

APPROACH

This research uses a mixed method approach for data collection and analysis for evaluating the learning resources developed for teaching 'Social Responsibility' – a key engineering practice skill. The student instructional designer involved in the development of learning resources collected and analysed the responses of students and the teaching team using a survey instrument to unpack the value of these resources in developing first year students' awareness of the concept of social responsibility for professional practice.

ACTUAL OUTCOMES

Learning resources produced influenced engineering students' awareness of social responsibility. The teaching team reported positive student engagement with real-world examples and insights sourced from practicing engineers. The perspective transformation of the student instructional designers and the industry engagement team as seen through reflection serves to influence the use of students and industry practitioners as "partners" in resource development. Student feedback on the resources also provides opportunities for improvements of professional practice integration into core curricula.

CONCLUSIONS/RECOMMENDATIONS

We anticipate that this research will shed light on how university-industry partnership can be extended to develop authentic learning resources around professional practice. Further work is needed to capture and analyse the reflections and learnings of all stakeholders to understand how and when perspective transformations occur, to strengthen curriculum integration work.

KEYWORDS

Students as partners, professional practice, Social Responsibility, Engineering in Society

Introduction

Employability is described as a set of understanding and capabilities that equips graduates to excel in their chosen careers and contribute to the communities in which they operate (Dacre Pool & Sewell, 2007). Within the engineering community 'Social Responsibility' is a key pillar of professional practice, and an understanding of it supports the credibility and reliability of every engineer (Canney & Bielefeldt, 2015). Concerns for safety, ethics and sustainability are often associated with an engineer's responsibility towards the society (Angela R Bielefeldt, 2018). From personal experiences and those recounted second-hand, this engineering practice principle often goes overlooked in tertiary engineering education despite its importance (Smith, Smith, Battalora, & Teschner, 2018). Generally treated as an assumed knowledge, this area of practice is rarely covered explicitly in the core curriculum (Zandvoort, 2008).

Within an outcomes-based higher education context, learning design is frequently associated with what students must demonstrate upon successful completion of a degree course (Biggs & Tang, 2011). Learning opportunities within units of study (or subjects) are intentionally designed to allow students to develop, practice and apply knowledge and skills and receive feedback for improvement (Cooper & Krishnan, 2020). Often students are asked to provide feedback on the design of learning and their achievement through institutional surveys designed to capture student satisfaction (Nair, Adams, & Mertova, 2008). A question that is frequently asked of students is: how we feel the learning resources helped us achieve the learning outcomes. While it is an important question about relevance to assessment tasks, often it stops short of seeking information from students about the relevance of learning resources provided for their future professional practice.

Many students and graduates struggle with the notions of safety and sustainability in the workplace and the roles engineers play in society (Trevelyan, 2019), alongside the prominence of professional ethics. If engineering education is premised on preparing students for practice, then it is pertinent to design learning resources that is comprised of examples from practice. Engineering students need to be directly taught about their social responsibility and learning resources should be developed to accommodate this need with insight from practicing engineers.

While seeking student perspectives imply that higher education institutions are concerned about student development and welfare, there are ways in which students can partner with academic staff to improve the quality of learning resources (Healey, Flint, & Harrington, 2014). This paper showcases one such partnership between students, academic staff and industry practitioners and evaluated the learning resources developed by a Student Instructional Designer for a first-year unit of study, "Engineering in Society" offered at Deakin University in Australia, from both the perspectives of students and teaching staff.

Current undergraduate and postgraduate engineering students at Deakin University in Australia were recruited as Student Instructional Designers in the "Partners in Learning" program. The purpose of this professional practice internship / placement program is two-fold: 1) to generate career education opportunities for students 2) to produce and integrate engaging authentic professional practice resources into the core curricula with input from students and industry practitioners. Within this program, students, academic staff and industry practitioners participated in a collaborative, reciprocal process and contributed directly, although not in the same way, to conceptualise, design and implement online learning resources to provide students an opportunity to self-learn outside of class hours preparing them for the content ahead (Pons, 2016).

Student partners used interviews to seek input from various engineering practitioners and gathered real-world examples around their concerns for ethics, safety and sustainability and their overall responsibility as an engineer in the society (Matthews et al., 2019). Student partners analysed the interviews to develop a set of key learnings around social responsibility from reoccurring themes, case studies, and professional practice skills useful to students (Pons, 2016).

