33rd Annual Conference of the Australasian Association for Engineering Education (AAEE 2022)
4 - 7 December 2022 – Sydney, NSW

WESTERN SYDNEY UNIVERSITY

Student Perceptions of Introductory Design Activities

Simon Howell
School of Engineering and Built Environment, Griffith University, Queensland, Australia
Corresponding Author Email: s.howell@griffith.edu.au

ABSTRACT

CONTEXT

The first year at university is a crucial time of transition as students adjust to their university experience and start making connections with their future disciplines. The curriculum and introductory assessment need to introduce students to university expectations, promote active learning, and also allow the teaching staff to monitor student performance to identify those who might need support. This paper describes the Design Activity workbook assessment task embedded into an introductory first-year Engineering Design course. The activities in the Design Activity workbook aimed to encourage students to consider design issues which interested them, and see things from an engineering point of view. In addition, the workbook activities aimed to support student transition to university through encouraging regular attendance, as the activities were only marked if students attended class in the relevant week.

PURPOSE OR GOAL

As the course contains students from three different degrees, there was a need to identify if there were any differences in performance in the activities across the three groups. In addition, although students have previously made positive comments about the Design Workbook in the end of term course feedback surveys, there was a need for a more detailed understanding of student perceptions of the Design Workbook activities. In particular, the teaching team wished to know if students found the activities interesting and career relevant.

APPROACH OR METHODOLOGY/METHODS

Student marks were analysed to identify if there were any differences between students from the three degrees in the course. In addition, students were invited to complete an online survey regarding their perceptions of the design workbook activities. The resulting survey data was analysed and common themes were identified for discussion.

ACTUAL OR ANTICIPATED OUTCOMES

Students generally found the Design Workbook activities interesting and useful as they could tailor the activities to their own interests. Students also saw clear links between the activities and design issues in the world around them, as well as the relevance to their future careers.

CONCLUSIONS/RECOMMENDATIONS/SUMMARY

The majority of students found the activities interesting and relevant to their future careers as engineers and designers. Students made some suggestions for improvement, including adjusting the activities to better cater for students in software engineering and other technology related degrees.

KEYWORDS

First year students, first year assessment, student transition, teaching engineering design.

Introduction

The first-year at university is a challenging time for many students as they wrestle with making sense of what it means to be a university student and simultaneously deal with a wide range of other challenges (Baik et al., 2015). It follows that first-year curriculum and assessment have a crucial role in supporting students to transition to become successful university undergraduates connected to their discipline (Kift, 2015). Kift (2009) notes that the curriculum must be engaging, promote active learning, expose students to the different learning environments, at the same time as allowing staff to monitor student progress to identify those who might need support or an intervention. When considering transition and early monitoring of student performance, Taylor (2008, p. 22) describes use of "assessment for transition", where a course might contain an assessment item with a low overall weighting that can be marked quickly, but also flag students that might be in need of assistance.

This paper describes such an assessment task, the Design Workbook, embedded into 1701ENG Creative Engineering, a core first-year Engineering course at Griffith University, Queensland, Australia.

The Design Workbook in Creative Engineering

Creative Engineering is an introductory project-based course where students work in groups throughout the trimester on a design project addressing a real-world problem. The course also has a strong focus on the UN Sustainable Development Goals. Students have a three-hour studio session each week, and an optional two-hour "Common Time" session where they can consult the course convenor, or work with their peers. The course is required for students in engineering and industrial design degrees, and also recently became required for first-year students in the Bachelor of Intelligent Digital Technologies (IDT). The IDT degree is relatively new and is designed for those interested in emerging technologies and problem-solving in the information and communication technology industry.

The Design Workbook is a 10% task, consisting of a series of smaller 2% activities submitted throughout the term. As assessment "frames learning, creates learning activity and orients all aspects of learning behaviour" (Gibbs, 2019, p. 23), the Design workbook task aimed to:

- encourage regular attendance assisting students to keep their group work on track
- encourage students to explore the course topics and link them to their own interests
- introduce students to the PebblePad ePortfolio system used by the university
- allow the teaching team to monitor student involvement with the course
- be quick and easy to mark during the weekly studio session

All students had access to the Design Workbook in the ePortfolio platform used at the university. The workbook contained six activities which became available to students progressively through the course, and were aligned with the course topics. Each activity was worth 2%, with students able to receive a maximum mark of ten, based on their best marks from up to five activities. To encourage attendance and participation, students were informed that activities would only be marked if they were present in the workshop in the relevant week, and if they had submitted their work before their workshop.

