

## Why is teamwork so hard to teach well at university?

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### ABSTRACT

#### CONTEXT

Team-based projects in undergraduate university courses offer a great opportunity for students to develop teamwork skills in authentic, industry-focussed contexts. However, designing and running team-based projects at university is difficult. In the Faculty of Engineering, Architecture, and Information Technology (EAIT) at The University of Queensland, student evaluations and staff meetings show there are mixed experiences with team-based projects. To shed light on these observations, we have embarked on a research study to investigate practices and outcomes of team-based teaching in the EAIT Faculty from the perspective of students, staff, and industry.

#### PURPOSE

The purpose of this research study was to investigate the expectations and experiences of staff and students in team-based project work in core engineering, architecture, and design courses in the EAIT Faculty. We explored the motivations, beliefs, and practices of teaching staff who design and run team-based projects in their courses; the expectations and experiences of students undertaking team-based projects; and the perceived value of teamwork in industry. This paper presents the early findings of this study.

#### APPROACH

We used a mixed study design for this research study. To gather research data, we surveyed over 190 undergraduate EAIT students across four different year levels; we conducted interviews with 13 EAIT Course Coordinators who use team-based project assessment; and we conducted interviews with 5 industry representatives who employ our graduates. We then analysed the survey data and interview data using Nvivo to identify key elements of good team-based teaching practices in the EAIT Faculty.

#### OUTCOMES

The results from the study have highlighted several emerging themes. Firstly, EAIT students, EAIT staff, and industry agree that practising and developing teamwork skills at university in preparation for entering the workplace is very valuable. Secondly, students report mixed experiences in team-based projects from good to very poor, depending on the team membership, the design of the project task, the support of project mentors, and the marking and feedback from teaching staff. Thirdly, teaching staff acknowledge that team-based project work is difficult and time-consuming to do well, but there are some guiding principles for designing and executing team-based projects that should be used.

#### CONCLUSIONS

This study provides evidence that team-based project work is very valuable for undergraduate and postgraduate students and does equip them with important professional skills highly valued by industry. The study also identifies a range of teaching practices which can lead to improved experiences and outcomes for students and staff in team-based projects.

#### KEYWORDS

Team-based projects, Team-based assessment, Professional skills

## Introduction

Teamwork is well recognized as a key employability skill for university students. Professional accrediting organisations (Engineers Australia, 2019 and ABET, 2022) and researchers around the world advocate for the development of teamwork skills for undergraduate students (Caeiro-Rodríguez et al., 2021, Beddoes, 2020; Chickering & Gamson, 1987). Prior research studies into teamwork at university have found that student learning and satisfaction is impacted by a range of factors including the size and diversity of the team (Chen et al., 2015, Beddoes and Panther, 2018); the instruction from teaching staff about teamwork; and the perception of non-performing team members (Oakley et al., 2007). Additionally, it has been reported in the literature that staff are underprepared to teach teamwork, having had varying experiences of teamwork during their own studies and careers (Lingard & Barkataki, 2011). It is clear that more needs to be done to assist teaching staff to adopt good practices that support student learning and experience in teamwork activities.

This research study sought to identify the attitudes, beliefs, and perceptions of students and teaching staff involved in team-based projects in the Faculty of Engineering, Architecture, and Information Technology (EAIT) at The University of Queensland (UQ) and the views of industry professionals. The EAIT Faculty has a total of 7,443 students, 5,760 of whom are undergraduate students studying in a range of disciplines including Chemical Engineering, Civil Engineering, Mechanical Engineering, Electrical Engineering, Software Engineering, Architecture and Design. Of this number, 4,142 are studying undergraduate engineering. Although teamwork in engineering education has been covered extensively in the literature, our study had the relative novelty of combining student, staff, and industry views in the same study.

## Methods

This project was a mixed-method sequential study, incorporating quantitative survey data and qualitative interview data. Since our primary objective was to understand student and staff experience in team-based projects as well as industry perspectives on teamwork, qualitative methods that provide rich descriptions are appropriate.

### Participants

The participants of this study comprised three separate groups of people – EAIT engineering and computing students (194), EAIT Course Coordinators teaching into engineering, computing and architecture courses using teamwork (13 Coordinators across 19 courses), and industry representatives who employ our graduates (5). Only Course Coordinators with teamwork teaching experience were invited to participate. Five Course Coordinators had concurrent or recent (within previous two years) experience working in industry. The study secured ethical clearance for these three groups.

