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Investigation of lack of engagement among students taking part in group work in engineering subjects

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ABSTRACT

Group work is a compulsory part of engineering courses in international universities. However, it is also an area of low satisfaction among both students and staff, particularly in relation to the lack of perceived participation and disagreements between some students. The aims of this work were to: identify factors contributing to poor engagement with group learning using qualitative methods; to identify if these factors could be related to integration between home and international students; and to determine if tailored intervention could mitigate against such factors. Six group activities were observed, involving over 400 foundation and master's level students. Qualitative inductive analysis techniques were used, including observation and semi-structured interviews, to identify reasons for lack of engagement. Particular consideration was given to the participation of international students in a UK context. Some reasons for lack of involvement were identified such as groups containing too many individuals, with insufficient volumes of work to complete. It was also noted that students lacked the necessary skills to be able to delegate and negotiate tasks. Changes, including group size and volume of work were applied and were shown to improve student satisfaction and to increase involvement of students.

KEYWORDS

Engineering groupwork, international students, group member interaction, student satisfaction, qualitative analysis, psychologically safe teamwork

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Introduction

A widely recognised requirement from the engineering industry is that engineering students can work in teams and have the ability to lead and support team development (UKSPEC – Engineering Council, 2020). This requirement is based on agreements made under the Washington Accord for graduate attributes (International Engineering Alliance, 2014) and expresses the internationally recognised need for engineers to have experience of collaborative working. Therefore, the need for engineers to have experience of working effectively in diverse and multi-disciplinary teams in higher education is an international requirement, for higher education courses. As a result, students in higher education degrees in engineering, are required to demonstrate that they can '*function effectively as an individual, and as a member or leader of a team*' (AHEP 4 – F16 pg 31). In the UK higher education sector, if this cannot be demonstrated, then a degree course cannot achieve accreditation from the UK Engineering

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Council. This learning outcome is generally achieved through the inclusion of compulsory group work activities within the degree structure, often linked to credit bearing assignments.

However, as an area of dissatisfaction for both students and educators, there is a need to examine current pedagogy and to identify best practice in terms of effective learning of both thematic content and collaborative working skills. In this paper the issues arising in group work are explored though observing group work in action. Using the results of these observations, changes were made to the structure of group work, support for students and the types of tasks set. These changes were then evaluated to identify which mitigations may have supported greater involvement in group work tasks and how student participation in group work can be changed. To investigate the participation of students, qualitative inductive analysis was used to examine the student experience through close observation of the processes and interactions between individuals during the work, while both positive and negative opinions were recorded. Specifically, the research asked if:

- Tailored intervention can be identified that will provide indicative evidence of improved student engagement in small scale classroom trials.
- Qualitative analysis with no hypothesis as proposed by Braun & Clarke (2022) can be used to identify factors contributing to reduced student engagement in group assessment.

This research forms part of a wider study looking into the attainment of international students in the Engineering Department of a research-intensive university in the UK. The wider study seeks to identify if a lack of integration with home students could be contributing to an awarding gap between home and international students and, if this cause was identified, how a more cohesive working environment could be developed.

Background

Group work, which can also be known as cooperative learning, peer learning or constructive learning, is a practice where individuals are divided into small groups of at least two individuals, to complete tasks involving cognitive and collaborative dimensions (Palmer & Hall, 2011). These individuals are seen as a collective unit and are jointly responsible for an assigned task. The aim of group work can be to learn content knowledge, discuss a topic, complete a group assignment or answer questions (Li & Campbell, 2008), while developing skills such as communication, decision making or problem-solving techniques (Pritchard, Stratford & Bizo, 2006).

In engineering, group work activities often take the form of design projects, where students research and design a structure or system. They can be collaborative technical problem solving, such as designing, building or programming a product and may last from an hour to several weeks or longer (Smith, 1995). Most are designed to be as close to a realistic project in industry as possible (Pang & Kootsookos, 2021).

A prominent feature of group projects is a focus on the outcome and a knowledge-based assessment (Palmer & Hall, 2011). This is despite the requirements from the Washington Accord stating that students should be equipped to function effectively "*as a member or leader in diverse teams*" (International Engineering Alliance, 2014). In many group assignments, students are assessed on the outcome of their project, rather than their collaborative skills. This outcome may be a report, presentation, poster or demonstration. In higher education students tend to be graded on the quality of group work submitted, with little consideration for effort or individual input (Johnston & Miles, 2004). As it is often difficult for academics to assess the contribution of individuals, grades for contribution are often obtained from peer review (Willmot & Crawford, 2007; Gammie & Matson, 2007), even though this has been shown to be unpopular with students (Gibbs, 2009). Published research suggests that little, if any, teaching or training is given to students in group working skills or socialisation with others, such as allocating work roles, resolving conflict or negotiating multicultural differences (Seat, Parsons & Poppen, 2001; Baker & Clarke, 2010). There is a tendency to believe that students will arrive with these skills or develop them independently through practice. For staff, the dynamics of group work is very different to that of lecturing and may be an area in which they do not feel prepared. For the development of effective group work, staff need time to develop resources and investigate appropriate pedagogic research to identify appropriate learning tools (Allen, Warburton & Adeoye, 2024)

