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Exploring first-year student perceptions of online work-experience modules

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ABSTRACT

CONTEXT

The structure of the first year of the engineering degrees at Griffith University was recently revised, and essentially requires students to choose their major at the end of the first term of study. This need to select an engineering major early can be a disadvantage, with previous research noting that students who lacked information about their discipline area were more likely to leave the discipline. As the first year has a crucial role to play in enhancing student identity development and connecting students to their future disciplines, it follows that students must be given suitable guidance to allow them to understand their degree and the engineering majors within it. This paper describes using virtual work experience modules offered by Engineers Australia (EA) as part of an assessment task designed to support students in choosing an engineering major.

PURPOSE OR GOAL

As this was the first time to use the online work experience modules in an assessment task, the teaching team wished to understand if the online work experience modules could help first-year students better understand the engineering industry and their preferred major. Therefore, this paper focuses on exploring first-year student perceptions of the EA work experience modules.

APPROACH OR METHODOLOGY/METHODS

Students were invited to complete an online survey regarding their major choices and perceptions of the online work experience modules. The resulting survey data was analysed and common themes were identified for discussion.

ACTUAL OUTCOMES

While there is positive support for the modules in terms of helping students to understand the engineering industry and engineering majors, it appears the EA modules may not be suitable for use with first-year engineers without additional support. Although some students described finding the modules as interesting or engaging, the difficulty level may be too high for the average first-year student.

CONCLUSIONS/RECOMMENDATIONS/SUMMARY

There is nothing wrong with having challenging work experience modules designed to mirror the workplace. A potential improvement could be to have a wider range of modules, with some designed to provide an introductory experience to a major, and other more difficult modules for later year students. Future research into the design of suitable modules is recommended.

KEYWORDS

First-year students, engineering majors, online work-experience.

Introduction

The first year in engineering degrees has often consisted of a shared set of required core courses consisting of at least one project-based introductory engineering course, with a mix of fundamental courses related to mathematics and physics (Crosthwaite, 2021). After completing first year, students would then specialise in their preferred major from the second year of their degree. In response to calls for Australian universities to better prepare their students for the engineering industry of the future (Crosthwaite, 2021), and shifts in engineering education approaches (Froyd et al., 2012; Crawley et al., 2014), universities have been tinkering with the structure of the first-year and when students select their engineering major.

The Bachelor of Engineering (Honours) degree program at Griffith University is available on two campuses, at Nathan in Brisbane, and at the larger Gold Coast campus. Both campuses offer civil, electrical/electronic, mechanical, and software engineering, but Nathan students can also choose from additional majors including environmental and mechatronic engineering.

The structure of the first year of the engineering degrees at Griffith University was last revised in 2017 (see Howell et al., 2021) with some additional revisions made for 2023 for administrative reasons. The current structure requires all students to take eight courses over their first year, divided into six common core courses, and two foundation courses that change depending on the students' intended major. In the first term, students take four core courses. Then, in the second term, students take two core courses and two foundation courses related to their major.

This first-year structure essentially requires students to choose their major before commencing their second term of study in their first year. Although the ability to commence a specific major earlier can mean that students do not have to do other first year engineering courses they may perceive as being irrelevant to their major, the need to select an engineering major early can be a disadvantage. Previous research has noted that students who lacked information about their discipline area were more likely to leave the discipline, and highlighted engineering as a particularly problematic area where information was "elusive" (Thiry & Weston, 2019, p. 130).

As the first-year has a crucial role to play in enhancing student identity development and connecting students to their future disciplines (Kift, 2015), it follows that students must be given suitable guidance to allow them to understand their degree and the engineering majors within it. This role often falls to a core introductory engineering course, and previous research has linked introductory common courses with engineering student retention (Brawner et al., 2013).

At Griffith, the compulsory introductory course is 1022ENG Engineering Design Practice, which is a project-based design course, usually built around a humanitarian-engineering project set in a developing country or region. In previous years, students have participated in the Engineers Without Borders (EWB) project, or a suitable project with an external partner directly arranged by the course convenor.

To give students some insight into their future engineering careers, the Industry Research and Experience (IRE) task assessment item in 1022ENG was revised to include using a range of virtual work experience modules recently released by Engineers Australia (EA). According to EA (n.d.), the modules were designed to assist students to better connect theory with practice, understand what it might be like to work in the engineering industry, and potentially contribute to the work-experience requirements associated with engineering degrees.

