ACHIEVING BALANCE: WHAT IS THE OPTIMUM PROPOSITION OF STAFF-LED TO STUDENT-LED SESSION DURING A WEEK-LONG DESIGN PROJECT

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ABSTRACT

The Engineering Project Weeks (Global Engineering Challenge and Engineering You're Hired) at the University of Sheffield are designed to develop transferable skills, with a particular focus on ethics, inclusivity, and sustainability to meet learning outcomes set out in 'Accreditation of Higher Education Programmes' (AHEP 4) requirements. These project weeks consist of two 35-hour blocks with a 23/12 split between staff-led and student-led learning. A survey of first- and second-year students indicated that the ratio was generally well received, with most students rating the balance as "about right." First-year students showed a preference for more student-led time, while second-year students preferred more staff-led time. Despite these differences, overall satisfaction was highest when the balance was perceived as appropriate. The results suggest that maintaining a consistent structure across both cohorts is effective and efficient. These findings provide guidance for educators designing project-based learning, suggesting that while a consistent structure is effective, a scaffolded approach that adjusts the staff-led to student-led ratio based on students' academic progression may further enhance learning outcomes.

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1 INTRODUCTION

The Engineering Project Weeks at the University of Sheffield consist of two teaching blocks in which students focus exclusively on solving a design challenge while working in interdisciplinary teams. The first- week is for first-year engineering students, and the second week is for second-year students. The importance, implementation, operations, logistics, staff and facilitators training, resources, and costs of these weeks have previously been published by (Toqeer et al., 2024). The Project Week provides students with valuable experience in teamwork, employability skills and also serves as a recruitment tool to attract prospective engineering students. However, due to their scale, these weeks are costly in both financial and staff resources to organise, deliver, and assess. External regulatory and budget pressures necessitated a simplification and rationalisation of the event's organisation.

The weeks are planned to simulate the typical employment pattern of a 35-hour working week. The timetable is divided into distinct sections, during which students engage in various activities such as attending teaching sessions, participating in facilitated learning, presenting their ideas in a "boardroom," or working independently. Staffing is the largest expense and achieving an effective balance between staff-led and independent learning is essential for maximising resource efficiency. This study aims to determine the effective balance between staff-led and independent (student-led) learning within the context of Project Weeks. The findings are expected to inform other educators considering the ratio of staff-led to student-led work in project-based learning.

Project-Based Learning (PBL) is widely recognised as an effective method for engineering education, enhancing students' engagement, learning outcomes and skill development. However, finding the effective balance between teacher guidance and student autonomy is critical, especially during intensive project weeks. Recent research highlights the importance of structured support that gradually shifts towards student independence as learners develop expertise. A meta-analysis conducted by (Zhang & Ma, 2023) found that structured PBL with small teams of four to five students and well-defined project durations yielded the highest effectiveness. Similarly, (Lavado-Anguera et al., 2024) emphasised that project durations aligned with students’ cognitive processing capabilities lead to better retention and application of engineering concepts.

One of the key challenges in PBL is providing appropriate scaffolding. Initial teacher guidance plays a crucial role in preventing student frustration, particularly among first-year students who may struggle with open-ended tasks. Mallibhat et al. (2024) identified effective scaffolding models, including just-in-time resources, structured check-ins and peer mentorship, which help bridge the gap between instruction and independent learning. As students’ progress, instructor intervention should gradually shift to a coaching role, promoting independent decision-making (Al Jassmi et al., 2024). This transition ensures that students develop self-regulation skills while still having access to necessary support. Studies show that PBL fosters industry-relevant skills such as teamwork, project management, and problem-solving. Badir et al. (2023) highlighted that capstone projects and challenge-based learning linked to real-world problems improve student motivation and employability. Furthermore, integrating industry partners into project-based courses provides professional networking opportunities and enhances project quality.

To optimise project weeks, engineering educators should implement a structured start that gradually transitions into student independence. Providing clear objectives, resources and milestones at the beginning of a project helps students establish a strong foundation before assuming greater control over their work. As students gain problem-solving abilities, scaffolding should be reduced, allowing them to take ownership of their projects. However, excessive teacher led intervention can inhibit creativity and limit students' ability to take ownership of their learning process (Flus & Hurst 2022).

