Effect of group formation on performance, task management and social loafing

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Abstract: *Engineering graduates of today are required to adapt to a rapidly changing work environment. In particular, they are expected to demonstrate enhanced capabilities in both mono-disciplinary and multi-disciplinary teamwork environments. Engineering education needs, as a result, to further focus on developing group work capabilities amongst engineering graduates. Over the last two years, the authors trialed various group work strategies across two engineering disciplines. In particular, the effect of group formation on students' performance, task management, and social loafing was analyzed. A recently developed online teamwork management tool, Teamworker, was used to collect students' experience of the group work. Analysis showed that students who were allowed to freely allocate to any group were less likely to report loafing from other team members, than students who were pre-allocated to a group. It also showed that performance was more affected by the presence or absence of a leader in pre-allocated rather than free-allocated groups.*

Introduction

In most organizations and circumstances, team work outperforms individual work (Slavin, 1990). Groups contribute a diversity of knowledge and experience to a given task that is not available to individuals. Research has shown that when teams are properly designed, the overall performance of the teams seems exceed the sum of individual contributions (Miner, 1984). As a result, there is increasing pressure on universities to incorporate team-based activities as part of their curricula, with the expectation that such activities will equip graduates with the required skills to tackle teamwork in the workplace. This is particularly important for engineering graduates who are expected to work in multi-disciplinary teams, and solve problems in unfamiliar circumstances.

In order to meet these requirements, team work has become more prevalent in engineering education, particularly as class sizes increased. Many team activities in engineering are based on students working together in small groups towards a cooperative project (Ledlow et al., 2002; Mehta, 1998).

Unfortunately, the process of working in teams during academic activities still fails to replicate that of group work in professional settings. Team work in both professional and academic setting can suffer from process losses associated (Miner, 1984). One of the most prominent examples of process loss when working in teams is social loafing. Social loafing refers to the decrease in involvement and effort by individuals when performing a task in a group (collectively), rather than individually (coactively) (Latane, Williams, & Harkins, 1979). Social loafing has been explained in terms of "equity in effort", i.e. individuals tend to put less effort in collective tasks because they expect other group members to also loaf (Jackson, & Harkins, 1985). Social loafing, however, seems to be more prominent during team-based academic activities than in the workplace. This discrepancy was partially attributed to differences in

reward and punishment mechanisms between university and the workplace (Buttefield & Pendegraft, 1996). In particular, student feedback over many years identified that there were rarely any consequences for the social loafer, which would generally not be the case in most organizations.

A more important reason could lie in the way teams are formed. Team formation draws a wide variety of responses from researchers: some supporting completely random teams (Foyle, 1995) and others organizing groups based on ensuring a mix of skills and experience or personalities (Michaelson, 1995). In many academic settings, teams are composed of individuals who are new to working together, either because they are new to university, or because the teaching staff that composed the teams are often uninformed about the importance of group dynamics. Student teams frequently operate without explicitly assigned roles or established authority and are often classified as "informal". Group processes may generate a group leader, but not always the best leader, which could detract from successful completion of a task. Finelli, Klinger, and Budny (2001) found that it was critical to incorporate the five elements of positive interdependence, interaction, individual accountability, interpersonal skills and group processing into any group activity.

This paper focuses on the effect of team formation on performance, and on reported social loafing in the group. Among the studies that evaluated the effect of team formation on group achievement was the study by Butterfield and Pendegraft (1996). They showed that specific games that encourage individual communication and self-disclosure within the group, and therefore increase interpersonal relationships, have a positive impact of the team subsequent performance. In this study, we aim to observe the effect of group formation by comparing group performance and perceived social loafing between two cohorts of students. One cohort was asked to freely choose their team members, while the other cohort was more restricted in their choice.