The literature suggests that, in practice, the majority of student groups are self-selecting and are often composed of friendship groups. Indeed, Mantzioris & Kehrwald (2013) concluded that student selected groups had the highest satisfaction and academic achievement rates over random and academic selected groups. Group self-selection can also be favoured by staff as a way to prevent conflict within groups. However, in their quantitative analysis of group learning Cen *et al* (2016) demonstrated an improved group performance when there was increased diversity in areas such as gender and level of skill. This was measured by grade awarded for group work compared to individual grades in other assessed work. In contrast, Popov *et al* (2022) highlighted the issue of multicultural groups and challenges they may have with group discussions and group management, alongside peer-feedback. It is known that in most higher education courses, home and international students do not mix spontaneously (Vita, 2010). In such circumstances, it may be expected that students placed in groups which are selected at random, or by course leaders will experience discomfort and/or unproductive group functioning, exacerbated by unfamiliarity with rules of communication.

In a small percentage of group projects students are allocated to groups, randomly by academics (Chapman *et al,* 2006). Although random selection is often used by academics to show group allocation is 'fair', it has low satisfaction levels from students and has been shown to produce poor learning outcomes. With issues as simple as group selection frequently arising, it is perhaps unsurprising that group work is often an area of stress for both students and academics.

It has been noted that assessed group work is a neglected area of research (Frykedal & Chiriac, 2017). This is particularly true in relation to participation and attainment of international students and other minority groups, with much of the research around these student experiences being focused on communication issues such as limited language ability and cultural differences (Strauss, Mackey & Crothers, 2014). There is also little research that has been focused on group work in engineering disciplines. Even outside the area of engineering, much of the work that has been carried out has looked at a limited number of students in a single subject, normally from one cohort and rarely more than one time (Stenberg, Campoamor-Olegario & Yong, 2019; Diangelo, 2006; Shuang & Dall'Alba, 2012). If we are to make progress in the development of practice in group work, there is a need for greater understanding in how best to apply pedagogy in this area and to look for best practice across subject disciplines.

Despite there being a variety of literature researching behaviours in group work, the research tends to fall into a similar set of methods. The most popular method across literature is the use of surveys to elicit opinions from either students or educators (Stump *et al, 2011)*. Focus groups and interviews are also used frequently. If there is a secondary supporting method used to support findings, this tends to be comparison of statements found in surveys and focus groups with grade outcomes. Observations of group work in action (Aritz & Walker, 2007) or workshops where educators discuss group work practices are used infrequently to gather data on group study.

Methods

Stage 1: Exploration of the problem

Many published studies focus on one activity and one set of students, and this raises questions with regard to the applicability of the research to other areas of education. In this work, several activities and cohorts were examined to identify common issues experienced in group work activities, before changes to the group activities and group structure are made and evaluated. The cohorts are all studying in a large multidisciplinary engineering school and, where possible, all group activities observed involved home and international students.

Observations were carried out using qualitative analysis, with no hypothesis (Braun, V., & Clarke, V. 2022 & 2022a). Prior to observations, possible areas of researcher bias, such as the effect of English as an additional language on participation, were identified. Following data collection principles of reflexivity (Wilkinson,1988) were used to test on the data collection techniques during observations for any indication of researcher influence on subjects or confirmation bias.

Observations recorded student participation and distribution of work by type of student, off-task activity, number and theme of verbal interactions, evidence of conflict, evidence for student leadership or dominance, student confusion on task and any other behaviours that appeared relevant to the group work process. When appropriate, students involved were questioned informally regarding their

involvement and the perceived involvement of others in tasks. Some students also opted to give opinions on tasks and involvement of others. The reasons for the arrangement of the groups and perceived learning outcomes for the tasks were discussed with academics. All observations and comments were recorded longhand and later coded for themes. Demographic details of the students can be found in Table 1.

The study was approved by the University of Birmingham Ethics Committee.(Ref ERN_0904) Students were coded to identify them as home or international students (paying international fees), their gender and country of origin. No other personal details were collected or stored. Students were given the opportunity to opt out of the study at any time and data was stored in line with local policies of the host institution.

Table 1: Summary of cohorts observed in initial observations

Observation	Level of study	Engineering Department	Number of Students in cohort	Age Range	Home students (%)	Female Identifying (%)
1	7 (Masters)	Civil	58	24-53	47	14
2	3 (Foundation)	General Engineering	56	19-25	0	29
3	7 (Masters)	Civil	202	22-33	5	41
4	7 (Masters)	Civil	56	22-48	59	13

Observation 1 – Postgraduate Students MSc Topic based activity

An observation was conducted to examine the behaviour of groups undertaking a master's level qualification in engineering. There was a range of industrial experience from none to over 25 years. The group work was a formative activity within an intensive module week.