This study closely aligned with the above quoted literature that the role of the teacher should shift from that of a lecturer to a mentor. Instead of delivering solutions, instructors should focus on coaching and advisory roles, encouraging student-driven inquiry and problem-solving. This approach enhances student autonomy while ensuring that guidance is available when needed. The above studies reinforce that an effective PBL model combines structured teacher guidance in the early stages with progressive student autonomy as learners gain confidence. Engineering programs should ensure that students are empowered to lead projects while staff provide essential scaffolding to maintain engagement and learning effectiveness. By implementing gradual scaffolding, real-world challenges, structured feedback and mentorship, institutions can create a balanced PBL environment that maximises educational outcomes and workforce readiness.

2 METHODOLOGY

As part of a broader initiative to simplify and rationalise the program, the timetables for first- and second-year Project Weeks were mirrored, ensuring identical amounts and timing for staff-led and independent learning in both weeks. Of the total 35 hours per week, 23 hours were staff-led, and 12 hours were student-led. The distribution of staff-led hours was skewed toward the start of the week, when students typically require more support. These sessions were staffed by PhD facilitators, engineering staff facilitating teaching or a combination of both. It should also be noted that four of these hours were “boardrooms”, which are classified as staff-led because staff presence was required. However, student teams spent only a small fraction of this time in direct contact with staff, with the majority of the session dedicated to independent work. The staff and facilitator were given training to lead these sessions.

Additionally, for first-year students only, a student-facing visual timetable was introduced. This timetable used colour coding to indicate the expected stage of the design cycle and icons to illustrate the nature of each session (e.g., teaching delivery, facilitated learning, self-led work), as shown in Figure 1. This was implemented for practical reasons, given the rolling delivery of program updates, while also providing an opportunity to compare first- and second-year cohorts.

To evaluate the effectiveness of the chosen ratio of staff-led to student-led time, students were given a voluntary, anonymous survey. Identical surveys were distributed to first- and second-year cohorts to allow for direct comparison of results. The surveys contained four questions relevant to this study:

1. Which Programme do you belong to?
2. Overall, how would you rate the project week?

3. What are your thoughts on the amount of time spent with a hub facilitator this week?
4. What are your thoughts on the amount of time spent on independent learning (without hub facilitator) this week?

Questions 2, 3, and 4 were rated on a five-point Likert scale. Question 2 ranged from "Poor" to "Great" and Questions 3 and 4 ranged from "Definitely not enough time on..." to "Far too much time on...".

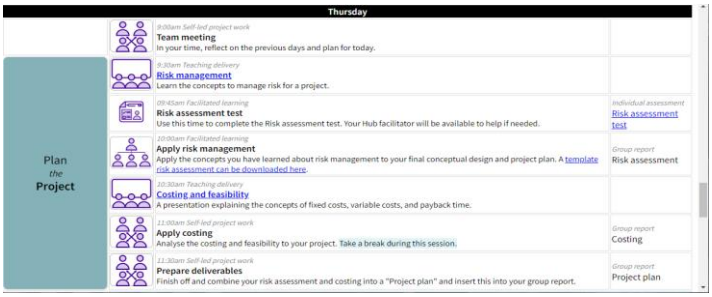

Fig. 1: Timetable with colour coding to indicate the expected stage of the design cycle and icons to illustrate the nature of each session.

It should also be noted that the timetable is constrained to 35 hours, and students have no other coursework obligations during this period. There is no expectation for them to work outside of the scheduled sessions. Project Week is assessed on a pass/fail basis, and additional work beyond the timetable does not contribute to a higher end-of-year final mark. The survey has been designed to allow students to record their feelings about the amount of time spent on staff-led and student-led sessions as independent questions. There were 1,484 1st-year students divided into 252 teams across 42 hubs participating in Global Engineering Challenge and 1,407 2nd-year students divided into 240 teams across 40 hubs participating in Engineering You're Hired, totalling 2891. Each Hub is a room on a campus and have 36 students in a multidisciplinary team of 5-6 students working on a project to solve an engineering design problem.