Participating courses were selected across all schools within the EAIT Faculty: Architecture, Design and Planning (5), Chemical Engineering (4), Civil Engineering (1), Electrical Engineering and Computer Science (5), Mechanical and Mining Engineering (1); some courses were taught across multiple schools (3). The courses spanned over all year groups with the following breakdown: 1<sup>st</sup> year (3), 2<sup>nd</sup> year (5), 3<sup>rd</sup> year (6), and 4<sup>th</sup> year/postgrad (5).

### Data collection

Data was collected from participants using surveys and semi-structured interviews. Student participants were asked to fill in an online survey with 34 questions, including a mix of qualitative questions and free text responses. Participating Course Coordinators advertised the survey to their students in one of their lectures. Participation in the survey was voluntary and anonymous. The survey took approximately 15 minutes to complete.

Course Coordinators and industry representatives were interviewed by one or two people from the research team. The interviews were intentionally semi-structured to ensure we could collect

similar data from our participants but also to collect issues that the Course Coordinators and industry representatives wanted to highlight. The interviews lasted for 45 to 60 minutes and were audio-recorded.

## Data analysis

The interviews were coded using NVivo and were analysed using thematic analysis (Braun & Clarke, 2006). Analysis began with accurate transcription and reading of all interviews by researchers to familiarise themselves with the data and to note potential insights. Next, a systematic, open coding of the data was completed with initial insights for discussion. Researchers examined this for insights and themes relevant to the study's aims, including matching themes between viewpoints (students, Course Coordinators, and industry professionals). One researcher with qualitative data analysis experience collated the preliminary codebook into possible themes and refined them as the data was analysed including highlighting compelling extracts. A second researcher independently reviewed the data for themes to increase the reliability of the proposed themes. Some coded data, while important, formed background information and was not categorised into themes.

## Findings

### Teamwork skills valued by all study participants

Our study revealed that the three parties involved in this study – students, Course Coordinators, and industry representatives – agree that team-based project work in university courses is very important and should be continued. Firstly, our industry representatives reported that teamwork was integral to the way that they do business, with multi-disciplinary teams being the norm in their workplaces. They encouraged the university to continue to foster teamwork skill development for students at university; one industry representative reported that teamwork skills are as important in the workplace as technical skills.

Secondly, our students appreciate the value in developing teamwork skills at university. 78% of respondents (155 students) agreed or strongly agreed with the statement 'Team-based activities have improved my teamwork skills' and 89% of respondents thought that we should run 1 or 2 team-based courses each semester; only 7% of student respondents voted for having no team-based courses.

Thirdly, our study showed that the Course Coordinators were all committed to running positive and productive team-based assessment in their courses. They understand how much industry values teamwork through their industry research projects and through prior work experience. The Course Coordinators are motivated to provide students with a positive learning experience through team-based assessments.

Course Coordinators and industry representatives expressed similar views on the range of teamwork skills which are important for graduates. The skills that they identified as important included communicating clearly and openly, identifying strengths and weaknesses of team members, giving and receiving feedback from peers and teachers, conducting team meetings, brainstorming ideas with team members, managing team documents, writing team reports, resolving conflict, and managing or leading team projects.

*"As an engineer we need to work as an engineering team to come up with collaborative ideas to fix problems, so yeah, at every step along the way it's all teamwork."* Industry Rep 1

*"I think teamwork skills learnt in the engineering degree are some of the most beneficial skills. I think teamwork should continue to be incorporated into all years of the engineering degree. As much as we complain about group work, we learn a lot from it"* Student 128

## Staff and student experience in team-based assessment is mixed

True to the title of our paper, our study confirmed that team-based projects are difficult to run well and student experience with teamwork is varied. Our Course Coordinators described team-based projects as 'messy' and 'more complex' than individual assessment. Some reported that Course Coordinators should carefully consider whether team-based assessment should be used in their courses at all; one Coordinator suggested that team-based projects should be used as an exception rather than as a rule. Moreover, another Coordinator reported that the success of a course can hinge on the success of the team-based project, especially for those courses where the project has a high assessment weighting (>50% of total course grade).

*"So, it's a little bit of a dual-edged sword. To some extent you have to expose them [students] to working together in teams early so they can build the necessary skills to be able to work in teams effectively later. But the flip side of course, is that it's much easier to assess students if they're not working in teams."*  
Coordinator P

At the same time, we found that the student experience with team-based projects in the EAIT Faculty is mixed and often poor. When students were asked to rate their 'Overall Experience of team-based Assessment (scale 1-10)', they returned an average value of just 5.9 with a standard deviation of 2.2 (154 respondents).