These learnings were curated into text and video-based social responsibility learning resources by a Student Instructional Designer (the corresponding author) with examples from practice focussing on firsthand accounts to guide the direction of student-led learning. A series of video resources,

focusing on safety, ethics, and sustainability, were produced by making use of the appeal of animation to engage students with case studies from industry partners. The intent of these video resources along with supporting text-based resources was to generate an awareness of the 'Social Responsibility' of engineers early in the unit (Zandvoort, VanDePoel, & Brumsen, 2000).

The research reported in this paper is concerned with evaluating the impact of learning resources produced through students and industry practitioners as partners. Our intention was to find what students found interesting and engaging about the learning resources, what they found challenging and difficult to understand and what they now knew about an engineer's social responsibility that they did not know prior. We also wanted to explore the teaching team's view on the usefulness of the student-led learning resources that were produced for inclusion in the first-year unit of study. The next section presents the methodology that was used for data collection and analysis, the subsequent section reports the findings from student and academic staff surveys and the final section discussed the findings and its implication for practice in terms of strengthening learning partnerships to inspire, motivate and engage students in learning about engineering practice.

Methodology

In the second half of 2022, students who studied the first-year unit of study "Engineering in Society" were invited to participate in a short survey that elicited both quantitative and qualitative responses to the following research questions:

1. What did you find interesting or engaging about the social responsibility learning resources? and why?
2. What did you find challenging to understand from the social responsibility learning resources? and why?
3. What do you know now about social responsibility that you did not know before?

The student survey instrument utilised 12 questions seeking a variety of responses including written responses, multiple choice, multiple answers, sliders, and categorisation to ensure a balance between these alternative response methods to maximise the number of completed submissions. Questions were developed to check students' current understandings, recent learnings, engagement, and feedback to validate written responses provided for the three key research questions above, as well as to allow the researchers to confidently answer the key research questions posed from the student's perspectives.

The survey instrument for the teaching team focused on qualitative responses about how useful they found the resources, how well they aligned with the learning outcomes of the unit, and what they thought could be improved regarding the materials. No incentive was provided to students or staff to complete these surveys. Staff were asked to comment on the following questions:

1. For supporting student learning, how useful did you find the Engineering Social Responsibility learning resources? and why?
2. Please provide us your perspective on the alignment of the Engineering Social Responsibility learning resources with the unit learning outcomes and assessment.
3. How could the learning resources be improved to better support you and learners to explore the concept of Engineering Social Responsibility?

With appropriate ethical clearance in place, both staff and student surveys were administered via Qualtrics research survey tool. No personal information about the students or the teaching team were collected in this study to ensure anonymous participation. Results from the survey was analysed and descriptive statistics and analytical visualisation of data was prepared. These results are presented in the next section.

Outcomes

Findings from the student survey

Of the 200 students enrolled to study “Engineering in Society” at Deakin University, 17 students participated in this survey. Four student responses were omitted from this study as they were incomplete. All three members of the teaching team participated in study, two responded to the survey and one is a co-author of this paper. The results of the student survey are presented first. Analysis of student responses to the survey are categorised and presented as key themes emerging from their responses.

Social Responsibility in Engineering

As indicated in Figure 1, most student respondents identified all the statements as relating to social responsibility in engineering. The remaining responses were evenly split across the rest for those who didn’t select “all of the above”.

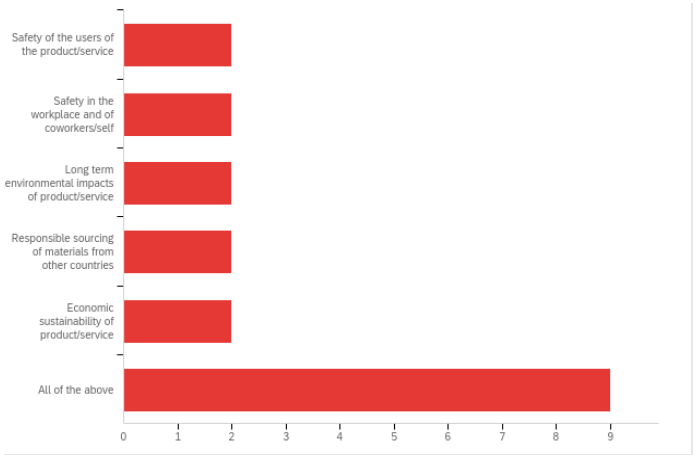

Figure 1: Q3 - Which of the following statements represent the social responsibility of engineers? (Multiple can be selected)

Ethics in Engineering

Most student respondents shared the same view (see Figure 2) regarding professional ethics, with only some incorrectly identifying the “work satisfactorily” option as belonging to professional ethics. “Practice competently” received more responses than “demonstrate integrity” despite it not belonging to professional ethics.

