

Flipped Classroom and Project Based Learning

Surendra Shrestha

Western Sydney University

Corresponding Author Email: s.shrestha@westernsydney.edu.au

CONTEXT

The rapid advancement in information technology is feeding into increasing popularity of flipped classroom (FC) approach, where students take ownership of their own learning outside the classroom and the class time is effectively used for discussions. This approach has resulted in improved student engagement and learning (Kim, Kim, Khera, and Getman, 2014). Another widely used strategy is the use of project-based learning (PBL) where students work collaboratively in teams to solve authentic real-world projects. In this approach, students take their own pathway for completing the assigned projects (Robinson, 2012). This results in motivated and engaged students culminating in better learning outcomes. At Western Sydney University (WSU), a hybrid approach that uses FC strategies in a PBL based subject was implemented to address the increasing disengagement of students.

PURPOSE

The purpose of this paper is to evaluate the effectiveness of the hybrid approach in improving student engagement and student learning.

APPROACH

Effectiveness of the hybrid method is evaluated through a comparative analysis of student performance in the subject over past six years. Student engagement was assessed through workshop participation and journal entries. Student journals and student feedbacks were used to gauge student perception and acceptance of the hybrid approach.

RESULTS

Active participation in workshop sessions, journal entries and the student results indicated that the students were better engaged in the hybrid learning and teaching (L&T) style when compared with the traditional L&T method.

CONCLUSIONS

Student responses, journal entries and observations in workshop sessions indicate that the hybrid approach was successful in better engaging the students. Performance of students, evidenced through the mark and the grade received, improved significantly when compared with the student performance in an equivalent unit in the previous years.

KEYWORDS

flipped classroom, project based learning, learning management system, learning outcomes.

Introduction

The rapid advancement in information technology (IT) is feeding into increasing popularity of flipped classroom (FC) approach, where students take ownership of their own learning outside the classroom and the class time is devoted to discussions. This instructional approach can result in improved student engagement and learning (Al-Zahrani, 2015; Little, 2015). In addition, when designed well and delivered properly, the approach is well received by both the learners and the facilitators (Gilboy, Heinerichs, and Pazzaglia, 2015). Another widely used strategy is the use of project-based learning (PBL) where students work collaboratively in teams to solve authentic real-world projects. In this approach, students take their own pathway for completing the assigned projects. This results in motivated and engaged students culminating in better learning outcomes (Bell, 2010; Robinson, 2012).

Like FC, the rapid pace of IT development has made implementation of PBL method much less complex. This is mainly due to the simpler user interface of the software driving massive inter-connected databases, making it easier and faster to explore and extract relevant information on line. Furthermore, use of learning management system (LMS) by educational institutions has facilitated dissemination of learning and teaching (L&T) material. The system allows students to access and engage with the L&T material at their convenience, resulting in better learning outcomes (Shrestha, 2015).

Following its high profile iPad initiative in 2013, Western Sydney University (WSU) embarked on the university-wide implementation of LMS. More recently, WSU launched yet another bold initiative of designing and building technology driven collaborative learning spaces (CLS). This is the result of WSU embracing itself as a 'student centred' university, where meeting student needs has become one of the central missions of the organisation. One aspect of achieving this goal is to continuously reinvigorate L&T material and style to continue to improve student engagement. As a part of this, a hybrid model that makes use of FC in a PBL based subject (unit) was developed and implemented in a senior level Civil engineering program in Autumn 2016. The unit selected, deliberately, was the one in which students traditionally struggled.

This paper presents the preliminary findings of the adopted strategy. Effectiveness of the hybrid model has been evaluated through a comparative analysis of student performance in the subject over the past six years. Student journals and student feedbacks were used to gauge the student perception and acceptance of the hybrid approach. These journals were also used along with in-class participation to determine student engagement.

Learning & Teaching: Design & Implementation

Weekly lectures and tutorials were replaced with full-day workshop sessions evenly spaced throughout the semester; with two facilitators per workshop – each student attended five evenly spaced full day workshop sessions during the semester. The first workshop was devoted to familiarise the students with the new L&T approach. A brief session on team dynamics, using the Belbin model, was held during this workshop. Following the team dynamics session, a student activity was held during the first workshop session to self-identify strengths and weaknesses of individual students. Project teams were then formed, where students were able to pick team members to complement their own strengths and weaknesses. A typical project team consisted of four members, the number varying between three and five.

Each team was handed out the project brief towards the middle of the first workshop session. Team members were then given time to discuss the project and its requirements. The brief given was based on real world engineering projects - each team was required to provide sustainable and practical engineering solutions to the land development project satisfying all regulatory requirements (usually the Council where the project is proposed); the focus was

on hydrological analysis of a catchment. Every team in the class were working on different land development project; hence, each team were expected to have their own solutions. The first workshop time was also used to provide clarifications and guidance, as required.

