Performance of students' choice team versus teacher/facilitator's created team in project-based learning (PBL) units

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Introduction

The university lecturers focus on improving teaching practices and enhancing student learning through different teaching approaches. They identified a few approaches in teaching: content-oriented/teacher-centred, learning-oriented/student-centred to student-teacher and student-student interaction. In the twentieth century there were several movements to introduce a team based method, called the student centred approach, in schools and universities employing and completing several student projects by forming good teams in some units. In traditional teaching approaches, students could develop factual knowledge and problem solving skills in routine set problems, not the skills in solving open ended problems. The project based learning (PBL) methods focus on student skills on research and reasoning skills, team building and time management skills in multi-disciplinary projects along with content based learning. Therefore, both pedagogies focusing on content based learning and PBL are essential in parallel to provide a quality student engineering education. There are a few team building methods to complete student projects. It can be done on a random basis, on student choice or student can form their teams employing university learning management systems (LMSs). Jacobs and Hall (2002) pointed out some questions before to form a team:

- How big should be a team?
- How long the team should work together? and
- How should teams can be formed?

Team learning in class room activities has been widely acknowledged in the literature. Research on team learning focussed on some advantages on student learning experience. The main key points were (Harmer, 2007):

- Developing student self-confidence and recognition, improving presentation and talking skills for individual student.
- Elucidating critical and creative thinking and decision-making skills, allowing students to make their own decision without being told by the teachers.
- Decreasing anxiety of students and improving cooperation and negotiation
- Enhancing student learning.

Previous literature on team formation on team effectiveness suggested two categories: teacher-assigned or student self-selected. There are many studies focusing on analysing team performance of a single method or comparing teacher-assigned vs self-selected methods are available (Harmer, 2007, Hassaskhah and Mozaffari, 2015). The teachers formed the student team either at random basis, or by alphabetical order of family names or by personality traits or academic heterogeneity. Students, on the other hand were free to form their teams preferably with their friends. Whatever the methods, Fink (2004) illustrated two critical aspects of team works; it enhanced learner's autonomy and influenced quality of learning. Two important perspectives were investigated: team formation methods on team dynamics including cooperativeness, workload sharing, degree of participation, completion of set tasks on time (Hilton and Philips, 2008, Russell, 2010, Mitchell, et al., 2004) and performance outcome including final grades (Mahenthiran and Rouse, 2000, Mushtaq, et al.,

2012). The literature on both team formation methods put contradictory views; some literature strongly advocated for teacher-assigned method, whereas other literature suggested the other method (Hassaskhah and Mozaffari, 2015).

Based on the trend on team formation, Hassaskhah and Mozaffari, (2015) carried out a study on how team formation such as student-assigned vs teacher-assigned impacted on team dynamics and outcomes. They articulated that mode of team formation is very sensitive to the success of the team outcomes. They concluded that team tasks output for teacher-assigned teams is better compared to that of the student-selected teams. Opposite is true for team dynamics.

Team dynamics varies significantly in both student team formation methods. Friendship plays an important role in forming team in student-assigned (student choice) method and team dynamics is improved. The students in this method viewed that their friendship could improve communication, cooperation and acceptance in the teams (Hilton and Philips, 2008). They consider these aspects are the main characteristics for student learning and completion of the projects on time. In another opinion, student choice method had a different characteristic factor as 'lack of task orientedness' (Hilton and Philips, 2008). Because of friendship, the team focus would distract from main academic task to social task ('*off-topic talk*'). Therefore, task-oriented outputs are faded away. Teacher-assigned (teacher choice) method in forming student teams, on the other hand, is seen initially as '*negative*' to team performance but during the actual team works, the team members cooperation is satisfactory and it leads the team performance to a better outcome of the projects (Hilton and Philips, 2008, Hassaskhah and Mozaffari, 2015, Yang and Jin, 2008).

Considering three student team formation methods such as teacher choice, student choice and randomly by a computer program, Pociask, et al. (2017) pointed out that teacher choice method led in diversity in teams, but students' performances were not better than that resulted from student choice or computer-controlled methods. The authors suggested that '*student formed teams can be a reasonable option for instructors to consider when planning a team-based course'.*

Thorough out the literature review, it is revealed that student team are bifurcated into two general categories: teacher choice and student choice. Both methods are considered in this paper. The purpose of this paper is to explore the formation of good teams in Master of Engineering PBL units with an aim to achieve better outcomes. This paper is also focussing on how good teams lead to complete the set project tasks enhancing students learning in all areas required to become work ready engineer suitable for industries. It will be articulated to illustrate the points when a team leads to be a good team or not to be a good team. An important goal is to articulate proper interaction between student to student and student to facilitator, a basis of forming a good team, to ensure individual student learning. The effectiveness of formation of student teams is evaluated by student satisfaction data obtained through university Moodle system, not based on unit final grades.