Students were asked to undertake five different, but connected exercises, each lasting 2.5 hours over a period of five days. The activity took place in the afternoon, after 5 hours of earlier lectures and activities. The exercises were themed on Systems Engineering. Groups were allocated randomly on the first day, with students selecting cards numbered 1-8 and it was intended that students remain in those groups for all five exercises. Each group was made up of at least seven students and was heterogeneous, with between 2-4 home and 3-4 international students, containing both part-time and full-time students and students with and without industry experience. The random nature of the groups was facilitated by distribution of the cards in the previous study session, where it was likely that students were sat in friendship groups. This was a low-stakes activity with no credit bearing assignment linked to it, although each day three groups were selected randomly to present their findings to the cohort.

One academic observed the student groups during the week, with observations focused on one group for around ten minutes before moving on to another group. Students were familiar with the observing academic as a course tutor. They were not given details of the reasons for the observations. Students were not asked directly about their feelings on the work they were completing, however any comments made were noted anonymously.

Observation 2 – Foundation Year Group Project

This activity asked a cohort of 56 undergraduate students studying a foundation year in engineering and physical science to build and program a robot to move through a maze. This is an ongoing activity which lasts for the duration of the semester and after initial instructions and a timetabled teaching session on campus, students were expected to carry out much of the work in their own time. Groups were self-selected via University VLE or informing teaching staff of group membership in person. The groups were mostly homogeneous, comprising of students from one culture and first language. Students in this cohort were mostly of Saudi Arabian (60%) or Chinese (30%) origin. Of the eight groups

seven contained one gender, with two groups all female identifying. Groups were made up of between six and eight individuals.

In the first session students were informed of the details of the project and asked to join a group. They were issued a robot in kit form along with an instruction manual for how to build and program it. In the second session students were asked to construct their robot and to start familiarising themselves with the programming language they would need to use. Both sessions lasted around two hours.

In researching this activity, the observing academic was introduced as a member of staff from the engineering department, who was researching group activities across the department. Students were told that the academic may observe them and ask questions, but that they did not need to answer questions or engage with the academic if they preferred not to. Students were identified as home or international, by gender and by country of origin. Notes were taken during the activity and written up shortly after.

Observation 3 – Master's program Assessment Support

This activity asked students studying an MSc in engineering management to peer review dissertation project proposals that had been written prior to starting work on projects or meeting with supervisors. This programme cohort is mainly international, mostly of Chinese origin with ten home students present during the activity. This was a three-hour timetabled session that took place in a large lecture theatre, although students were free to move to other areas of the building if they wished. Groups were self-selected and mostly made up of friendship groups. Students first divided into groups of two, read each other's project proposals and then made recommendations for improvements. They then formed into a larger group of six individuals or more to discuss the proposals further. The groups were generally homogeneous to one nationality, e.g. all students within a group were of Chinese origin. All home students were in two homogeneous groups of five individuals. Students were given suggestions by their peers for areas for improvement in the proposal.

In researching this activity, the observing academic acted as a member of staff offering advice to students on project proposals and listening in to discussions. Students were informed that the academic was completing research on group work and may want to talk to them about their experiences. Notes were taken during the observation and were written up shortly after the activity.

Observation 4 – Postgraduate Students MSc Topic based

This observation was conducted with groups undertaking a master's level qualification in engineering. There was a range of industrial experience from none to over 25 years.

The group work was part of an intensive module week, with sessions taking place in the afternoon after five hours of earlier lectures and activities. This activity was focused on completing a series of questions related to the work covered during the taught sessions during the day. Groups were self-selecting and mostly made up of friendship groups. They were mostly homogeneous and made up of either home students or international students.

One academic observed the student groups during the week, with observations focused on one group for around ten minutes before moving on to another group. Students were familiar with the observing academic as one of the course tutors, however, they were not given details of the reasons for the observations of the group work. Students were not asked directly about their feelings on the work they were completing, however any comments made were noted anonymously.

Stage 2 – Assessment of Changes to the Structure of Group Work

Following initial observations changes were made to the design of group work including the following mitigations.

1. Limit group size to 4 individuals

2. Allocate students to heterogeneous groups made up of two home and two international students as far as possible.
3. Increase the workload and the expected output for student groups, alongside presenting expectations and suggested times for activities.
4. Create tasks that are not UK-centric
5. Give students training in giving feedback and managing discussions.
6. Give each member of the group a defined role with a description of the expectations of that role.

