

Full Paper

Introduction

Teaching project management to graduate engineering students involves getting students to acquire knowledge areas and skills in both 'technical' as well as non-technical 'behavioural' topics. Managing an engineering project requires having technical knowledge as well the ability to, individually and collaboratively, apply skills and techniques of critical thinking, analysis, synthesis, computations, decision making, negotiating etc.

Research suggest that Project Based Learning (PBL) is an effective, integrative instructional approach that engages students in their learning in both curricular and generic behavioural and contextual competencies that potentially facilitates and enhances learning (ChanLin, 2008, Wurdinger & Qureshi, 2015; Rios-Carmenado et al., 2015; Chua et al., 2014; Spalek, 2014, Tseng et al., 2013).

In this research we applied Project Based Learning (PBL) in a postgraduate engineering project management subject offered simultaneously in two different modes, namely, standard (face-to-face/in-class) mode and distant/ electronic mode (ePBL). Specifically, we monitored the student participation in a PBL and ePBL assessment and the quality of outputs submitted by groups in both modes of study. In the next section we define PBL and ePBL, followed by a description of the project-based assessment and group forming process. We then discuss the student participation and the academic performance of their assessment outputs.

Project Based Learning (PBL)

Project Based Learning (PBL) is defined as "a systematic teaching method that engages students in learning knowledge and skills through an extended inquiry process structured around complex, authentic questions and carefully designed projects and tasks" (Markham et al., 2003, p. 4). PBL is also a form of student-centered learning that resembles a workplace experience. It involves working on a problem for a 'considerable' length of time, producing a solution to a problem with an end product such as a report (Bédard et al., 2012; Helle et al. 2006).

In a PBL context students work in groups in an environment resembling a real project that requires them to drive their learning by applying concepts, technologies and tools (Çakiroğlu, 2014). This experience allows students to become actively engaged in their learning and not only passive recipients of knowledge, thus increasing their comprehension and processing abilities (Chinnowsky et al 2006, Johnson 1999, Cano et al. 2005, Kunberger, 2013). Thus, PBL supports increased student motivation, criticality and engagement in self- regulated learning strategies (Stolk and Martello 2015). The instructor's role in a PBL environment relies more on facilitation than on providing knowledge especially in areas of skills development such as problem solving, effective collaboration and communication with team members, negotiation and conflict resolution.

For a meaningful and engaging PBL experience for students, Lee et al. (2014,p 2), suggests the following criteria (derived from the nonprofit Buck Institute for Education) should be considered: "1) the project presents an authentic, real-world challenge; 2) the project is academically rigorous, demanding breadth and depth; 3) learners apply learning by using high- performance skills such as working in teams, communicating ideas, and organizing and analyzing information; 4) learners engage in active exploration by gathering information from various resources; 5) learners interact and

make adult connections; and 6) various formal and informal assessment practices are embedded within the unit.”

PBL in Distant Learning (e-PBL)

In distant mode learning, students do not get the face-to-face exposure of standard study modes, and their learning is completely facilitated through an online environment. To enable distant students to be part of a PBL experience, they would need to work in virtual teams through an electronic- Project Based Learning (e-PBL) experience.

Student Engagement (SPARKPlus)

In our experience of more than 15 years of university education, we observed that one of the main concerns that students express when working in groups, is that group members do not equally engage with and/or contribute to group discussions and deliverable(s). Consequently, the major contributors in groups feel frustrated and cheated when the same grade is equally awarded to all team members. Therefore, and in order to deal with such issues, we used SPARKPlus.

SPARKPlus is a web-based self and peers' assessment kit that enables students to confidentially rate their own and their peers' contributions to a team task or individual submission(s). When students complete their SPARKPlus rating, they will be able to see two scores that summarises their group rating:

First, Self Assessment to Peer Assessment (SAPA) shows the ratio of an individual's reflections of his/her own performance to the average of his/her peers' reflections of their performance to date. If SAPA is greater than one it means the individual's estimates of his/her own performance were greater than his/her peers' estimates for his/her performance. If it is less than one then it means the individual's estimates of his/her own performance are less than what his/her peers think he/she has contributed.

Secondly, the Self and Peer Assessment (SPA) factor which is the outcome of the individual's self-ratings and his/her peers' ratings of them on both the tasks and the way the peers functioned as a team. If it is greater than one then that shows the impact on the individual's grade would result in their individual mark being adjusted so it is greater than the group mark.

If all the SPA are close to one, this indicates that all group members contributed equally to the task at hand. If all the SAPA are additionally close to one, then this means that all members rated everyone equally indicating that the team operated without significant conflict with a high level of agreement about equal contributions by each group member to the group task.

When used over a number of times, and through reflection on self and anonymous peer assessment, it allows students to improve their judgment of their own and their peers' contributions (<http://spark.uts.edu.au>).

Assessment Task

Students in both study modes were required to work in groups to produce a detailed project management proposal bid report for an engineering project. An assessment brief detailing the specifics of the project requirements was made available. The task included producing six weekly deliverables that constitute the main components of the proposal as well as a final bid report. A marking guide detailing the expectations of each deliverable and the final report were also provided. A week after each deliverable's due date, feedback on it was presented to the group. Students were instructed to use the given feedback to improve the quality of their final report that constitutes sections representing each weekly deliverable.

For their final report, students were instructed to account and agree on their individual % contribution to the work performed accompanied by their signatures where the total of all contributions added up to 100%.