Methodology

Both randomly formed and student choice team are practiced in our Master of Engineering program. Both team formation methods are presented and discussed in this study. Teachers lead the team formation using different methods such as randomly selected, selection based on surname, selection based on disciplines, etc. In student choice method, on the other hand, a standard approach of using university LMS systems (Moodle) is considered. In the LMS, names of different teams are created, and students are asked to choose the team they like. There was a provision of forming a team of 4 to 6 in these units because of large number of students in the unit (on an average about 100). It is envisaged that there will be an impact of number of students in a team on team performance, however, this aspect has not been considered in the paper. It is also envisaged that team behaviour such as process, progress meetings, input, keeping meeting minutes, preparing meeting agenda, etc impacts

on group outcomes which were also outside the scopes of this paper. The details of the two methods are schematically shown in Figure 1. The aspects of team formation by Moodle site (LMS) are being more practiced lately in our Master of Engineering program. The impact of team formation by either way is evaluated in this study based on completion of the projects and their satisfaction scores. It is to be noted that all the teams had an opportunity of having regular meeting with teacher or facilitator to discuss their progress, issues faced such as data collection, communication between team members, etc. Students were asked to use team forum/discussion group created in the LMS for communicating between the team members. Over the 12 weeks term, teams were asked to submit their scopes and objectives of the project in week 3, draft report in week 9 and final report in week 12. They were provided good feedback both in week 3 and week 9 submissions. They had to present the project progress twice, one in week 4 and another in week 10. These activities helped them to produce good report and achieve quality outcomes.
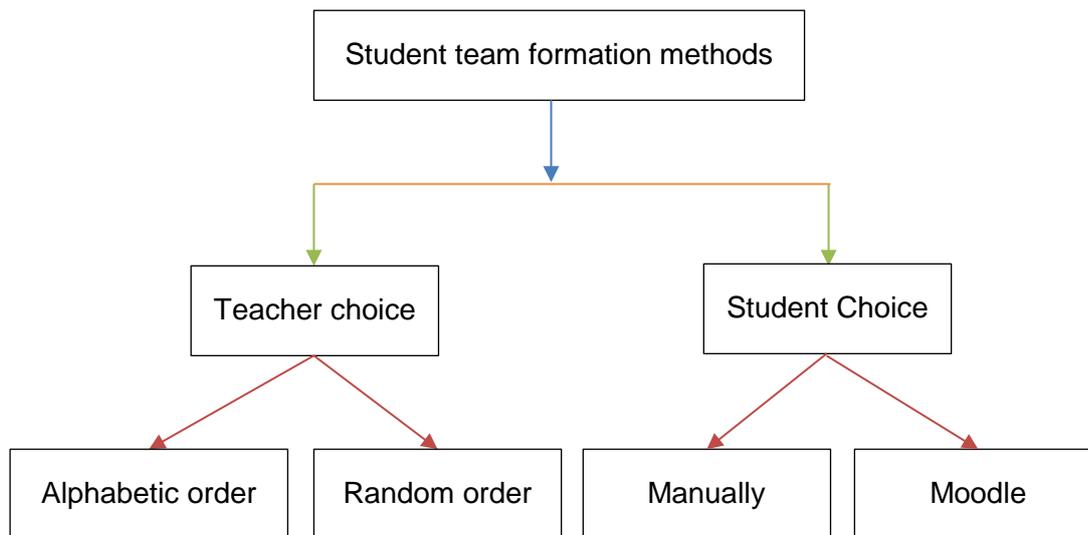

Figure 1: Student team formation models

Results and Discussions

In the past, team effectiveness in both teacher's choice and student's choice team was analysed based on team dynamics and team outcomes. Some studies focused only on team dynamics (Bacon, et al., 1999, Russel, 2010) whereas others focused on team performance through final grades and successful completion of the projects (Mushtaq, et al. 2012). The effectiveness of the teams formed in both the ways are evaluated in the current study based on team performance (i.e. presentations, reports, feedback, etc) through student satisfaction score, not based on the student final grades.