*"I felt absolutely hopeless as I watched my team crumble apart due to some conflicts"* Student 102

## Elements of effective teamwork design and execution

Our study found that Course Coordinators can have a big influence on the success of team-based projects in courses from design to execution. Our interviews revealed that there are many ways that Coordinators can encourage impactful and positive team-based projects, including:

- setting teamwork as a course learning outcome,
- motivating students through explicit tuition on teamwork and links to professional practice,
- designing team-based projects to foster real collaboration,
- forming teams with consideration,
- scaffolding and mentoring project to support student learning,
- managing dysfunctional teams, and
- implementing fair and clear marking schemes.

These seven themes are discussed in the following sections.

### 1. Setting teamwork as a course learning outcome

All Course Coordinators confirmed that they include developing teamwork skills as an explicit learning outcome in their course. By including teamwork as a learning outcome, students and teaching staff can appreciate the importance of the team activities to student learning.

*"There is definitely [one] maybe as much as two learning objectives around teamwork. [It's] fundamental and you know, we promote that from day one in the course."*  
Coordinator S

### 2. Motivating students through tuition on teamwork and links to professional practice

Our study revealed that students were more engaged and satisfied in team-based projects where the Course Coordinator and teaching staff gave some explicit training in the benefits and mechanics of teamwork. Also, students were more motivated and engaged when teaching staff could explain the link between team-based university assessment and the development of professional skills for the workplace; these links include giving examples of industry teams and involving industry mentors and guest lecturers in the course. These study findings were consistent with the work of Jones (2009) and Chattering and Gamson (1987) who argued that students are more engaged when their motivation is piqued and when they have direct contact with their teachers.

*"[I say to the students] when you go to the interview, they will ask you: 'Have you worked in groups? Have you resolved conflicts? And if you haven't, you don't have any stories to tell', so I pitch it to them, and I think that helps."*

Coordinator A

### 3. Designing team-based projects to foster real collaboration

Team-based projects need to be scoped and designed carefully to allow genuine collaboration amongst team members. Many students in our study reported that some of their team projects were more like large individual assignments, with little potential for real group collaboration.

*"The course didn't require students to collaboratively learn as a team, rather the skills acquired from these courses would be better conceived individually'.*

Student 163

On the other hand, students reported that they appreciate tackling a project that is well designed and well suited to collaborative learning and that these projects can be enjoyable and bonding experiences. For example, in a first-year engineering project course, student teams are tasked with building and operating a remote-controlled fire truck capable of extinguishing a small fire; this is a complex, multi-disciplinary task which cannot be done by individual students. This project is generally well received by students.

*'We had clear instructions in the course, had fun socialising, learnt a lot through new team members'*

Student 84

Designing team-based projects is not easy though. Many Course Coordinators reported that it takes considered thought, experience, and many iterations to design and deliver effective team projects that allow for genuine collaboration.

*"The team task design I think is crucial"*

Coordinator R

*"I think [including teamwork is] something that warrants careful consideration by Course Coordinators. And I think it warrants a 'it's in a course by exception'. There needs to be strong justification for it to be in a course."*

Coordinator A

### 4. Forming teams with consideration

Our study showed that Course Coordinators use many different methods to form teams in their team-based assessment, from student-selected teams to allocated teams. Coordinators reported that self-selected teams typically lead to less dysfunction but had the downsides of more administration load in early weeks of semester and less opportunity for students to work with people they do not know. On the other hand, Coordinator-allocated teams lead to more diversity and more scope for students to form new connections with other students. Our study found that many EAIT Course Coordinators use a semi-random team formation method where Coordinators start with random team selection and then adjust membership to increase diversity.

*"Number one, we designed the teams to be multi-disciplinary. An important learning outcome of that course is to work as part of a multi-disciplinary team because graduates, upon graduating will find themselves working as part of multi-disciplinary teams. So, it is about learning to appreciate the knowledge and input from different disciplines. We also try to design gender diverse teams... But those are the main criteria: multi-disciplinary and then gender diverse."*

Coordinator S

Our study showed that students do care about how the teams are formed; over 85% of students answered 'Yes' to the question 'Does the way teams are formed in your courses matter to you?' At the same time, students have differing views on how teams should be formed, from self-selected teams to randomly allocated teams.