Presentations were incorporated into the module to support students with strategies to manage difficult conversations and for leading a meeting. As part of this, two role plays were introduced to allow students to practice leading meetings and having a difficult conversation in a psychologically safe environment.

Students were given a role within the group of Facilitator, Researcher, Reporter/Designer and Finance. These roles were adapted from the work of Cohen & Lotan (2014). Each role had a brief which described the work each student was expected to do towards the task. The roles were swapped each day, so each student was required to undertake each role.

Points 3-6 were identified as mitigations to increase feelings of psychological safety for students and are being tested for effectiveness. Points 3 and 4 were identified as possible ways to reduce feelings of isolation or difference from other team members. Points 5 and 6 were introduced as ways to give students an understanding and greater confidence in expected behaviours of team members.

Two further observations were made to assess any changes in engagement. Demographic details of the students can be found in Table 2.

Table 2 - Summary of cohorts observed in observations 5 & 6.

Observation	Level of study	Engineering Department	Number of Students in cohort	Age Range	Home students (%)	Female Identifying (%)
5	7 (Masters)	Civil	56	22-47	64	13
6	7 (Masters)	Civil	48	22-48	69	8

Observation 5 – Postgraduate MSc Students Topic based

Observations took place during the first module of a transport engineering programme. The programme has a varied cohort of students, including career changers, those upskilling to further their careers and those who have recently completed undergraduate study. All home students were studying part-time, with the majority of the international students studying full-time. Experience in industry ranged from no experience to over 25 years.

As this was the first module, no students had previous experience of groupwork on the programme or how group work had been carried out in previous years. The module is intensive and taught over five days. Group work takes place between 15.30 and 17.00 from Monday to Thursday, with outcomes being delivered on Friday.

The output for this groupwork was to produce a presentation, but the group work was also related to the main written assignment for the module. Therefore, there was incentive to take part, although final marks were not fully dependent on the effort of other students.

The observing academic was a member of staff with whom the students were familiar. Students were informed by the module lead that the observing academic was completing research on group work and may want to talk to them about their experiences. All observations were written up shortly after the activity, along with any comments made by students. However, it was noted that during the group work few comments from students were recorded.

Observation 6 Postgraduate MSc Students Topic Based

Observations took place during the second module of the same transport engineering programme. All home students were studying part-time. The full-time international students were the same group observed in observation 5, however the part-time home students were a different group. As this is the first module of the second year for part-time students, they had experience of three group projects within the same programme from the previous year. Similar to observation five, the module is taught over five days, and group work takes place between 15.30 and 17.00 every day.

The output for this activity were two posters that were to be presented in an event where they were assessed by course tutors and peers. A marking rubric was provided which covered areas of knowledge such as design choices and safety systems and presentation skills such as the use of appropriate language for a target audience. Students were expected to both present their work and to assess the work of others. The output was indirectly linked to one of the module assignments.

The observing academic was a module lead, who the students were familiar with. Students were informed that observations were taking place and that they may be asked questions about the group work. Observations were written up shortly after the activity and it was noted that few comments from students were received.

After the completion of both activities, semi-structured interviews were carried out with both home and international students to ascertain if students were comfortable with the new structure of group work and if they felt it had improved their learning experience. Interviews took place after observation 6, when students were asked to reflect on their experiences. Part-time students who had taken part in group work on the same course the previous year, were asked to reflect on any changes they had identified. A total of ten students were interviewed across a cohort of around one hundred students. The home/international status of the students are shown in Table 3.

Table 3 – Student Interviews with home or international status

Interview Number	Home or International	Code
1	Home	22DH
2	International	22PI1
3	International	23SI
4	International	23JI
5	Home	23AH1
6	Home	23AH2
7	Home	23BH1
8	Home	23BH2
9	Home	23CH
10	International	23MI

Results

Table 4 summarises the features within the first four observations and the frequency with which they occurred during the four activities.

Table 4 – Features within the observations and frequency of occurrence (observations 1-4)

Observation Feature	1	2	3	4	Frequency
Groups made up of 6-10 individuals	✓	✓	✓	✓	4
Random allocation used in group formation	✓				1
Students form their own groups		✓	✓	✓	3
Academic allocation used in group formation					0
UK students take on leadership role	✓			✓	2
Lack of interaction between UK & international students in heterogeneous groups	✓		✓	✓	3
Attempts made to engage non-participating students	✓				1
Some students not engaged	✓	✓	✓	✓	4
In heterogeneous groups, tasks completed by UK students only	✓			✓	2
Tasks completed by one or two students within the group	✓	✓	✓	✓	4
Tasks UK centric	✓		✓		2
Students left early or did not return for further sessions	✓		✓	✓	3
Work completed in less time than allocated	✓	✓	✓	✓	4
All students communicate in English	✓		✓	✓	3
No immediate negative result from non-engagement	✓	✓	✓	✓	4

Table 5 summarises the features within the observations once changes were made to the design of the group work and the frequency with which they occurred during the activities.