Each of the activity topics shown in Table 1 consisted of a question prompt, space for the students to upload a relevant image, and an outline of the sections the students had to address in their answers. All answers had to be a minimum of 150 words long, although students could write as much as they wished above that. The activities were designed to be quick to mark during the weekly studio classes, and students could receive a mark of "0" (activity not completed by the deadline or absent), "1" (activity partially completed), or "2" (fully completed).

Table 1: Overview of Design Activities

Activity	Due Week	Activity Description
1	Week 2	Identify an example of a product or a piece of infrastructure that is badly designed. Explain why you chose your particular item, why you think it is badly designed, and make one suggestion for how your chosen could be improved or fixed.
2	Week 4	Identify an example of a product or a piece of infrastructure or a design concept that you think is particularly cool, innovative, interesting, or inspiring. Explain why you chose your particular item, why you think it is cool, interesting, innovative or inspiring, AND comment on what problem it solves or who might use the item you selected.
3	Week 5	Identify an example of a product or a piece of infrastructure or a design concept inspired by biomimicry that interests you OR Identify an example of a product or a piece of infrastructure or a design concept that interests you which could be improved through use of biomimicry. You will need to explain your choice and how nature has improved or inspired relevant aspects of the design concept.
4	Week 8	Describe how you would use ONE OR MORE of the S/C/A/M/P/E/R tools to improve the item you have chosen. You should explain what you would do to improve the item you have selected, and why you would make these improvements.
5	Week 9	Select a product or piece of infrastructure that could be improved or redesigned in a way that is relevant to a UN SDG. Explain why you chose the particular product or piece of infrastructure, how you could improve/redesign it, and how/why it is relevant to a UN SDG.
6	Week 11	Think back on your group work processes. You need to explain ONE thing you personally thought you did well in terms of working in your group this term, and ONE thing you might do in future groups to improve group work processes.

Aims and Objectives

As the course contains students from three different degrees, there was a need to identify if there were any differences in performance in the activities across the three groups. In addition, although students have previously made positive comments about the Design Workbook in the end of term course feedback surveys, there was a need for a more detailed understanding of student perceptions of the Design Workbook activities. In particular, the teaching team wished to know if students found the activities interesting and career relevant.

Methodology

Students enrolled in 1701ENG Creative Engineering during Trimester 1, 2022 were invited to participate in an online survey. To reduce the risk of overlapping with numerous course surveys typically faced by the students at the end of the term, the researcher decided to do the survey earlier, and only focused on student perceptions of the first five activities. The survey link was placed inside the Design Workbook and students were told they needed to have completed at least one activity to be eligible to complete the survey. The survey was open for the final three weeks of term (week 9 to week 12). To encourage survey completion, participants were able to enter a draw to win one of four $50 gift cards.

Student activity marks were downloaded from the university learning management system and analysed in SPSS. Responses to open-ended survey questions were collated in NVivo for analysis and searched for common themes.

Results and Discussion

Table 2 presents the average marks out of ten for the first five activities across the three different degree groups in the course. As the distribution of engineering marks was not normal (Shapiro-Wilk test, $W(248) = 0.87$, $p < .001$), a Kruskal-Wallace test was used to test for differences between the three groups. The results indicated that marks were significantly different between degree groups, $H(2) = 11.45$, $p = 0.003$. Post-hoc testing showed the marks for Intelligent Digital

Technologies (IDT) students were significantly different from those in Engineering (p = .003) but not from those in Industrial Design. There were no significant differences between marks for Engineering and Industrial Design students. The significantly lower marks for the IDT students may suggest the activities are not meeting their interests or needs, and a focus group with these students could help identify suitable improvements to the Design Workbook task.

Table 2: Overview of Student Degree and Average Activity Marks

Degree	Number of Students	Average mark
Engineering	248	7.62
Industrial Design	13	7.31
Intelligent Digital Technologies	23	6.17

Of the total of 284 enrolled students, 281 students completed at least one Design workbook activity from Activities one to five. Of these 281 students, 79 students completed the survey, for a response rate of 28.1%. Table 3 presents an overview of the survey respondents. Although Creative Engineering is a first-year course, there were three responses from third-year students, and three from fourth-year students enrolled in the course. Later year students occasionally take Creative Engineering at a later stage of their degree as they have transferred to Griffith University, or they may have previously failed the course on their first attempt.

As the majority of survey respondents were engineering students, the survey results may not reflect the opinions of the non-engineering students in the course. Additionally, due to the small number of responses from non-engineering students, it is not possible to do any meaningful statistical analysis of survey responses from students from the different degree programs.