*"My favourite team formation was a completely student-selected one. But I didn't mind a course where we were all buddied up with a friend and then we were grouped by these pairs together. At least then you got a choice of one person you wanted to work with."* Student 105

*"I believe it is an important skill for us as students to be able to interact with strangers and learn how to form even basic working relationships with other people. This skill will not be developed if students can choose their own groups and does not encourage social behaviour."* Student 122

We found that students are more likely to engage positively in the team-based activity if teachers clearly explain the purpose and intent in forming the teams.

## 5. Scaffolding and mentoring to support student learning

Our study found that the team-based projects were more successful when Coordinators used a scaffolded approach to the project milestones and when they ran weekly mentoring sessions. In many courses, the project scaffolding starts with a Team Charter where students record a range of details including student contact details, aspirations for the project, preferred communication platforms, and their approach to dealing with conflict and dysfunction. Students are encouraged to refer to this Team Charter during the semester as needed. Further scaffolding during semester includes setting intermediate deadlines to help students progress in a timely matter and running weekly meetings with mentors and tutors.

Our study highlighted the important role that good tutors play in delivering successful teamwork projects. Our Coordinators agreed that good tutors can make a huge difference to the smooth and effective delivery of team-based assessments and acknowledged that mentoring projects is more complex and challenging than assisting students with standard worksheet questions. At the same time, our study found that tutor training in teamwork in the EAIT Faculty is patchy and often missing; our tutors complete a standard UQ Tutor training program which is designed for worksheet/ tutorial worksheet questions. Coordinators agreed that tutors need more specialist training to help them to deal with complex, group activities and team dysfunction. These findings align with the findings of Oakley and al (2007).

*"I set some expectations about what the mentor role is. Even before the start semester when I'm recruiting the mentors, I've got a description of what their role is and it includes coaching, assisting the team around project management and team dynamics."* Coordinator F

*"I think that the tutors are the unsung heroes in a lot of this. I think when you've got really passionate tutors that jump on board with you and believe that the way you're doing things is good, then that provides a turbo boost for the course. I think you're probably going to have more impact by empowering your tutors and getting them fired up and because that's where the teaching happens really in the tutorials."* Coordinator H

### Managing dysfunctional teams

Our study revealed that dysfunctional teams are one of the main sources of angst for students and teaching staff in team-based projects. Dysfunction can take many forms including disengaged team members, differing levels of communication skills amongst team members, and differing expectations about quality and timeliness of project deliverables.

*"I have had deeply dysfunctional teams which are very stressful."* Student 36

Having mechanisms in place to encourage productive teamwork and minimize dysfunction can lead to much greater satisfaction all around. Mechanisms for preventing dysfunction including using well-considered team formation, asking students to complete a Team Charter at the start of the project (as mentioned above), and using a peer assessment marking scheme (details below). If dysfunction does arise during semester, Coordinators reported that they have several methods to deal with problems including setting up private meetings with groups and, for very dysfunctional teams, changing out group members. Coordinators agreed that dealing with dysfunctional groups during semester can be challenging and time-consuming.

*“... one team this year, they had a really dysfunctional [team]. The student who was most impacted by that came to see me and I first talked to her team mentor...and then I could ask questions about well: ‘What work do they actually give you? How do you communicate this? Did you set formal team guidelines?’ The teams had, at the start of the semester, set a Team Charter, so: ‘these things you’re upset about, are they consistent or inconsistent with the expectations in your Team Charter?’”*

Coordinator F

## 6. Implementing clear and fair marking schemes

Our study found that Course Coordinators use various methods to mark team-based assessments. Most Coordinators use a rubric-based scheme to mark the group project deliverables (typically a group report or group presentation), with the marking rubric comprising a series of marking criteria relevant to the project and to the deliverable. What differed among the Coordinators’ marking systems was their approach to group and individual marks. Some Coordinators gave all members of the team the same mark with no adjustment for individual contribution. Other Coordinators adjusted the group marks to give different marks for the individual members of the team.

For those Coordinators who did adjust marks, most use a student peer-assessment factor (PAF) to convert the group mark to different individual marks. The PAF was calculated in different ways by different Coordinators; some use a points allocation system where students are asked to divide 100 points amongst the team members, others calculate a PAF by asking students to score the contribution of team members according to several criteria on a scale of 1-5.

Several Coordinators expressed concern with applying a student PAF without moderation; they preferred to retain the final say in how group marks are adjusted for individuals, using a range of inputs including student peer assessment, mentor assessment, and individual contribution as recorded in the report. It should be noted that many Coordinators reported that adjusting group marks to arrive at individual marks is very time consuming and tricky.