L&T materials in the form of PowerPoint slides and short video clips (from on-line sources and created) were posted at regular intervals. Duration of video clips ranged from three and half minutes to 40 minutes. Students were required to review the material posted on line and complete pre-workshop activities before attending the subsequent workshop session. Students were then provided guidance (as required) and assistance during workshop sessions to complete various parts of the assigned project.

Students were encouraged to seek assistance from the teaching team outside the scheduled workshop sessions. In addition, towards the end of the semester, a supplementary 66-min long video (as a refresher video) was recorded and posted on line as per the students' request.

During the semester, each team was required to make a brief class presentation outlining their progress up to that time (different teams made presentations during different workshop sessions). Each team also shared their learning experience and findings with their peers by making oral presentations during the last workshop session. Each team prepared and submitted a technical report, which formed a part of the final assessment.

Student Journals & Student Feedback

Students were required to post regular entries in individual journals and group Wiki pages on vUWS, the LMS used at WSU. Wiki postings were for group work completed each week whereas personal journals were used to provide specific entries describing the member's contributions to the project. The Wiki page was accessible to all team members whereas the journal pages were dedicated to individual students and were not visible to team members. This was also the medium used to check individual student's engagement with the L&T material as well as his/her contributions to the team project. Each member's activities during workshop sessions were also observed to cross check journal entries and the student's engagement with the L&T material. The journal entries also included regular personal reflections as the students progressed through the semester. The journal entries were used to assign mark for assigned tasks for pre- and post-workshop sessions.

Personalised e-mails, seeking their experience of the L&T style, were sent to every student enrolled in the unit at the end of the second workshop session. This was an unusual experience for the students, as they were used to providing feedback only at the end of the semester. A total of 13.7% students enrolled in the unit responded. Student responses included both the 'best aspects' and 'needs improvement' aspects of the unit. This helped in developing and implementing additional material to help the students gain better understanding of the unit material. End-of-semester student feedback on the unit was administered centrally; 48% of students responded. Additional feedbacks were received from 6.5% of students, after the final results were published.

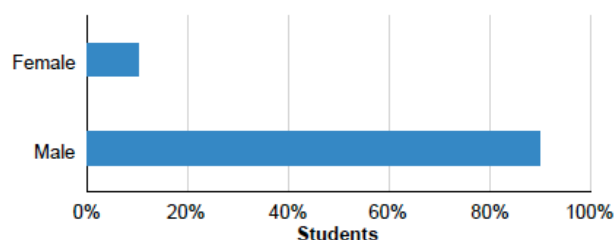


Figure 1: Gender Mix

Similar to any other typical unit in Civil engineering program at WSU, the proportion of female students in the unit was 10% (Figure 1). Similarly, about 10% of students in the class were international students (Figure 2). Due to de-identification of data before analysis, it was not possible to determine the proportion of female and international students who responded to the survey questionnaire. However, it was known that all students were enrolled in the unit for the first time. Therefore, all students were exposed to this L&T style for the first time.

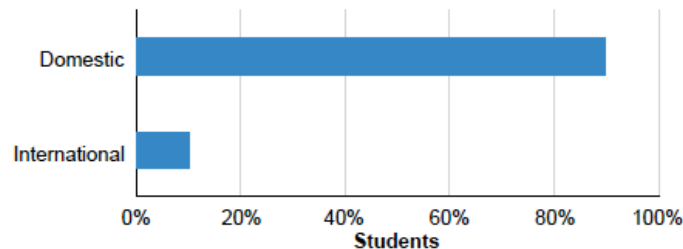


Figure 2: Domestic vs International students

Results and Discussions

Journal Entry

The journal entries indicated that the students were better engaged in workshop sessions when compared with traditional style of teaching and learning - lecture sessions supplemented by tutorial sessions. Both in-semester and end-of-semester feedbacks suggest that the students enjoyed the new learning environment. While the students found the authentic real-world projects to be challenging and fell outside their comfort zones, the student feedback suggest that they enjoyed the challenge as they were able to see the project's practical significance. The following (end-of-semester) response from one student echoes a number of similar responses.

"The new style ... was enjoyable as it provided an alternative to normal lecture/tutorial/exam.... – the extensive use [of] technology ... was ... highly useful."

One student posted the following note after the first workshop session.

"I was part of the new ... learning experience today.... I worked in an engineering firm ... for 4 years and the way that you are teaching this unit is ... the best way students can get a feel for the kind of work and collaborations they would be expected to do when they graduate...."

Specific quotes, from 25 randomly selected student journals, were extracted. These were de-identified and emerging themes generated. These themes were then analysed to determine student perception on the L&T approach developed and implemented. The findings are presented in Jones and Shrestha (2016), who concluded that the hybrid approach was well received by students. The students found the content interesting and delivery method engaging. The role played by technology driven collaborative learning space (CLS) in content delivery is presented in a companion paper by Shrestha and Wang (2016) in this conference.