Table 5 : Features within the observations and frequency of occurrence (observations 5-6)

Stage 2 – Assessment of Changes to the Structure of Group Work

Observation Feature	1	2	Frequency
Most groups made up 4 individuals	✓	✓	2
Academic allocation used in group formation	✓	✓	2
UK students take on leadership role	✓	✓	2
Lack of interaction between UK & international students in heterogeneous groups			0
Some students not engaged			0
Tasks UK centric	✓		1
Students left early without reasonable explanation			0
Work completed in less time than allocated			0
All students communicate in English	✓	✓	2
Students use training in group work techniques			0
Each group member has a defined role within the team	✓	✓	2

Discussion

Although in observations 1-4, the types of students taking part in group work in each of the observations were different, as were the activities and the structure of the groups, it is possible to identify common issues which could hinder learning. In each of the four observations the individual outcomes, such as presentations or the functioning of the robot were at least acceptable and sometimes of a high standard, therefore it was not possible to link the material outcome to ability to work together as a team (Channon *et al,* 2017). As none of these activities had an immediate summative grading, it was also not possible to link group behaviour directly to a measurable outcome. It was possible to identify individuals who were extremely motivated and involved in completing tasks in each group activity, but this was only sometimes possible to identify in the outcomes. This supports the claim that quality of output cannot be used to identify group work failings. Equally, there was little difference in quality of outcome for observations 5 and 6. Therefore, grades for outcome will not guarantee high quality group working skills were demonstrated.

Group projects observed in observations 1-4 had at least six members working on the project and sometimes up to ten members. Two or three members of each group were completing work while others were unproductive, either off-task or only appearing to be engaged. In observations 1, 2 and 4 a maximum of 3 students were completing work at any one time, with other students presenting stalling

activities such as looking at course pages, scrolling on phones or visiting the bathroom. There did not appear to be any immediate negative consequence to a student from the lack of involvement, however research has shown that disengaged team members can cause conflict (Huerta *et al, 2024)*. For those completing tasks, the focus was on completing work in as short a time as possible, with little evidence of in-depth thought being applied. This does not support suggestions that group work can lead to notable gains in student achievement (Chang & Brickman, 2018). In observation 4 students started to leave early as soon as work was completed. This caused dissatisfaction for one student who stated:

"*If you get your head down, you can have the questions answered in 10 minutes. So, they get their heads down and then just (leave)". To be honest I'm quite (disappointed)*" (23AH1). Note that in this and other quotations, brackets have been used to paraphrase colloquialisms.

The literature suggests that smaller groups may support those lacking in social confidence. Ballantine & Larres (2007) suggest that group size should remain small and no greater than 4 individuals, as larger groups of five or more may inhibit those with less confidence from expressing their opinions. This conclusion is supported by Cohen & Lotan (2014) whose work with primary age children also suggests the optimum number of students in a group should be four and groups should be no larger than five. Both suggest that limiting groups to four individuals could positively affect the willingness of students to take part in group work by reducing social stress and putting students in a more comfortable position to speak out or take responsibility for tasks.

This view was supported by observations 5 and 6, as the most impactful of the changes made to groupwork appeared to be the reduction in group size. It was observed in both observations that in the majority of groups, most students were on task for much of the activities with minimal social loafing. There was also a significant reduction in the number of students leaving early. It was noted that when students did leave early, it was due to issues such as childcare or medical appointments and arrangements were made within their group to complete their portion of the group work in the evening for the next day.

During interviews, students who attended group work for observation 5 had very little to say, either negative or positive about the size of group. Most responses were non-comital or stated that everything seemed fine. When asked to comment on group size one international student raised an interesting point about presentations being made to the whole cohort, stating:

"Have smaller groups - groups within groups. Each sub-group does not need to present to the entire audience, but just to their parent group. This will save time." (23JI)

Part time home students involved with observation 6 were asked directly if they had noticed any difference in the size of group between their first and second years. Students interviewed were not aware of any differences and most stated that groups were the same size as the previous year, although groups had in the year before been made up of six or more individuals. However, one part-time home student stated:

"I didn't notice any difference in the size, I have noticed the groups have been more effective. I don't know if that is random chance or, but. I've certainly had much better group work experiences this year, than I did last year." (23AH2)

In observations 1-4, it was possible to see that if the group activity did not involve enough tasks for the number of individuals in a group, then it was easy for students to make little effort and exhibit social loafing (Ying *et al* 2014). Alternatively, individuals could try to be involved but have difficulty in taking ownership of one of a limited number of tasks if they lacked confidence in a group or social setting. It was noted in observations 1 and 4 that international students who had little involvement on day one of the group work were less likely to return for further sessions, although this was not identified as an issue with home students.