Table 3: Overview of Survey Respondents

Variables	Values	n	%
Gender	Male	66	83.5
	Female	13	16.5
Degree	Engineering	74	93.7
	Industrial Design	2	2.5
	Intelligent Digital Technologies	2	2.5
	Other / Prefer not to say	1	1.3
Status	Domestic	72	91.1
	International	7	8.9
Age Group	17-19	58	73.4
	20-24	8	10.1
	25-29	5	6.3
	30-39	4	5.1
	40-49	3	3.8
	50+	1	1.3
Year Level	First Year	73	92.4
	Second Year	0	0
	Third Year	3	3.8
	Fourth Year	3	3.8

For each statement in Table 4, participants could select a response from Strongly Agree (5) to Strongly Disagree (1). The mean from all responses for each statement is presented in order from

highest to lowest mean. The two highest responses suggest that students agreed that activities allowed them to choose design issues relevant to their interests (4.57) and helped them to understand real world design topics (4.23). Based on the broad agreement with most of the statements, it would appear the activities are seen positively by the students. However, the two lowest responses suggest there is some uncertainty about the career relevance of the activities (3.78), and the marks (2%) allocated for each activity (3.96).

Table 4: Overview of responses to survey statements from highest to lowest mean

Survey Statement	Mean
The Design Workbook activities allowed me to choose design issues that interest me	4.57
The Design Workbook activities encouraged me to see design issues in the world around me	4.38
The Design Workbook activities helped me understand real world design topics	4.23
The Design Workbook activities were relevant to the course topics	4.23
I think the minimum word limit of 150 words for each Design Workbook activity is just right	4.23
The Design Workbook activities were interesting to do	4.19
The e-portfolio system for the Design Workbook activities was easy to use	4.18
The Design Workbook activities supported my learning	4.00
I am satisfied with the amount of marks (2%) allocated to each Design Workbook activity	3.96
The Design Workbook activities were relevant to my future career	3.78

Table 5 presents the number of activities completed by survey respondents. The majority of survey respondents completed at least four activities, and most taking 15-29 minutes, or 30-44 minutes to complete the activities. When asked regarding their favourite Design workbook activity, more than half (53.2%) chose the Biomimicry activity, with no-one selecting "none interested me".

Table 5: Overview of Activity Completion, Time, and Favourite Activity

Variable			*n*	%
Activities Done	1		1	1.3
	2		0	0
	3		1	1.3
	4		14	17.7
	5		63	79.7
Time taken	< 15 mins		8	10.1
	15-29 mins		25	31.6
	30-44 mins		29	36.7
	45-59 mins		8	10.1
	60+ mins		9	11.4
Favourite Activity	#1 Bad Design		10	12.7
	#2 Interesting Design		12	15.2
	#3 Biomimicry		42	53.2
	#4 Scamper		13	16.5
	#5 UN SDG		2	2.5
	None interested me		0	0

As shown in Table 6, when considering Career Relevance, the Scamper and UN SDG goals were selected as the most career relevant by equal numbers of students (22 students, or 27.8%). Five students (6.3%) indicated that none of the activities had been relevant to their careers. As the majority of survey respondents completed at least 4 activities, the survey may not capture perceptions of those who completed between 1 to 3 activities, and potentially did not enjoy them as much as the students who completed the survey.

Table 6: Overview of Activity Career Relevance

Activity	*n*	%
#1 Bad Design	11	13.9
#2 Interesting Design	9	11.4
#3 Biomimicry	10	12.7
#4 Scamper	22	27.8
#5 UN SDG	22	27.8
None were relevant	5	6.3

Table 7 displays sample comments regarding why participants felt that an activity was the most interesting to them, or the most career relevant to them. When considering all responses related to why students found the activities interesting, the dominant theme is related to the activities being relevant to student's own interests, with one respondent referring to an activity allowing "curiosity" instead of something "I would ordinarily see as homework". For career relevance, students on the whole described the activities as being relevant to their career as they could see links to engineering or design skills, the ability to solve problems, or the importance of sustainability.