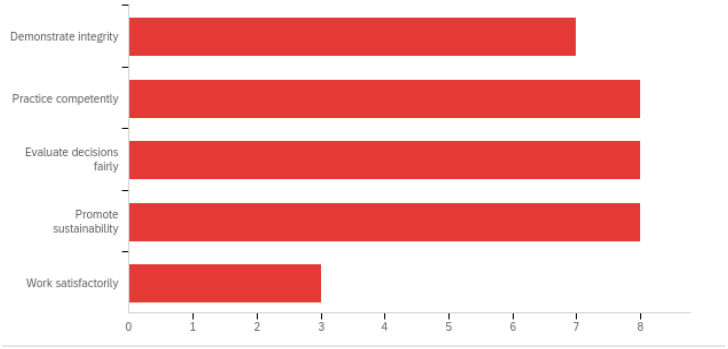

Figure 2: Q4 - Which of the following statements are describing an aspect of professional ethics and not personal morals? (Multiple can be selected)

Corporate Social Responsibility and Social License

Only a minority of student respondents correctly identified “Consideration” (see Figure 3) as not being a key component of social license, despite this being addressed in the learning resources. All students recognised “Legitimacy” as a key component of social license.

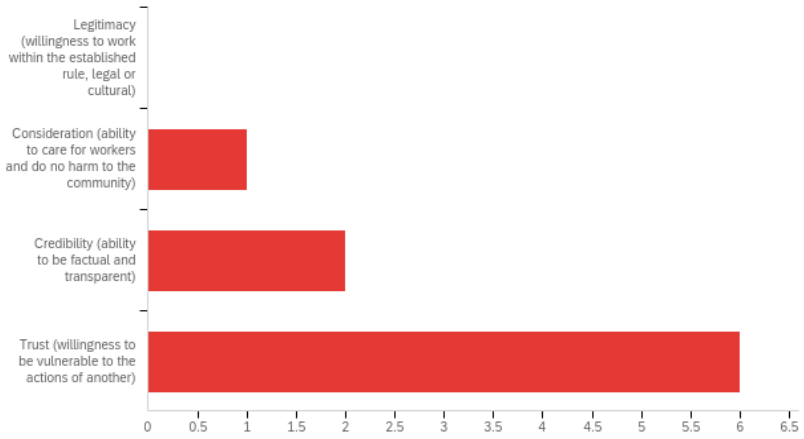

Figure 3: Q5 - Which of the following is not a key component of developing and maintaining a social license?

Safety in Engineering

Most student respondents mixed up risks and hazards, with many selections made incorrectly, though this is noted to be a slim majority.

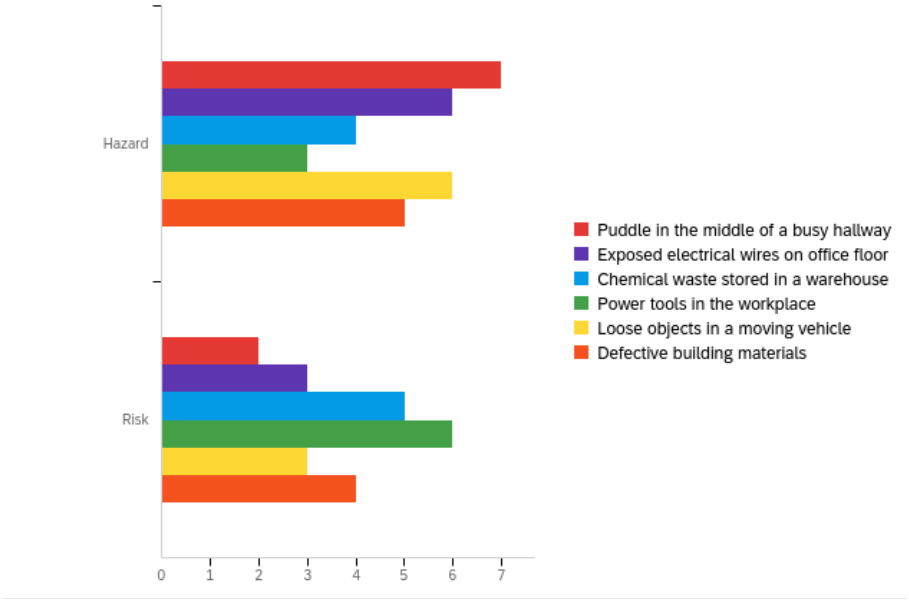

Figure 4: Q6 - Categorise the following items as either a risk or a hazard using your learnings from the video resources

Sustainability in Engineering

Student respondents recognised that most of the statements came under sustainability in engineering practice, with “All of the Above” receiving the highest number of selections alongside “Minimising the impact… on the environment”. When not selecting “All of the Above” most students did not recognise data storage as being a part of sustainability.