In the initial observations the group assignments were serial in nature, with activities where all group members were expected to work together on a single task, before proceeding to the next. This appeared to result in more dominant individuals taking on a greater percentage of work while others were excluded, another factor which might encourage disengagement. It was considered that simultaneous engagement might be achieved by increasing the volume of work expected, so the required output is commensurate with the work expected from the number of individuals. Tasks could be developed with multiple roles where individuals are expected to work on different aspects before coming together. Such

an approach is likely to satisfy the requirement for learning activities to reflect the future workplace authentically.

When the volume of work was increased, alongside simultaneous tasks, students from observation five and six reacted in a positive way. It was generally felt to be fair and a sufficient volume to be completed by the number of people in each group. A part time home student from observation five stated:

"One person couldn't do it. Three people couldn't do it. You needed everybody to actually do a part" (23AH1)

A second-year part time student from observation six stated:

"I felt last year, it ended up being one or two people would, sort of, end up doing everything and this year every time, everyone has come together to work on it." (23BH1)

Both comments reinforce observations that an increase in workload volume has improved group coherence and the integration of individuals from different backgrounds.

One issue noted in the later observations was that with the greater volume of work, activities did become more prescriptive. In observation 5 this made progress slower as, despite time expectations being given, students looked to academics for an indication of when a task should be completed. No group appeared to want to break the silence in the room, by being the first to initiate a discussion. However, another perspective offered by a student was that it was easier to regulate the work being produced and for group members to hold each other accountable if sections were incomplete.

"The tasks for module 1 were very structured, every day we had a list of things to get done and it was obvious if we hadn't done them." (23BH2)

Through presenting students with a set of tasks to complete, groups could monitor their own progress, and learners were empowered to regulate the volumes of work completed by other members of their group.

Much has been written about the formation of groups with self-selection being suggested as the most effective form of group composition (Mantzioris & Kehrwald, 2013), and with outcomes being most successful in heterogeneous groups (Cen *et al* 2016). However, it was noted in observations 1-4 that the majority of international students in heterogeneous groups were silent for much of the duration of the activities. The exceptions were international students with 10 or more years industrial experience. There was no clear connection to competence in the language of instruction (English). Attempts made by home students to engage international students were observed, but were mostly unsuccessful, and home students did not persist. One home student remarked, "*there is only so much you can do and then you give up*" (22AH). An alternative explanation was given by an international student who stated, "*I'm tired by the afternoon and it's more difficult to take part in group work*." (22PI)

In observation 4 where a heterogeneous group had been put together from two smaller homogeneous groups of 4 home students and 3 international students, work was being completed by the home students while the international students were taking no part in the task. Despite tutor involvement to encourage conversation, there was no evidence of communication between the home and international students. By the second day this group had divided into two self-selected homogeneous groups which were working more effectively.

However, homogeneous groups composed of only international students appeared to be disadvantaged in the UK setting. In observation 2, most international students were proposing dissertation projects which required the collection of data from a UK context. However, lacking knowledge of UK culture, legislation or practice led to poor advise being given by their peers as to the suitability of projects. For example, a project to reduce energy loss in a listed building by replacing windows with UPVC triple-glazed windows was highly praised, despite its inconsistency with UK planning regulations that protect buildings with societal value afforded by their heritage. Groups made up of students from UK industry were able to provide each other with much more accurate advice. It was noted that students in homogeneous groups were comfortable in giving each other feedback and none reported finding feedback difficult.

In the observations 1,3 & 4, there was no clear correlation between group selection method and quality of outcome, there was also no clear correlation between successful group dynamics and outcome

produced. It was noted that when group communication broke down to a point where groups needed to be reallocated, in each case this occurred in a heterogeneous group.

It is likely that different interpretations of approaches to group work, possibly from different cultural understandings of correct behaviour, can lead to discomfort and frustration amongst group members. Although, it has been shown that under ideal circumstances heterogeneous groups may produce better outputs (Cen *el al,* 2016), simply allocating students to heterogeneous groups will not result in improved outcomes for all students. Instead, explaining the reasoning behind group allocation and giving students training in such areas as conflict resolution, cultural differences in expression or having difficult conversations may help group cohesion, alongside giving them useful workplace skills.

In observations 5 & 6, allocating students to groups did not appear to cause any serious discontent amongst the cohorts. It was noted that in observations 1 and 4 a number of students had asked to move groups, in observations 5 and 6 only one student requested to be reallocated. On questioning, this student was in the single group of three individuals and felt excluded from the conversation of the other two students in their group. Academic allocation was accepted as normal practice for home students in observation 5 and when interviewed after they had taken part in other differently structured group work, they felt that the group work using this allocation method had achieved "*better results"*.