Method

The Study

In 2008 and 2009, the authors undertook a study to assess student satisfaction and academic performance as a function of group formation. The study was conducted on two core design based engineering undergraduate units, one in second year Civil Engineering (ENB274) titled Design of Sustainable Systems and the other in third year Electrical Engineering (ENB342) titled Signals, Systems and Transforms. These design based group projects aimed at providing students with the chance to synthesize skills learnt in their course into a cohesive problem solving task, while enhancing student's appreciation for the environment, society and economies. The main goal of these projects was to empower students to think critically and creatively while pursuing alternative, yet realistic and cost-effective solutions for sustainable development.

The project deliverables of ENB274 include the design of a sustainable residential development conceptual plan including a subdivision layout and infrastructure (road, stormwater drainage and water services) where students work in groups of four (4) each responsible for one of the following areas: Sustainable Transport, Land Planning, Water and Wastewater Management and Environmental Impact Assessment. The group assessment task is worth 50% of total marks and involves presenting a two stage report.

The aim of ENB342 is to provide students with fundamentals of deterministic analogue and discrete-time signals, analysis of linear systems driven by such signals, and digital filter design. The group assessment task is worth 25% of total marks and student groups involve 3 students. Other important learning

objectives of these units (ENB274 and ENB342) are to develop fundamental skills needed to participate effectively in multidisciplinary teams, develop communication skills, and for students to be exposed to a wide range of problem solving tools and strategies.

Participants

Total enrolment in ENB274 in 2008 was 141 students consisting of 32 groups against 179 students in 46 groups in 2009. The response rate in 2008 was 96%, and 94% in 2009. ENB342 enrolment in Semester 1, 2009 was 111 students in 38 teams. Responses were gained from 76 students in ENB342 resulting in a response rate of 78% for the electrical engineering students. The ENB274 responses includes 13 mixed male, female groups out of 32 in 2008 and 12 mixed male, female teams out of 46 in 2009, whilst in ENB342 responses were received from 5 mixed male, female groups out of 38 groups.

Academic Unit	Group Size	No of Groups	M/F %	Mixed M/F Groups %	% Groups with Leader	Response Rate Tasks TW %
ENB274 - 2008	4	32	88/12	40	21.8	96
ENB274 - 2009	4	46	84/14	26	19.6	94
ENB342 - 2009	3	38	95/5	13	31.6	78

TW –TeamWorker online tool; M – Male; M/F – Mixed male/female groups

Table 1: Student Group Organisation

Apparatus

A group management tool developed at QUT, TeamWorker was used to monitor group progress as well as individual student contributions to their group. Teamworker was developed and implemented across a number of professions and units at Queensland University of Technology (QUT). It was created to enhance team teaching and learning processes and outcomes include team creation, administration, development and evaluation (Murray & Lonne, 2006). Importantly, TeamWorker can facilitate the early identification of problematic group dynamics thereby enabling early intervention and permits the teacher to create a structured, closely monitored team work experience in which students could engage with and experience the critical characteristics of effective team practice. It does not take the place of the teacher but, rather, supports the teacher and students in existing team projects in a way that helps to maximize students' awareness of how effective teams perform and to minimize the consequences of conflict becoming unhealthy.

Participation through Teamworker was assessed and monitored throughout the semester and was worth 10% of the total marks for the unit. Activities within TeamWorker were setup by the unit coordinator and included establishing group working procedures and group goals. In addition, a survey was developed and administered through Teamworker to evaluate group performance, engagement and satisfaction. This paper focuses on the students' answers to two questions, namely " Did all the team members contribute equally hard in getting to the solution? Use a five point agree disagree rating scale where 1 = strongly disagree; 3 = uncertain: 5 = strongly agree" and "Describe how team responsibilities were managed; Was a leader appointed? How did you plan for the task ahead?".

It should also be noted that all first year engineering students are exposed to the use of TeamWorker. Further, across a number of units and Civil engineering students (ENB274) are generally more exposed to TeamWorker than Electrical Engineering students (ENB342).

Team formation

In ENB274 student groups in both 2008 and 2009 were partially engineered, allowing students to pick one partner. The teaching staff then "collated" two pairs based on previous results in design-based units, therefore forming teams of four. Additional criteria were also used to form the group, such as making sure that there was never a single female within a group, and allowing a maximum of two international students or mature age students per group. In ENB342 students were allowed to form groups of their own choice.