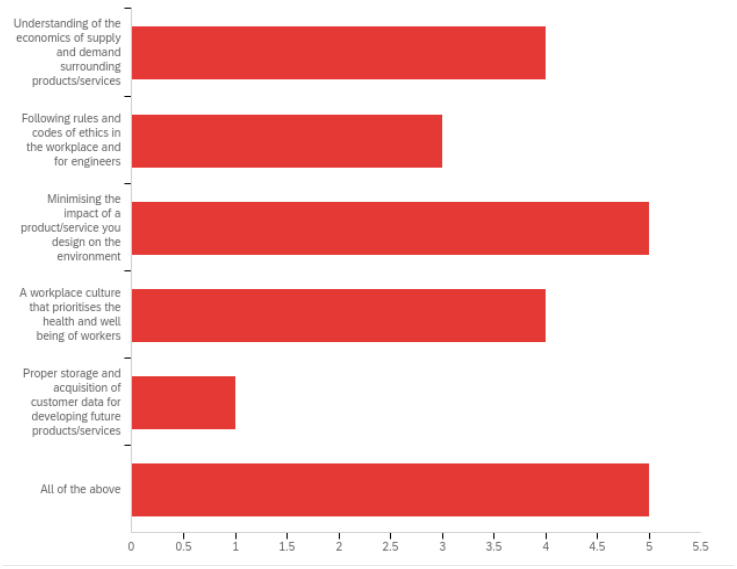

Figure 5: Q7 - Which of the following statements represent sustainability in engineering practice? (Multiple can be selected)

Student Engagement

Student respondents rated the video resources as more engaging when compared to the text-based reading materials provided. The use of video resources in a facilitated studio environment delivered on-campus and online scored the highest for engagement.

Table 1: Q8 - How engaging did you find the social responsibility learning resources presented in SEJ104 - Engineering in Society? (0 - not engaging at all, 10 - very engaging)

Field	Minimum	Maximum	Mean	Std Deviation	Variance
Videos	4.00	10.00	8.00	1.94	3.75
Reading Material	0.00	10.00	6.75	2.90	8.44
Additional Reading/Links	0.00	10.00	6.38	2.87	8.23
SEJ104 Week 02 Studio	6.00	10.00	8.50	1.41	2.00

Findings from the teaching team survey

Supporting Student Learning

Learning resources were overall received positively by the two teaching team members who responded to the survey. They commented about the usefulness of these resources in studio sessions and how the resources could be improved to promote student engagement.

Table 22: Q3 - For supporting student learning, how useful did you find the Engineering Social Responsibility learning resources? and why?

	Response
1	They were great. I like them, as a resource and I think the students would like them as a resource to read through and watch the videos which are great, but we probably need [a case study] at the tail end of those. A case study within the class, so they could review a case study and then they discuss it. I think that would work really well, that's what I found with it, because it was really good as informative notes. I liked it a lot because the resources

	were very clean. Summary: I think that would be better, as a pre seminar. Where they could actually watch it or pre studio and then we do some active learning within it like a case study.
2	The resources were very clear, straightforward, and engaging. Our students watched the short videos before the discussion in class - both the videos and the text on the unit site provided a good starting point for a discussion where students shared their past experiences and provided suggestions for how to solve the issues in the scenarios they provided or improve the situation they found themselves in personally or professionally.

Alignment with Learning Outcomes

The resources had a mixed reception regarding unit learning outcomes. They were noted to align with the "social aspect of the unit", but there was difficulty for students in converting learnings from the resources into unit assessments. For example: *"The problem with the assessment was they were struggling to link their understanding of each part of the Olympic games [students were tasked with developing concepts for a sustainable Olympic Village] with each one of these [topics]. What might be good is if we gave them examples of it, and then they think of other examples, but that would have to be within the assessment resources."*

Suggested Improvements

The main improvement that staff suggested for the resources was to include the use of specific case studies to provide examples for students to work with and use to initiate class conversations. Another member of staff suggested that *"The Indigenous aspect could be improved, or better say developed further to align with the level of experience students have and build from there… Also, this part could also include other global cultural aspects".*