The virtual work-experience modules are available at https://yea.engineersaustralia.org.au/engineering-virtual-work-experiences and offer experiences in thirteen different engineering areas: Aerospace engineering, Biomedical Engineering, Chemical Engineering, Civil Engineering - Construction, Civil Engineering - Water, Electrical Engineering, Environmental Engineering, Mechanical Engineering, Mechatronics Engineering, Mining Engineering, Software Engineering, Systems Engineering, and Telecommunications Engineering. A smaller range of online engineering experiences is also available via the Forage platform at https://www.theforage.com/.

Previous research into engineering virtual work-integrated learning modules concluded that simulations could enhance student understanding of engineering practice (Male & Valentine, 2019). Similarly, Chesler et al. (2015, p. 7) used a series of virtual internships with first-year students, and argued that such internships can help undergraduates develop an understanding of engineering practice, and assist students to develop "the identity, values, and habits of mind of professional engineers—that is, they learn to think like engineers".

Accordingly, for 20% of the course marks in 1022ENG, the 2023 version of the Industry Research and Experience task required students to:

- complete and reflect on two online work-experience modules (6 marks)
- research their preferred major and explain the reasons for their choice (4 marks)
- discuss three industry relevant skills they believe they need to develop (4 marks)
- discuss an example of their ethical behaviour relevant to the EA code of ethics (3 marks)
- demonstrate the ability to reference, both in-text and in a reference list (3 marks)

Aims and Objectives

As this was the first time to use the online work-experience modules in the IRE task, the teaching team wished to understand if the online work-experience modules could help first-year students better understand the engineering industry and their preferred major. Therefore, this paper focuses on exploring first-year student perceptions of the EA work-experience modules within the IRE task.

Methodology

Students enrolled in 1022ENG Engineering Design Practice during Trimester 1, 2023 were invited to participate in an online survey to explore their opinions on the online work-experience modules. A range of demographic data was also collected as this survey is part of a larger project. Invitations to complete the survey were sent via announcements in the course site shortly after the week eight due date for the Industry Research and Experience task, with an additional reminder announcement sent two weeks later. The online survey was hosted on the Lime Survey platform, and open for a period of three weeks. As an incentive to encourage survey completion, participants were able to enter a prize draw to win one of four $50 gift cards after completing the survey. Survey results were later downloaded and processed in Excel and SPSS.

Results and Discussion

From the initial 52 survey responses, eight partial responses were removed as they were incomplete, and an additional two responses from second-year students in 1022ENG were removed, leaving a total of 42 valid responses. As there were 194 engineering students enrolled in the course, the response rate was 22.7%. The demographic details of the survey respondents are shown in Table 1. Female students (n = 13, 31%) may be over-represented in the survey respondents, as approximately 15.5% of the engineering cohort at Griffith is female. In addition, as 34% of the engineering cohort at Griffith are the first in their families to attend university, this group may also be under-represented when compared to the survey respondents (n = 8, 19%).

Table 1: Demographic details of survey respondents

Variables	Values	*n*	%
Gender	Male	28	66.7
	Female	13	31.0
	Other / Prefer not to say	1	2.4

Variables	Values	*n*	%
Campus	Gold Coast	22	52.4
	Nathan	20	47.6
Student Type	Domestic	36	85.7
	International	6	14.3
First in Family?	No	34	81.0
	Yes	8	19.0
Age Group	17-19	38	90.5
	20-24	2	4.8
	25-29	1	2.4
	30-39	0	0
	40-49	1	2.4

Survey participants were asked to indicate their reasons for studying engineering, and could select from a range of options as shown in Table 2. Students were able to select more than one option, and could also add their own reasons as part of an 'other' option. The top three responses were related to the student's own interest in Engineering (*n* = 37, 88.1%), for a high salary (*n* = 25, 59.5%), and because 'I'm good at maths' (*n* = 22, 52.4%). In addition, 23.8% (*n* = 10) of respondents noted that they had a relative or friend who was an engineer.