*“So, first of all, we don’t do a PAF, a peer assessment because that can be fraught with some difficulties with students sometimes ganging up against somebody and trying to punish them ... [or] what can happen is that there’s a mismatch amongst our student expectations of the value of different tasks”*

Coordinator P

*“I moderate every single team in there and I’m moderating it for these reasons because I know that it can be very contentious, and I want to actually provide as an accurate reflection as possible as to what the PAFs are.”*

Coordinator S

The timing of the peer assessment also varies amongst Coordinators. Many use a peer assessment at the end of semester to adjust group marks. Others try to incorporate peer assessment during the semester to allow students to receive feedback on their team performance during the project.

*“... they had this interim peer review in week three, so they could raise issues early and say things like write comments or score people low on things like ‘this person doesn’t contribute to the team discussion’ or ‘they didn’t submit their teamwork on time’... When people got an unsatisfactory score, then I followed up with each of those individual students who had an unsatisfactory score to say, ‘look in this peer assessment, this is what your peers marked you down on. It’s you’re not submitting work on-time or you didn’t do this, so here’s what you could do to improve that’. So that’s one formal way of doing it.”*

Coordinator F

Interestingly, our study revealed that students value peer assessment in team projects very highly; 94% of the students voted ‘Yes’ to the question ‘Should team-based assessment include peer assessment?’ Students see peer assessment as a useful means of keeping their teammates in check and a way to air their grievances with dysfunctional team members. It seemed that students were comfortable with having different methods of peer assessment provided the teachers explained clearly how it worked and how it was applied.

*“Peer assessments coupled with mentor meetings might aid in getting more accurate and clear feedback on how teams are running”*

Student 31

## Challenges for Course Coordinators

As highlighted above, Course Coordinators face many obstacles and challenges in designing and running complex, team-based projects in their courses. One of the key constraints identified was the limited time available to design and run the team projects well. Coordinators reported that it takes significant time to design group projects, to moderate group and individual marks, to deal with dysfunctional groups, and to mentor tutors.

*“One of the big constraints is, just the time that it takes. So, the time you spend setting up teams, monitoring teams progress, dealing with team issues.”*

Coordinator F

Coordinators also reported a lack of guidelines or standards for using team-based assessment. Our study revealed that there is little coordination of team-based project design and execution at a School or Faculty level. Most Coordinators do their own thing, with some advice from a close teaching colleague. All Coordinators agreed that some Faculty-wide guidelines on running effective team-based projects would be helpful. Ideally, the guidelines would be principle-based suggestions rather than prescriptive, mandated instructions.

## What does excellent teamwork look like at university?

As mentioned above, all participants agreed that team-based projects at university are worth pursuing. Our study showed that team-based projects can work very well and be very satisfying for both students and teachers. Our Coordinators reported that when teamwork activities are going well during semester, students are engaged, chatty, enthused, and produce high quality deliverables such as team reports and presentations.

*“So, I think that overall, we do very well with our teamwork, and we get good feedback from the students to say they've enjoyed the process. Another sideline advantage of our course (it's not written in the objectives) is to for students to make friends and to make connections in their first year at university. And I believe that we are successful in that as well”.*

Coordinator S

Similarly, when students really engaged in team-based activities, they reported that they learnt a lot, enjoyed the project, developed professional skills, and built new friendships.

*“The project fit the course content really well and I felt like it simulated a real-world scenario of what it's like to be an engineer working in groups”*

Student 10

*“Both courses built upon teamwork and leadership qualities in meaningful ways that allowed students to adapt and thrive”.*

Student 67

## Conclusions and Further Research

In conclusion, our research study found that team-based projects in undergraduate and postgraduate courses in the EAIT Faculty at The University of Queensland are challenging to design and execute well but are very important if students are to develop highly valued teamwork skills before they enter the workforce. Course Coordinators are faced with the challenging and complex tasks of designing projects to foster genuine collaboration, forming teams, training tutors, dealing with dysfunctional teams, and establishing clear and fair marking schemes. Our study revealed that team-based assessment should not be taken on lightly, but rather needs thoughtful design and execution. Our research study found that the most positive student experience in team-based projects occurred when students worked on interesting, well-designed, well-scaffolded projects, had access to strong mentoring support throughout the project, and had some agency and support to deal with dysfunctional team dynamics.



We have many areas to explore for future research on teamwork including how to encourage students to give and receive feedback from their peers in person; how to use peer assessment to best effect; how to incorporate more reflective practice in team-based projects; and how to measure teamwork skill development across a degree program.

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