The student satisfaction score was obtained from university's online evaluations through Student Experience Survey (SES) in Moodle. The survey questions were on the following items, Moodle navigation, learning resources, assessment task, assessment requirements, assessment return and assessment feedback. The students were asked to provide constructive, effective and relevant feedback. They can complete the survey, anonymously, anytime from week 9 till they complete their exam. The students provide a rating on a 5-point Likert scale in each question. A unit performance matrix processes these ratings to provide overall student satisfaction scores for units through colour coding. CQUniversity's rating system is defined as 1 for strongly disagree, 2 for disagree, 3 for neither agree nor disagree, 4 for agree and 5 for strongly agree (Mandal, 2018, Mandal, 2019). To be statistically valid these rating, the student number of a unit should be ten or more and student response rate should be 50% or more and the corporate target for student satisfaction is 4.0/5.0 (Mandal,

2019). Officially, this rating is for unit evaluation only, however, realistically lecturer's ability and expertise of delivery and facilities provided for the unit has a big impact on these ratings.

Data from two units of CQUniversity's Master of Engineering courses, namely Australian Engineering Practice (ENEG20001) and Fluid Power Engineering and Control (ENEM20002) are used for the analysis. A comparison of team formation method by teacher-assigned and student-choice is carried out. For both the units, a teacher assigned method for 2017 (one year) and the student choice method for 2018 and 2019 (two years) are considered. Students' feedback and satisfaction scores articulate the best aspects of team formation. Figure 2 presents student numbers and student response rate through SES in Moodle for the period of 2017~2019. These data show that student numbers and response rate are more than 50 and 50% respectively. Therefore, data used in this study are statistically valid and acceptable. Figure 3, on the other hand, presents student satisfaction scores for both the units. It is seen in 2017 when student teams were formed by the teachers, the satisfaction score is 4.0/5.0 or a little over. A student satisfaction score of 4.0 on 5-point Likert scale is the corporate target (Mandal, 2019). In other years i.e. 2018 and 2019, the student teams were chosen by themselves. There was an upswing of student satisfaction, reaching 4.5/5.0. It is a clear improvement in student performance and engagement with their teachers. It should be noted, however, that factors such as Moodle navigation, learning resources, assessment task, assessment requirements, assessment return and assessment feedback played an important role in student satisfaction. Moreover, team compositions such as size (number of students), right combination of students (mixture of high achieving and low achieving students), their disciplines (mechanical, electrical, civil), etc has impact on performance.
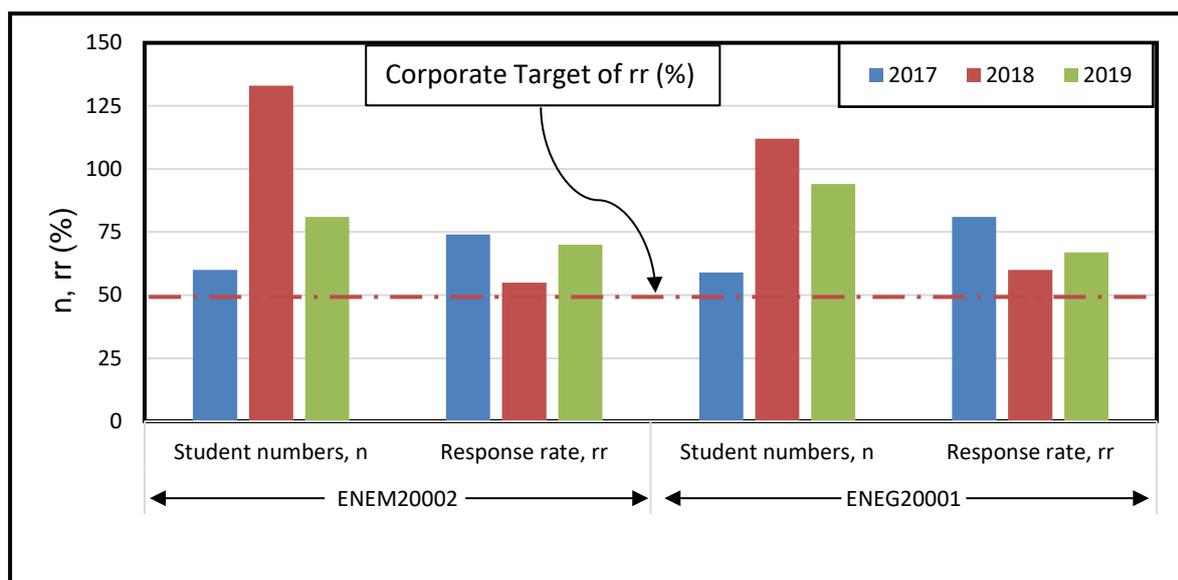

Figure 2: Student number, n and student response rate, rr of ENEM20002 and ENEG20001