Table 2: Reasons to study engineering

Reason	*n*	%
Own interest in Engineering	37	88.1
For a high salary	25	59.5
I'm good at maths	22	52.4
Relative/Friend is an engineer	10	23.8
Parental Pressure	6	14.3
Relative/Friend is studying engineering	6	14.3
Teacher suggestion	3	7.1
Other: Good-work life balance	1	2.4
Other: Skills you learn can be applied to nearly all jobs	1	2.4
Other: To help the environment	1	2.4
Other: Wanted to join a race team (GRT/SAE)	1	2.4

These findings have some similarities with surveys of engineering students in the United States showing that key factors influencing the decision to major in engineering include personal interest and job prospects (Carnasciali et al., 2013; Zahorian et al., 2013; McNeil et al., 2019). Both Zahorian et al. (2013) and McNeil et al. (2019) also identified the potential to contribute to society as a major factor linked to choosing engineering. Furthermore, McNeil et al. (2019) interviewed thirteen students and noted that student interest in math and science was the most cited reason for choosing engineering.

Choosing an engineering major

Participants were asked to indicate their preferred engineering major, and were also able to also select "Unsure" if they had not yet decided on a major. Responses are shown in Table 3, and grouped by gender (Male, Female, Other / Prefer not to say).

Table 3: Distribution of preferred major by gender

Major	Male (*n*)	%	Female (*n*)	%	Other / Prefer not to say (*n*)	%	Total (*n*)	%
Civil	7	53.8%	6	46.2%		0%	13	31.0%
Electrical / Electronic	9	81.8%	1	9.1%	1	100%	11	26.2%
Mechanical	6	85.7%	1	14.3%		0%	7	16.7%
Software	2	40.0%	3	60.0%		0%	5	11.9%
Mechatronic	3	100.0%		0.0%		0%	3	7.1%
Environmental		0.0%	2	100.0%		0%	2	4.8%
Unsure	1	100.0%		0.0%		0%	1	2.4%
Grand Total	28	66.7%	13	31.0%	1	2.4%	42	

The civil major (*n* = 13, 31%), was the most selected major across participants, followed by electrical / electronic (*n* = 11, 26.2%) and then mechanical (*n* = 7, 16.7%). This distribution across majors selected in the survey is somewhat different from actual student enrolments across the majors at Griffith, as the mechanical major is normally larger than the electrical / electronic major. It could mean that students intending to major in mechanical engineering are under-represented in the survey. There was only one student who indicated they were unsure of their major, and this seems unusually low.

Students were then asked regarding their confidence in their degree and major choices. For each statement in Figure 1, participants could select a response indicating their agreement on seven-point Likert Scale from Strongly Disagree to Strongly Agree. The statement 'I am sure I have chosen the right major for me' was not shown to the one student who was unsure about their major.