Discussion

Seventeen out of 200 students who were enrolled to study the unit and two teaching team members of the unit of study responded to the surveys. While student responses may not be statistically significant enough to determine broad generalisations about the impact of the resources on student learning, we believe the data collected provides enough insight to give a representation of student conceptions of their 'Social Responsibility' as emerging. Lower than anticipated number of responses limited the scope of the study, however inferences made are validated through qualitative analysis of responses from the teaching team. Student understanding of risks and hazards proved to be a topic of difficulty even after using the developed learning resources, with many incorrect responses (Figure 4). Similarly, responses to the social license question also received many incorrect responses (Figure 3). While the written responses expressed confidence in their understanding of ethics and safety, the language used in the question may have confused some student respondents, highlighting issues with the use of "practice jargon" that aren't necessarily fully understood by first-year students.

Student confidence in the subject, however, was matched by their understandings of social responsibility in engineering. Students commonly expressed surprise concerning the role of an engineer with a key focus on social impacts and ethical considerations. For example, *"[I] did not realise how much of it came down to the engineer's decisions"* highlighting improved awareness of 'Social Responsibility' in some first-year engineering students. Students reported a greater sense of engagement when they were given the chance to actively learn through experiences shared during discussions. While they appreciated the creative side of animated video resources, they commented on how the video resources provided a foundation on which students could begin to partially control how they learned the topics. One student noted that the resources served as an easy *"introduction on social responsibility, and the class discussion gave even more of a perspective from individual students ideas"* and another referenced the greater impact the class discussions had over the use of the written resources noting that *"reading the resources didn't make it seem 'real', it appeared as just information to memorise"*.

Student responses indicated that their overall impression of the learning resources was positive, with mean scores of the resources all above 6/10 (Table 1). Fields centred around the video components of the resources, standalone and implemented in a studio, received higher mean scores. These views are reflected in their written responses to the extended response questions on the student survey, with many students focusing more on the video resources over the written resources. The video resources received explicit comments focusing on what students liked about them, with one student noting that they found the videos *"very engaging much more than typical presentation style videos"* and another also noted that it aided recall *"[helped] me remember the material easily"*. These responses align with the currently understood positive impact of video-based learning on students through various aspects such as "a) grabbing students' attention; b) focusing students' concentration; c) generating interest in class" (Nadeak & Naibaho, 2020).

Written responses in the academic survey provided overall positive reception of the resources and their usefulness for engaging students in discussions. Distinct links to the assessment tasks was critiqued as they felt students struggled to apply their understanding. This observation matched the student responses for safety in engineering. It was acknowledged that the storytelling method utilised in the video resources provided an effective means of conveying ethical problems (McNett, 2016), with the aid of case studies being a potential means of improving their quality. All these findings imply that university-industry partnerships can go beyond sourcing research and industry-based placement opportunities and is effective in engaging students in thinking about practice. It is also evident that the teaching team find real-world examples more suitable for engaging students in discussions and prefer specific examples to tie an "engineering solution or engineering mindset" with a problem that was being solved. Students used their learnings to actively consider the impacts of social responsibility on an engineer's role, contrasting the neutral impact tertiary education has on student views of social responsibility (Angela R. Bielefeldt & Canney, 2016)

This study has also highlighted that student involvement can provide alternate viewpoints into what the present generation of learners find engaging (Trevelyan, 2019). Similar approaches to student-led learning and involvement in learning spaces provide further insights for effective approaches for engaging students as partners (Alpay & Gulati, 2010). The inclusion of student-led learning benefitted students developing the resources as much as it did the students receiving the content (Almeida & Daniel, 2022). We anticipate that this research will shed light on how student-university-industry partnerships can be extended to develop authentic learning resources around professional practice. Further work is needed to capture and analyse the reflections and learnings of all stakeholders to understand how and when perspective transformations occur, to strengthen curriculum integration work.

Conclusion

This paper evaluates how first year students engaged with learning resources developed by student partners in partnership with industry practitioners and the teaching team. Student partners, employed through the university placement program, collected the perspectives of industry practitioners to distil key messages informing the development of future resources. The research reported here looked at the usefulness of the learning resources in developing an understanding of 'Social Responsibility' – a key professional practice pillar promoted for graduate employability from both the perspectives of students and the teaching team. This study raises the potential for engaging senior year students in the co-design and development of engineering practice learning resources as a useful way for supporting their transition to practice.

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