International students when interviewed did not raise concerns about academic allocation and generally felt positive about the experience. However, one international student stated in relation to working with unknown colleagues:

"Familiarity/culture is a constraint. We need time to get to know members of the group. As groups are usually formed at random, we do not have enough time to get to know each other to work properly together." (23SI)

This may partially explain a comment made during an interview with two part-time home students who had been asked about participation by international students in group work:

1 – "They were, kind of, needed more encouragement to properly engage with the groups. Some of them. Yes, generally if they had already worked in the rail industry and had some background it was a lot easier to get them involved and for them to get their point across. Whereas those who weren't needed coaxing. Or they would just sit there quietly in the corner and would not contribute then." (23AH2)

2 – "Until someone reached out and said…" (laughs) (23AH1)

This may indicate that although smaller, academic selected groups and greater workload encourage integration between home and international students, there is still work to be done to encourage better communication between the two groups. It also appeared to show that part-time home students continued to take on a leadership role, although this was not noted in observations.

In the initial observations, other than students with significant industry experience, international students gave very little input on experiences from their home countries. None of the group exercises observed were written in a way that stated that outcomes should be focused on a UK context; however, in each case this was how the brief was interpreted. This may be a manifestation of dominant culture privilege (Harbour *et al,* 2003) where students were influenced to adopt the cultural norms and values of their place of study. It seems probable that international students would be at a disadvantage were tasks UK-centric or, if there is an influence to put tasks in a UK-centric context. This would be even more so were outcomes of these tasks to be knowledge-based. Therefore, groups containing only international students may have reduced learning opportunities as they are likely to have a more limited understanding of UK industry or policy.

To improve the development of knowledge or practice in activities and to avoid the dominant culture being assumed, activities in observation 6 were deliberately placed in a country which was not the residence of any of the students and which was outside the experience of the majority of students. The aim was to assist international students to feel able to have more input and adjust the power balance in the group as a whole. Through observation 6, it was not possible to identify if this change effected group dynamics or distribution of work. Although, as the activity was still in a European context, it may have been an area more familiar to home students, and this is an area for further research.

Lingard & Barkataki (2011) highlighted the need to teach students team working skills rather than expect them to pick-up the skills through experience. If we are to expect students to be able to work effectively as a group, we need to lose the expectation that all students will enter higher education fully equipped

with an understanding of how to function in a team. Therefore, there should be an enhancement in skills training regarding group work, such as conflict management, negotiation, goal setting, role identification among other areas. Group work could be enhanced through short 'training' sessions, which would also support entry into future careers.

In discussions with academic staff leading group work, there was an expectation that students would bring knowledge of how to organise themselves within a group setting from previous learning. Through the observations it is possible to see that this is not always the case. In situations where students had management experience outside their studies, they tended to take a lead, however there was then a tendency for them to take on the greater workload rather than delegate it to students who lacked this experience. In discussions with students the reason for this was to 'save time', the more experienced students did not feel any responsibility to teach less experienced students how to work in a group. The focus was on completion of the given task.

When individual named roles and responsibilities were introduced within the group work in observation 6 and detailed descriptions of the roles supplied, there was an attempt by students to adopt these roles. During the observation students were clear what their role was and could describe what they were doing toward that role. However, introducing team roles appeared to have only a small effect on group distribution of tasks, with students continuing to gravitate towards the tasks which either interested them, or they felt most comfortable doing. In interviews part time home students were not enthusiastic about this change. One home student stated:

"In my group people were quite resistant to caring about what their role was, if there was a particular bit they wanted to do, if that makes sense. I don't mean they weren't contributing. I suppose, just in a different way to… how they were prescribed." (23BH1)

In further discussions it appeared that although the imposed role may not have been useful in group cohesion or work allocation, there was some support in terms of personal development.

"*I hated being the designer, it's just not part of my skill set. I suppose it was good for me to try though"* (23CH)

This is a technique that may work better with students with less industry experience as professional engineers may be clearer about the roles individuals play when working in a group. This is an area for future research.

Equally, it was more difficult to identify evidence for the effectiveness of training students in having difficult conversations or in leading meetings. It was not obvious during observations that the techniques taught were being used and in interviews the roleplays, although enjoyed, were not considered to be useful in the context of the group work undertaken. As the majority of students on this programme are already professional engineers, these may be preexisting skills.

The original research aim for this work was to identify ways to improve integration and participation of international students in groupwork activities in UK higher education and to improve the dissatisfaction rates seen among higher education students when participating in groupwork activities. To this end, the work has been moderately successful in improving integration and participation of international students which has been noted in observations and by part-time home students. However, there is still work to be done in facilitating international students to feel more psychologically secure in the group setting. There has been greater success in reducing dissatisfaction rates, which has been identified through students remaining present and active in group work, alongside interview responses. In observations there have been much fewer students opting not to attend group sessions or opting to leave early following the changes made, this has particularly been the case for international students. In later interviews comments made about the group work undertaken were generally positive, with few students being able to describe areas for improvement.