Table 7: Overview of comments for most interesting and most career relevant activity

Activity	Sample Comment on Activity Interest	Sample Comment on Career Relevance
#1 Bad Design	Determining a bad design can be easy, however discussing why and providing examples why it is that, displays a true engineer. Which I think as an engineer we find problem and make solutions to those problems	Showed me just how poorly some people design things in my future field of work and that it is important to always plan and approach things from multiple perspectives or you might end up on a top 10 worst designs list.
#2 Interesting Design	This activity interested me the most as it gave me the largest scope to choose something tailored to my personal interests… Something I would ordinarily see as homework, I ended up viewing as 'curiosity'.	Because the type of jobs I'm going into, I will have to deal with lots of designs.
#3 Biomimicry	The whole concept of biomimicry interested me from the start when shown in class. And to see that engineers relied on the characteristics or designs of nature to construct incredible things is so interesting.	Being able to get inspiration from our natural surroundings to help solve modern problems is what I think is the most important aspect of being an engineer.
#4 Scamper	I got to get really creative and think of problems that people may or may not have but still find solutions to very small issues. It got me to think about how actual solutions are made.	Because it teaches engineers how to go about the creative process.
#5 UN SDG	It gave me a chance to research some environmental issues that have been bothered me for a while in real-life, and comes [*sic*] up with a possible solution.	Regardless of the career path we choose, sustainability and sustainable development are something we need to consider and understand

For the five participants who indicated that none of the activities were relevant to their future career, the survey asked them to give an example of an activity which would be relevant to them. One respondent noted that "an activity that explores UX/UI designs would be relevant for Software Engineers or students studying in other Tech-related degrees". This suggests there was a perception that there was too much focus on products or infrastructure in the activities, although some students gave examples of badly designed user interfaces when considering poorly designed products. Two others indicated they were not thinking of future careers at this stage, and therefore were unable to say if an activity was career relevant or not. The final comment simply stated "the fundamentals of engineering". This may imply the respondent was expecting more activities related to the scientific or mathematical foundations of engineering, but it is not possible to be certain what the respondent intended.

Students were also able to add answer a final optional open-ended question asking if they had any additional comments. From those who chose to answer, most comments suggested students enjoyed the activities as they were "short but engaging", did not take too much time, and provided an opportunity to learn new things. Students noted that the marking expectations were generally fair and clear, with some suggesting there should be more activities available for those who would like "extra credit", or that the activities should have a higher weighting. There was also a request for a more defined word limit range, for example, 150-300 words, or 150-600 words, rather than just a minimum limit. However, some felt the activities were done as a "last minute" type activity, or not a "core focus" as the major assessment items in the course had a higher weighting. In addition, one survey respondent who had completed only one activity noted the activities felt "like a waste of my time".

Given the overall positive feedback on the activities, it seems the Design Workbook task activities are meeting the broad course aims of targeting the student's interests. As noted by Sambell et al. (2013, p. 14), "assessment is arguably most productive in terms of promoting genuine, valued learning if it fosters individuals' own interests and concerns". As most respondents indicated the activities were interesting and career relevant, but not particularly time consuming, there is an opportunity to deepen the assessment task by increasing the minimum word limit, while still keeping the tasks easy to mark in the relevant session. Future versions of the activities will also aim to cater for students in software or technology related majors, as they may not find the infrastructure or product focus as engaging.

As the survey had few responses from non-engineering students, future research is required to gather their perspectives to inform the design of activities relevant to the needs of students in the industrial design and intelligent digital technologies degrees. There is also a need to explore the experience of those who chose not to engage with the weekly activities.

Conclusion

This article describes a Design Workbook assessment task containing a series of short engaging activities that can be embedded into a first-year engineering course. The majority of students found the activities interesting and relevant to their future careers as engineers and designers. Most importantly, the activities allowed students to choose design issues that interested them, and encouraged the students to see design issues in the world around them.

References

Baik, C., Naylor, R., & Arkoudis, S. (2015). The First Year Experience in Australian Universities: Findings from Two Decades, 1994-2014. Melbourne Centre for the Study of Higher Education.

Gibbs, G. (2019). Why assessment in changing. In C. Bryan & K. Clegg (Eds.), Innovative assessment in higher education: A handbook for academic practitioners (2nd ed., pp. 11-22). Routledge.

Kift, S. (2009). Articulating a transition pedagogy to scaffold and to enhance the first year student learning experience in Australian higher education: Final report for ALTC senior fellowship program. Australian Learning and Teaching Council Strawberry Hills, NSW.

Kift, S. (2015). A decade of transition pedagogy: A quantum leap in conceptualising the first year experience. HERDSA Review of Higher Education, 2(1), 51-86.

Sambell, K., McDowell, L., & Montgomery, C. (2013). Assessment for Learning in Higher Education. Routledge.

Taylor, J. A. (2008). Assessment in First Year University: A Model to Manage Transition. Journal of University Teaching and Learning Practice, 5(1), 19-33. https://eric.ed.gov/?id=EJ110540

Copyright statement