Results and Discussion

Table 2 details a comparison of group performance and engagement (based on participation in TeamWorker) over a two-year period.

Unit and Group Characteristics	No of Groups	Failure Rate %	Groups that Completed > 50% TW Tasks	Av Project Grade out of 7	Groups that Identified Social Loafers*
ENB274/2008	32	8	93%	5.4	
ENB274/2008 Leader	6		95%	4.7	1
ENB274/2008 No Leader	26		88%	5.6	5
ENB274/2009	46	3	89%	5.7	18
ENB274/2009 Leader	9		98%	4.9	1
ENB274/2009 No Leader	37		87%	5.8	4
ENB342 – 2009	38	11	87%	5.7	2
ENB342/2009 Leader	12		83%	5.8	3
ENB342/2009 No Leader	26		88%	5.6	5

* Social Loafers identified through TeamWorker (TW) peer and self assessment

Table 2: Group Performance

Results indicate that students in ENB342 (free-allocated teams) are less likely to report instances of social loafing than students in ENB274 (pre-allocated teams). This could mean that loafing is less likely to occur when students freely choose their team members, or that loafing still occurs but is less likely to be reported, simply because students do not want to report their friends or because they take responsibility for their choices. The first possibility, i.e. that loafing is less likely to occur, is supported by the fact that students in most ENB342 teams reported a prior history of working together. It is therefore unlikely that students would choose to work with loafers again. Further, most students in ENB342 reported that they knew what their strengths and weaknesses were, and that tasks within the group were divided accordingly to bring the project to successful completion. Loafing mainly occurs when a team member's perception is that his or her efforts are not necessary to reach the team's objectives. When tasks are precisely set, loafing is less likely to occur (Van Dick, Tissington, & Hertel, 2009). An important limitation of this result, however, lies in the fact that the groups compared belong to different year levels and different

engineering disciplines. Therefore, the findings still need to be confirmed using groups in same year level and same disciplines.

Findings from different group formation strategies also show that in the ENB274 cohort, groups who decided to organize themselves with no formal leadership structure achieved much higher performance than groups with appointed leaders. In the ENB342 cohort where students had full control of team allocation, there was little variation in academic achievement between groups that allocated a leader and those that did not. This is possibly a result of the level of responsibility felt by students. In the absence of a leader, student within the group share the same level of responsibility for the success of the project, and may therefore display a higher level of interest and motivation towards completing the project successfully. As for the ENB342 cohort, the level of student responsibility was already high through the self-allocation process, and successful completion of the project may not have been as sensitive to the presence or absence of a leader. The assumption of responsibility as a contributing factor to teamwork success needs to be assessed through further studies.

It is also interesting to note how students in the ENB342 cohort chose to organize themselves according to their grade point average (GPA). Students within the various groups tended to have very similar GPA. The standard deviation around the mean GPA within each group varied between 0.1 and 0.82. This is consistent with the findings in Shultz, Wilson, and Hess (2010). In their study, students who preferred to work autonomously rather than in groups reported that one their main dislikes of teamwork (other than social loafing) is grade reciprocity. These students felt uncomfortable with group work because of the diversity of desired achievements within the group. Some aimed high, others were happy to settle for less. As a result, students reported not liking the feeling of responsibility towards other team members' grades, or having to "pay" for others' poor achievements. It is therefore expected that when students are free to choose their team members, they tend to congregate towards others with similar GPAs in an attempt to reduce the effects of grade reciprocity.

Conclusion

The study presented in this paper evaluated the effect of group formation, i.e. pre-allocated versus free-allocated teams, in terms of group motivation and performance. Analysis using a recently developed online teamwork management tool, Teamworker, showed that students who were allowed to freely allocate to any group were less likely to report loafing from other team members, than students who were pre-allocated to a group. It also showed that performance was more affected by the presence or absence of a leader in pre-allocated rather than free-allocated groups. Additional studies are required to confirm the above-mentioned results, and further assess the rationale behind some of the findings.

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