Table 1: Distribution of responses by different programmes of study by year group.

	1st-year		2nd year	
	Enrolled	Response	Enrolled	Response
Aerospace Engineering	18%	19%	16%	17%
Biomedical Engineering	5%	4%	5%	6%
Chemical Engineering	6%	6%	5%	5%
Civil and Structural Engineering	7%	6%	7%	8%
Computer Science	18%	21%	21%	20%
Electrical and Electronic Engineering	10%	11%	12%	12%
General Engineering	7%	9%	5%	3%
Materials Science and Engineering	4%	3%	3%	4%
Mechanical Engineering	16%	14%	17%	19%
Mechatronics, Robotics and Computer Systems	8%	6%	9%	6%

3 RESULTS AND INSIGHTS

3.1 Response rate and distribution

There were 371 responses from 1st-year students and 309 responses from 2nd-year students, giving an overall response rate of 24%, (25% 1st-year, 22% 2nd-year). As can be seen in Table 1, the distribution of responses is broadly in-line with the distribution of degree programmes, indicating the results are representative of the overall cohort.

3.2 Overall results

The results of Questions 3 and 4 are shown in Figure 2, where 1 indicates "Definitely not enough time on..." and 5 indicates "Far too much time on...". The largest proportion of responses, in both first- and second-year surveys, is 3, corresponding to "Just the right amount". A broad interpretation of these results suggests that the 23-hour staff-led / 12-hour student-led split is "just about right." However, Figure 2 also shows that a significant fraction of students feels there is either too much or too little staff-led or student-led learning. 1st-year students tend to feel there is too much staff-led and too much student-led time. 2nd-year students skew toward believing there is too much self-led time and too little staff-led instruction. The graphs (Figure 2 and 3), and heatmaps (Table 3) provide information about distribution and correlation of the data. There is not much difference between mean and standard deviation for first- and second year staff-led and student-led activities. An overall mean was found to be 3 and standard deviation was 0.75 (this means just about right amount split time between staff and student led activities). As discussed earlier, the total project week duration is fixed, and the survey allows students to independently express their perceptions of staff-led and student-led time allocations. Consequently, it is possible for students to feel that both types of learning have either too much or too little time allocated simultaneously.

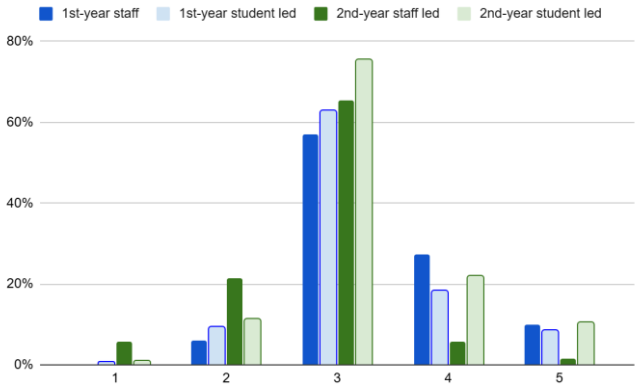

Fig. 2: Survey results for students' thoughts on the amount of time for staff-led and students led sessions. 1 indicates too little and 5 indicates too much.

3.3 Sum and balance

By summing the results from questions 3 and 4, it is possible to determine the proportion of students who felt that the total time spent on staff-led and student-led activities was either too much or too little. A result of 6 suggests that the combined amount is "about right," while a result below 6 indicates that the total time is perceived as too little, and a result above 6 indicates that it is considered too great. The

distribution for summing the responses for questions 3 and 4 is shown in figure 3. Figure 3 shows that a significant number of 1st-year students consider the combined amount of teaching to be too great. A greater proportion of 2nd-year students believe the combined amount of teaching is "just about right," but some express a preference for more teaching, although this effect is less pronounced than in the 1st-year cohort.