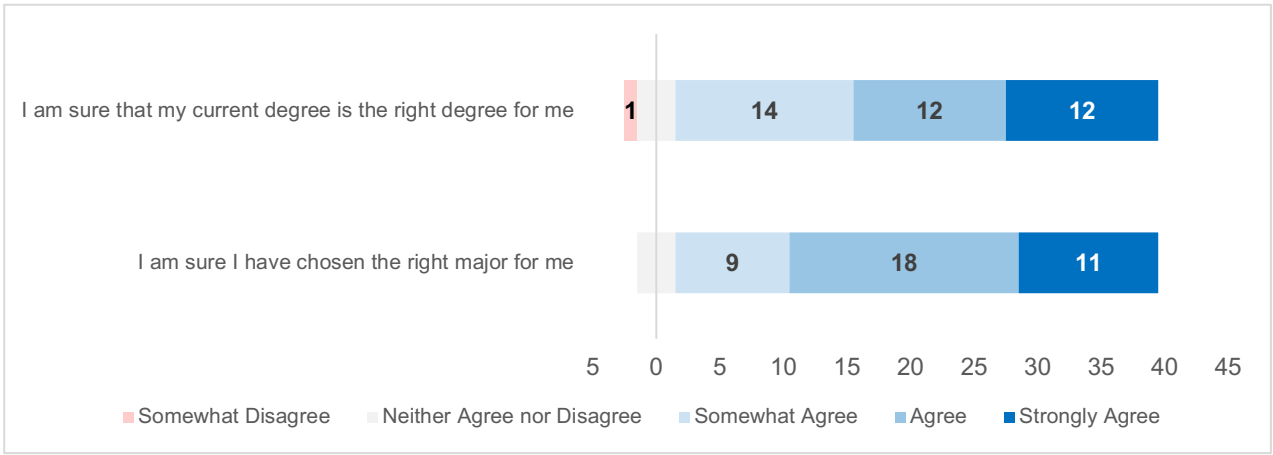

Figure 1: Overview of responses to survey statements regarding degree and major

Most students were generally positive about their degree choice, with only three students choosing ‘Neither Agree nor Disagree’, and one selecting ‘Somewhat Disagree’. In relation to their engineering majors, 45% of the students (*n* = 19) agreed that they had chosen the right major for them, with 21% (*n* = 9) somewhat agreeing and 26% (*n* = 11) strongly agreeing they have chosen the correct major. Three students were unsure and selected ‘Neither Agree nor Disagree’. There were no significant differences in responses across the different student demographic categories.

The 41 students who had nominated their preferred major were asked to describe reasons for their choice. Their answers were grouped into common themes for each major and shown in Table 4. It is not surprising that student interest in the types of topics typically aligned with the relevant major was a key reason to choose that major, and this matches similar findings by Main et al. (2022).

Table 4: Overview of reasons to choose an engineering major

Preferred Major	Themes	*n*
Civil	broad major with lots of options and good job prospects	6
	interested in infrastructure / civil-related projects	4
	career where I can use maths and make a difference	1
	closest to my preferred major (environmental) which is not available at my campus	1
	family business is in the civil field	1
Electrical / Electronic	interested in circuits, software, and technology area	8
	aligns with my double degree	1
	ability to work on broad range of projects	1
	parent is an electrical / electronic engineer	1
Environmental	passionate about protecting & improving the environment	2
Mechanical	interested in the automotive industry	3
	interested in designing systems and technology	2
	interested in aerospace	1
	interested in fields within major	1
Mechatronic	interested in automation / robotics	2
	interested in the mix of mechanical, electronic and software	1
Software	interested in programming and technology	4
	interested in the area, and has the least science	1

Overall, it appears that participants were fairly confident in their choice to study engineering, with many students able to identify their preferred engineering major at this point in their studies. However, as there was only one response from student who was unsure of their major, it is possible the survey results present a more positive view of student perceptions of engineering and their choice of major. Future research could do more to explore the perspectives of students who are unsure of their major, and help them find the degree and major that best suits their interests.

Opinions on the online work-experience modules

The Industry research and experience assessment task required students to complete at least two work experience modules, and most survey respondents did so (*n* = 36, 85.7%). However, there were two students (4.8%) who completed three modules, and four students (9.5%) who only completed one module. One of the students who had completed only one module commented they had "left it too late to do more. I would have liked to try both the aerospace engineering and mechanical engineering, but life goes on and I can only do what I can do".

Students were then asked regarding their opinions on the online work experience modules. For each statement in Figure 2, participants could select a response indicating their agreement on seven-point Likert Scale from Strongly Disagree to Strongly Agree. The statement 'the online work experience modules helped me understand my future major' was not shown to the one student who was unsure about their major. There were no significant differences in responses for the different student demographic categories.