Following the observations, a focus group of academics involved with the group work sessions was held. There was agreement that students had been more engaged and there was less dissatisfaction voiced among those who had taken part in the group work sessions. There was also acknowledgement from staff who had been against the smaller group size that this had had a significant impact on the engagement of students. No difference in terms of the quality of output was identified from previous years.

Increased academic workload was highlighted as a disadvantage, although one academic stated:

"It took a significant amount of time to put all of the material together, but next year I can see that some of it can be used again which should reduce the time needed."

A further disadvantage identified by academics was that although the presentations in observation 5 were limited to three minutes, with the increased number of groups this took a significant amount of time. As each group were reporting on similar themes there was a tendency for repetition, so later presentations were disadvantaged. In future years groups will be divided into smaller subsets to avoid this issue.

Early in the project, workload was identified as a key barrier to change. Therefore, a decision was made to test theories in a small number of group tasks. This was to prevent unnecessary workload, if it was shown that theories did not show significant improvement to student satisfaction. Consequently, in group work in a subsequent module where a course leader reverted to the previous practices with the same cohort of students, a reversion of student behaviour was seen. This supports the impact of the changes made to the structure of group work but also demonstrates the need for sustained approaches within the course setting to avoid progress being lost.

By using qualitative analysis, student experience and interactions could be seen between individuals, while noting positive and negative opinions between individual students and academics. From our observations we can conclude that qualitative analysis as proposed by Braun & Clarke (2022) can be used to identify factors contributing to reduced student engagement. Using this analysis the barriers to participation of international students such as group size, insufficient volume of tasks to complete for the number of group members and a learning environment where some students do not feel psychologically safe to challenge the dominant culture norms could be identified. It seems possible that these areas would not have been identified using quantitative approaches such as surveys or attainment data.

Limitations

The observations that have been caried out are limited in that only students studying engineering topics were viewed. There was also a limited number of observations, each with a different cohort of students. The majority of students, particularly in the second set of observations were mature students with experience of teamwork in the workplace. This may have affected the group dynamics and adaption to change. Due to the small number of female identifying students in each cohort, it has not been possible to consider on the effect of gender in engineering group work. As interviewers were well known to students interviewed, there is possibility that this relationship may have affected the comments participants were willing to make. Due to these limitations, in future work there is a need to repeat the interventions in further group work studies, particularly with undergraduate students and those with less industry experience.

Conclusions

Group work is an area of low satisfaction for both learners and educators, but an area vital for achieving approval and recognition of international higher education courses in engineering. This study has shown that qualitative analysis is effective in identifying the reasons for lack of student engagement in group work activities. It has examined student participation in a series of engineering group work activities, firstly to identify areas where there were barriers to student involvement, particularly for international students, and then shown that tailored intervention can be introduced to remove barriers and improve student engagement.

The six changes that were made to the structure of groupwork made an observable difference to the behaviour of students and the way that the groupwork was carried out. However, due to the number of variables that were changed from the first set of observations, it is not possible to rate the changes made to the structure of group work by importance. It was possible to identify which of the changes appeared to have the most impact on group coherence and on encouraging all students to take part through observation and some of the observations could be confirmed through triangulation with interviews.

The areas of change that appear to show least impact was non-UK based tasks and training students in group management techniques. The choice of a European country in which to locate the task may still have led students from Asia and the global south to feel they were less familiar with the geographical area and were therefore still at a disadvantage when compared to home students. Since the majority of students taking part in the group work studied are in employment, they are likely to have had training in team building and management techniques. Therefore, the activities introduced may have less impact on group cohesion.

Through these changes an optimised design for group work has been identified that better supports the integration of international students and may improve group working skills, alongside developing subject knowledge. When designing group activities educators and curriculum designers should give consideration to developing smaller groups with sufficient connected tasks that can be worked on independently, but as part of a wider project. Consideration needs to be given to the volume of work needed to occupy the number of students in a group. There is a need for further research to understand the impact of other changes such as specific group roles and non-UK-centric tasks, before recommendations can be made for their adoption.

As group work within the structure of an engineering degree is likely to be an ongoing requirement for accreditation or recognition, it is in our best interests as educators to ensure students gain useful skills through its pursuit. This may require greater thought being given by the educator to the type of task used in group work, alongside increased preparation. There should also be consideration of the skills that students are expected to use and develop through completing group work tasks. Asking academic staff to reevaluate their group work and to consider its objectives may have a significant impact on standards achieved.

Recommendations going forward will be to introduce some of the suggestions within this report across further programmes in engineering, to identify any positive or negative changes in group cohesion and productivity. Should similar improvements be identified, particularly for undergraduates and students in different engineering disciplines, it may be possible to improve satisfaction with group work for both learners and educators.

Declaration of Interest

No potential conflict of interest is reported by the authors.

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