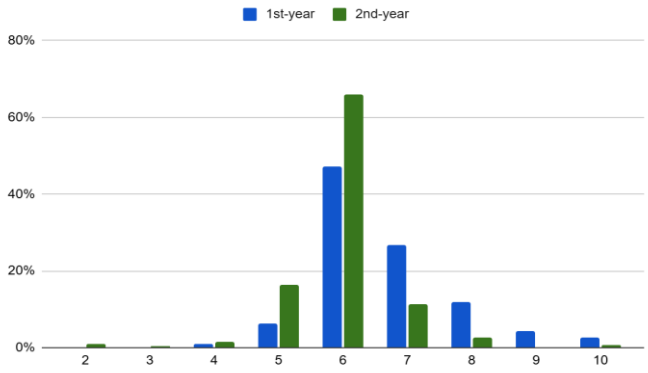

Fig. 3: Survey results summing the responses of questions 3 and 4 to determine if the staff-led and student-led teaching combined is felt to be not enough for too great.

By subtracting the response for question 4 from that of question 3, a number can be generated to represent the student's opinion on the balance between the time allocated to staff-led and student-led activities. A positive number indicates a preference for a greater proportion of student-led time, while a negative number indicates a preference for a greater proportion of staff-led time. The analysis of these responses is shown in Table 2. The results suggest that 1st-year students tend to prefer a greater proportion of student-led time. In contrast, a greater proportion of 2nd-year students show a balance of zero, suggesting they felt the ratio of staff-led to student-led time was correct. Overall, 2nd-year students show a different trend to 1st-year students, with a preference for a greater proportion of staff-led teaching.

Table 2: Balance between staff-led and student-led in responses, with a positive number indicates the balance should tend towards a greater proportion of student-led time and a negative number indicates the balance should tend towards a greater proportion of staff-led

Balance	-4	-3	-2	-1	0	1	2	3	4
1st-year	0%	1%	4%	16%	49%	20%	9%	1%	1%
2nd-year	2%	3%	10%	19%	58%	6%	2%	0%	0%
Combined	1%	2%	7%	17%	53%	14%	6%	0%	0%

3.4 Relationship to overall satisfaction

In question 2, students were asked to give an overall rating from "poor" (1) to "great" (5). This data allows for an analysis of the relationship between students' views on the amount of staff-led and student-led time, their sum and balance values, and how they rated the project weeks overall. Due to the discrete nature of the data, it is challenging to represent this correlation on a scatter graph, as many data points overlap. Instead, this analysis is presented as a heatmap in Table 3. The overall rating of the project weeks, from 1 to 5, is shown on the horizontal axis.

Table 3: Heatmaps of staff-led, student-led, sum and balance compared to overall satisfaction. Satisfaction is represented on the horizontal axis (1 for "poor", 5 for "great")

	1st-year					2nd-year					1st- and 2nd-year				
Staff-led															
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
1	0%	0%	0%	0%	0%	1%	1%	1%	2%	1%	0%	0%	1%	1%	0%
2	0%	0%	2%	2%	1%	1%	0%	5%	11%	4%	0%	0%	4%	6%	3%
3	1%	2%	9%	28%	17%	1%	1%	9%	29%	26%	1%	2%	9%	28%	21%
4	0%	1%	8%	13%	5%	0%	0%	2%	2%	2%	0%	1%	5%	8%	4%
5	2%	1%	3%	3%	1%	0%	0%	0%	0%	1%	1%	1%	2%	2%	1%
Student-led															
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
1	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%
2	0%	1%	1%	6%	2%	0%	0%	2%	2%	2%	0%	0%	1%	4%	2%
3	1%	3%	13%	27%	20%	1%	1%	9%	34%	27%	1%	2%	11%	30%	23%
4	0%	1%	5%	10%	2%	1%	1%	5%	7%	4%	0%	1%	5%	9%	3%
5	1%	0%	3%	3%	1%	0%	1%	2%	1%	1%	1%	1%	3%	2%	1%
Sum															
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
4	0%	0%	0%	1%	1%	0%	0%	0%	1%	0%	0%	0%	0%	1%	0%
5	0%	0%	1%	3%	2%	1%	0%	3%	9%	4%	0%	0%	2%	6%	3%
6	1%	2%	7%	22%	15%	1%	1%	11%	28%	25%	1%	1%	9%	25%	20%
7	0%	1%	8%	13%	5%	0%	1%	3%	5%	3%	0%	1%	5%	9%	4%
8	0%	2%	5%	4%	2%	0%	0%	1%	0%	1%	0%	1%	3%	2%	2%
9	0%	0%	1%	3%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%
10	1%	0%	1%	1%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%
Balance															
	1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
-4	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%
-3	0%	0%	1%	0%	0%	0%	0%	1%	1%	0%	0%	0%	1%	0%	0%
-2	0%	0%	2%	2%	1%	0%	0%	2%	5%	2%	0%	0%	2%	3%	1%
-1	0%	0%	4%	9%	2%	1%	1%	4%	9%	5%	0%	0%	4%	9%	3%
0	2%	2%	9%	21%	16%	1%	1%	7%	25%	25%	1%	1%	8%	23%	20%
1	0%	1%	5%	10%	5%	0%	0%	1%	4%	2%	0%	0%	3%	7%	3%
2	0%	1%	2%	4%	2%	0%	0%	1%	0%	1%	0%	1%	2%	2%	1%
3	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
4	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%