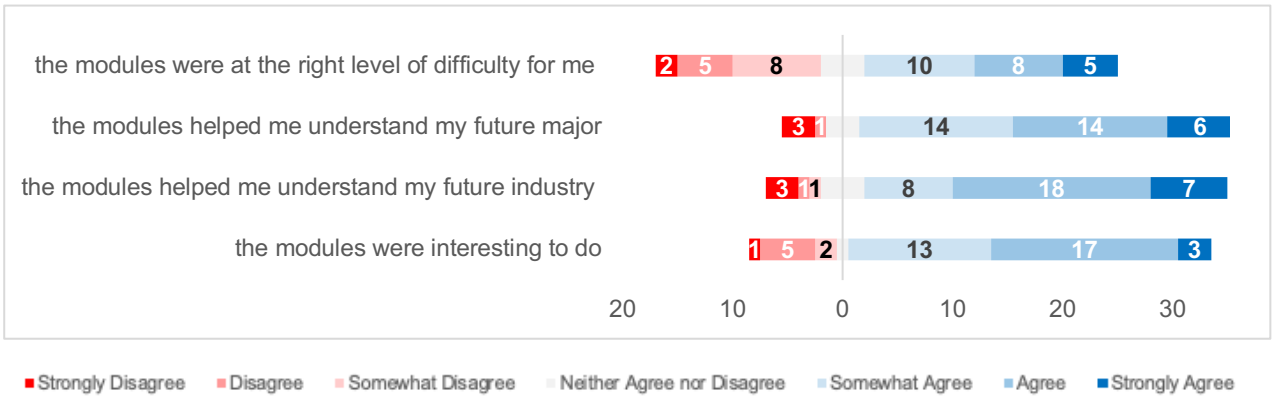

Figure 2: Overview of statements regarding the online work experience modules

Overall, the students were generally more positive than negative regarding the online modules helping with understanding their future major, future industry, and being interesting to do. However, participants had mixed opinions on the level of difficulty of the modules. 40% of survey respondents (*n* = 15) had negative opinions on the level of difficulty of the modules, compared to 50% (*n* = 23) who had selected more positive options regarding the difficulty level.

In an optional open-ended question, participants were asked if they had had any comments on the online work experience modules. From the 20 responses, two "No" responses were removed, and the remaining 18 responses were grouped into the three themes shown in Table 5.

There were nine responses related to the difficulty of the modules, with some students noting the modules were too difficult or confusing for first-years, or relied on knowledge they did not have yet. Others referred to variations in difficulty levels across the modules. On a more positive note, there were six comments aligned with seeing the modules as interesting, engaging, or useful to provide insight into an engineering major. However, there is room for improvement as there were four responses suggesting that the modules were not engaging representations of the relevant major.

Table 5: Overview of opinions on the online work experience module

Theme	*n*	Sample Comments
Modules were too difficult, or difficulty varies across modules	9	*They required us to do things that I've never done before, and gave no instructions on how to do it.* *The difficulty [level] was a bit all over the place.* *The environmental engineering module was on my level, but the water engineering module was a bit beyond me. I think if I was in my second year - or if I already had an internship under my belt - it would've been a lot more accessible.*
Modules were interesting / challenging and gave me insight into my major	6	*I think [the modules] genuinely did help me to get more excited about my major. The tasks were unfamiliar and initially I was a little overwhelmed, but that made it even more rewarding once I had solved it. I hope that I get that same satisfaction of solving problems in the real world that I got in the modules.* *The environmental engineering experience through EA was quite good. It let me understand a real-world application of environmental engineering and learn about some decision-making processes and their impacts.*
Modules were not engaging representations of the industry	4	*I didn't find the electrical engineering experience to be an engaging representation of the industry, where the tasks were just Excel data processing.* *Software one … wasn't interesting or captivating.*

This project aimed to gauge student opinions on using the EA online work-experience modules as part of a task aimed to help first-year students understand their degree and the majors within it. While there is positive support for the modules in terms of helping students to understand the engineering industry and engineering majors, it appears the EA modules may not be suitable for use with first-year engineers without additional support. Although some students described finding the modules as interesting or engaging, the difficulty level may be too high for the average first-year student. There also appears to be some variation in difficulty levels across the modules.

There is nothing wrong with having challenging work-experience modules designed to mirror the workplace, so a potential improvement could be to label the modules with a difficulty level. For example, there could be modules designed to provide an introductory experience to a major, with other more challenging modules for later year students. Future research into the design of suitable modules is recommended. The conclusions of this survey are also limited due to small number of responses, and could be improved by adding questions that explore if the modules had any role in influencing students choice of major. Further research using focus groups to explore how students choose their majors is also recommended, and could yield useful insights.

Conclusion

This article describes use of online work-experience modules within an assessment task in an introductory first-year engineering course, and concludes that the EA modules may be too difficult for first-year students. Accordingly, the next version of the Industry Research and Experience task will need some revisions, and potentially some additional resources to support student use of the online modules. Pleasingly, there is some support for the overall assessment task from the end-of-term course feedback survey: "This course also assisted in guiding students towards a

major through the industry research task which required more in-depth research that students often wouldn't do in choosing a major". Future research can explore approaches to ensuring students can choose the engineering major that best matches their interests and career goals.

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