Students in standard mode were given the opportunity to collaboratively work on the weekly deliverables and final report in class, and were encouraged to schedule meetings outside class time to work on their deliverables and final report. This was not possible for the distant mode students since they were located in various parts of the world, and would not be able to physically meet and work on their weekly deliverables or final report. Therefore, to get the distant students to work collaboratively, the university's online environment and e-learning management system (Blackboard) was suggested as a platform, however, students were free to use any other platform they preferred.

Group Formation

Standard Mode

151 students enrolled in standard mode of study. They were asked to self-select themselves into groups of 3-5 people in class by the second week of the semester. There was no particular criterion to the selection apart from the size of the group. Many students teamed up with people sitting next to them as most of them were in their first semester of postgraduate study.

Distant Mode

16 students were enrolled in distant mode. A work package was prepared for distant mode students to form themselves into groups. Students were emailed by the tutor and asked to log in to Blackboard and download the first work package. The work package contained instructions for setting up their online groups. There were four specific tasks to complete, one due each day for four days in week one of the semester. At the end of the four days the groups were formed.

The steps involved (1) Creating a post on the discussion board introducing themselves and giving a short bio and a joke (used as "an online ice-breaker"). (2) Reading all the introductory posts and identifying three other students they would like to form a group with, based on their introduction post. (3) Posting messages to them explaining why they think they would make a compatible team. (4) Self-enrolling in the designated groups feature in blackboard with 3 other students to form a group. Once they have a group and using the group's discussion board space, they discuss and agree on a "group code of conduct". (5) The final task in this introductory work package was to rate the participation of fellow team members in SPARKPlus.

The above steps gave the students experience with all the tools and processes they would need to use during the course of the semester. It served the dual purpose of forming the groups, and identifying any technical issues early on before they impacted on student learning.

From thereon, Students were able to virtually collaborate on producing the six weekly deliverables and the final report.

Discussion

Evaluation of the work produced by student groups in both study modes, and a comparison of the outputs are carried out. The study aimed to gauge whether there were noticeable differences in the performance of both groups resulting from the differences in group dynamics between standard and distant modes.

Assessment Evaluation

In order to eliminate any bias and ensure equal evaluation measures were applied, one marker assessed all the deliverables and the final reports. All students in both modes were able to communicate with the marker through Blackboard, and there was no face-to-face interaction between the marker and the students at any point during the evaluation period.

In total there were 33 standard groups and five distant groups. The final report average for standard and distant modes were 76.18% and 80.95% respectively. In general, the work produced by the distance students was of a higher quality, with the exception of those who failed to form groups, or formed them late and without completing the introductory work package. Other factors that could have contributed to the difference in assessment quality included the work experience and age of students in the two cohorts. As most of the standard mode students were enrolled in the master program immediately after completing the bachelor degree and without experiencing 'real-world' work, while most of the distant students were currently working.

The Group Work Experience

Students in both modes of study were instructed to complete a SPARKPlus survey for the second, fourth and sixth deliverables addressing for themselves and for each team member the following four criteria on a five-point Lickert scale:

1. Performs their tasks adequately
2. Participates in group discussions
3. Treats all group members respectfully
4. Provides leadership to resolve conflicts

The results of each survey were made available to the group members who took part in the survey. It would indicate to each group member how they rated themselves for the 4 criteria, and how their team members (anonymously) rated them for the same criteria.

Each student would get a view similar to the marked radar shown in Figure 1:

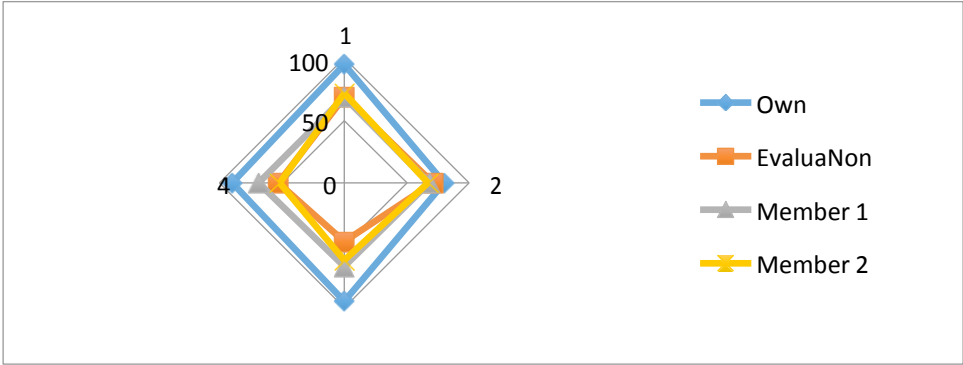


Figure 1: Example of SPARKPlus self and group evaluations.

It was interesting to note that for many students, their self evaluation and their peers' evaluation correlated more closely after the third SPARKPlus survey. This indicated that the longer students worked with their group members, the more realistic appreciation became apparent to their self and peers' contributions to the group effort.

Conclusions/ recommendations/ implications

We presented a PBL and ePBL experience in a graduate engineering management subject offered in two modes of study (standard and distant modes). Students in both modes were given the same assessment task to perform. Our observations and evaluation support research advocating the use of PBL and e-PBL in graduate management studies that aim to provide students with the ability to apply a variety of skills in environments resembling "real world" problems. Students in both modes of study produced a number of required deliverables over a few weeks that needed the application of various skills such as problem solving, leadership, critical thinking, decision making, and negotiating. The evaluation of student work showed that both PBL and e-PBL yield similar results of outputs.

We also monitored students' engagement in the group work through administering a survey where students evaluate their own contribution as well as their group members' contributions on three separate occasions over six weeks. We noticed that usually students have differing perceptions of their own contribution to the group work compared to their team members perceptions of their contributions, however, over time, by being aware of their peers' perception of their work, their perceptions and expectations tend to become more correlated.

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