It is unsurprising that the highest overall satisfaction occurs when students state that the amount of staff-led and student-led time is "about right," corresponding to a sum of 6 and a balance of 0. The more interesting correlation lies in the skew of the results around these values. There is slightly higher overall satisfaction among 1st-year students who indicated "a little too much..." (4) staff-led time and "a little too much..." (4) student-led time, resulting in a sum greater than 6 and a balance suggesting a preference for a higher proportion of staff-led teaching. In contrast, there is slightly higher overall satisfaction among 2nd-year students who indicated "needed a little more..." (2) staff-led time and "a little too much..." (4) student-led time, resulting in a sum less than 6 and a balance suggesting a preference for a higher proportion of student-led teaching.

3.5 Discussion

Our project weeks follow a traditional design cycle, with a structure that teaches students a concept at a specific stage of the cycle and then allows them to apply these concepts to their projects, either with a facilitator's assistance or independently without any staff support. The results show that students feel the ratio of staff-led to student-led time is approximately correct.

It should be noted that this study is limited to evaluating the effectiveness of the proportion of staff-led to student-led time based solely on student survey results. Students did not have multiple structures to compare, and this is not a longitudinal study. Additionally, 1st and 2nd-year students were different cohorts.

The results show that 1st-year students had a preference for more student-led learning, while 2nd-year students preferred more staff-led learning. Furthermore, the sum values for 1st-year students suggest that they felt there was too much of both staff-led and student-led teaching, despite the total time being fixed at 35 hours. This difference could be attributed to the greater maturity of 2nd-year students.

The project weeks are run between the first- and second semesters of the academic year. As a result, 1st-year students have completed one semester, while 2nd-year students have completed three semesters and are therefore significantly more experienced at undergraduate study. 2nd-year students are likely better equipped to appreciate the value of their learning and employability skills gained from participating in the project weeks and may also have a greater sense of value for the teaching provided by staff members.

Despite the preference expressed by 1st-year students for a greater proportion of student-led time and by 2nd-year students for a greater proportion of staff-led time, the correlation with overall satisfaction suggests that these views did not compromise their overall experience of the project weeks.

Logistically, it is easier and therefore more efficient to have identical structures for each project week. The survey results do not show sufficiently strong correlations to suggest that the proportion of staff-led and student-led teaching should be differentiated between 1st-year and 2nd-year students. It is also interesting to note the very symmetrical results on the heatmap for the combined 1st-year and 2nd-year data, centred around "about right" for staff-led and student-led time, corresponding to a sum of 6 and a balance of zero.

4 CONCLUSION

The results show that 1st-year students prefer a greater proportion of student-led teaching, while 2nd-year students prefer more staff-led teaching. However, students who expressed these preferences were also more satisfied with the project weeks overall. The results suggest that the 23/12 hours staff-led to student-led proportion is well received by students and if a single proportion is to be used for both 1st and 2nd-year cohorts, this ratio appears to be more effective.

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