Another important aspect we observed is that when the students choose their own teams, smart students always become proactive and select good/high quality students (friends) in their teams. They work better through good understanding, proper communication, taking correct responsibilities, producing quality report/document of their own tasks, etc. They also prepare themselves with coordinated effort for project presentations. It has also been witnessed in both the units and in Engineering Industry Project Investigation unit for undergraduate students. No doubt, they score higher marks in their presentations. On the other hand, some disadvantageous students could not find better students in their team which impacts on their team performance in terms of coordinated presentation, producing quality reports, proper communication, etc. This has been observed in both undergraduate and postgraduate units.
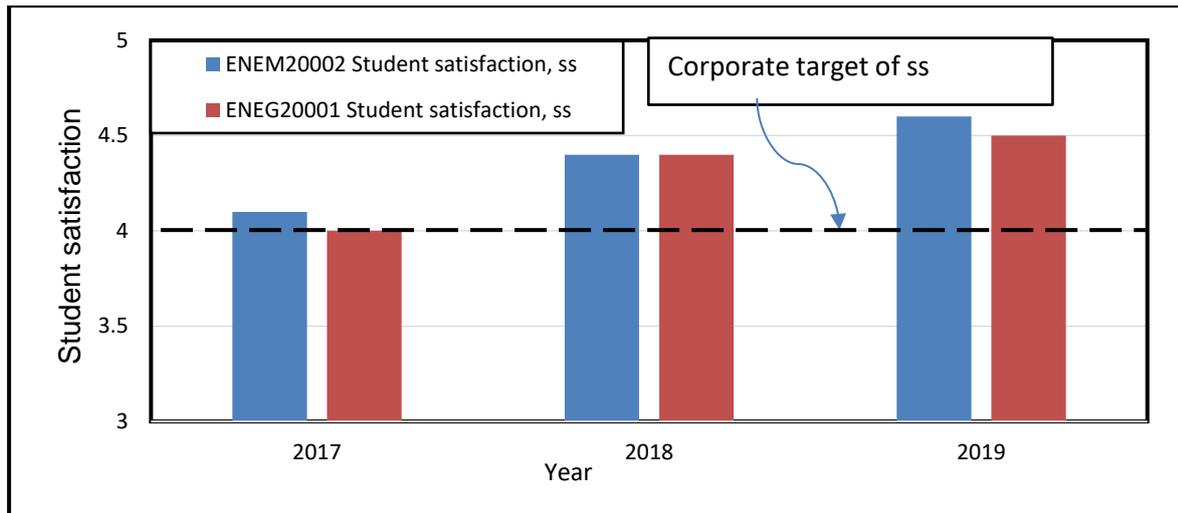
Figure 3: Student satisfaction, ss of ENEM20002 and ENEG20001

The unit coordinator's team-building efforts can resolve some of the limitations of forming good teams, which can improve their team output. It is to be noted that if high quality students form team by their choice, the team can successfully employ engineering principles into the project output, team dynamics into problem solving skills and student learning. Through the good team dynamic activities, their professional skills, such as time management, research, presentation, critical thinking and leadership can improve. Hence their satisfaction level culminates. Students' data articulate that team formation by student choice not only enhance the student leaning by achieving good grades (performance outcomes) by satisfying learning outcomes of the units, but also improve their satisfaction.

Therefore, it is necessary to develop a framework to rank the contributory factors to achieve student satisfaction scores. This study indicates that the team formation by student choice is a better method favoured by students. This finding agrees with findings of other researchers available in the literature (Pociask, et al., 2017). It is to be noted that team charter was used for both types of team formation, where team must have been agreed and signed with the contribution of each student in the team which they needed to submit with their project submission. We expect that each student in team should contribute equally, however, in some cases we have found that the contribution of each student is not same that determines their individual performance in a team.

Conclusions and Recommendations

Formation of student team enhances engagement, interaction and learning of a student for becoming practicing engineers in Australia. The student team formation for two units ENEM20002 and ENEG20001 were analysed in this study. Based on the analysis, the following conclusions can be made.

- A good student team enhances student learning.
- Team formation by student choice supports more in student's engagement, collaboration and learning and satisfaction.
- This initial study based on only 3 years data cannot identify correct reasons for superiority of a method of team formation solely based on student satisfaction as there are many other contributory factors. Team dynamics should be considered in the analysis.
- Further study is recommended for analysing data for a longer period of study to make more accurate trend of influence of team formation method on student performance.

- Impacts of team compositions such as number of students in a team, mixture of team members based on disciplines, right combination of team members (high achieving and low achieving students, etc) on team performance should be analysed.
- Team behaviour such as regular communication between the team members, timeliness, progress meetings, input from all members of the team, etc should be analysed.

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