Student Performance

Workshop attendance and participation as well as frequency of journal entry were used as surrogates for student engagement in the unit. As stated above, students were found to have been better engaged in the hybrid L&T style when compared with the traditional style. The challenge then was to compare learning outcomes; whether the students have achieved the unit learning outcomes. Regular journal postings and class interactions provided a sense of how the students were progressing during the semester. But, it was difficult to judge the

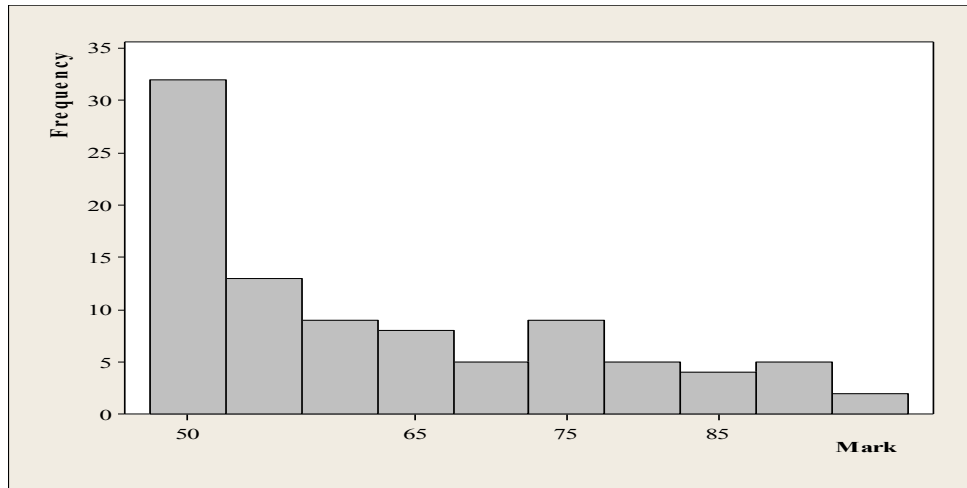


Figure 3. Mark Distribution (Autumn 2016)

degree of student learning until their final submission (technical report) complemented by in-class oral presentation. It was refreshing to see the students' confidence during oral presentation sessions. It was even better to see everyone engaged during the question-answer period after each presentation. It was evident that the students were able to successfully overcome the challenges through help from the teaching team and peer support. The mark distribution shown in Figure 3 indicates that every student enrolled in this unit achieved the unit learning outcomes.

Table 1. Grade Distribution (2011-2016)

GRADE	2016 (%)	2015 (%)	2014 (%)	2013 (%)	2012 (%)	2011 (%)
H	11.6	7.8	6.5	5.0	1.4	9.0
D	13.7	10.3	10.1	10.0	9.1	16.9
C	14.7	25.9	29.5	17.5	23.8	19.1
P	56.8	40.5	36.7	45.8	29.4	29.2
F	0.0	9.5	9.4	10.0	15.4	15.7
AF/FNS	3.2	3.4	5.0	7.5	7.7	10.1
Other	0.0	2.6	2.8	4.2	13.2	0.0
Student No.	95	116	139	120	143	89
F+AF/FNS+Other	3.2%	15.5%	17.2%	21.7%	36.3%	25.8%

It is interesting to note that while every student in this unit were attempting the unit for the first time, every one of them passed the unit. This is in sharp contrast to student performance in previous years in an equivalent unit using the traditional L&T style (please see Table 1). The good students performed better, as evidenced through higher proportion of Distinction (D) and High Distinction (HD) grades. The students who were at the failing range were pulled up by their peers, through peer support. This approach helped weaker students. The weekly meetings helped these students gain enough understanding to achieve the threshold mark for this subject. This was evidenced through student feedback - an excerpt from the student feedback states, "*The ability to work as a part of a team to work*

through and solve problems relating to the project” was one of the best aspects of the approach adopted in this unit. The most revealing outcome is that every student who completed all the tasks in the subject passed the subject.

Student Feedback

End-of-semester student feedback on the unit suggested that the students were able to see relevance of unit material. The responses (see Table 2) show that the students felt that the L&T approach helped them develop critical thinking strategies in addition to analytical skills, problem solving skills and communication skills. The response to the reasonableness in the amount of work required was not as promising, though. Almost half (46%) of the students who responded felt that the work required was excessive. This indicates the challenges the students faced with the material in this unit. In spite of this, the success rate was 100% - every student who completed all the assigned tasks successfully completed the unit requirements indicating achievement of unit learning outcomes.

Table 2. Student Feedback on Unit (Spring 2016)

Question item	Students who strongly agreed or agreed (%)
Relevance of unit content	82
Design activities helped learning	76
Assessment activities helped learn	73
Provided flexibility for study	65
Amount of work required reasonable	54
Helped develop critical thinking, analysing, problem solving and communicating skills	78

Conclusions

Student responses, journal entries and observations in workshop sessions indicate that the hybrid approach was successful in better engaging the students. Performance of students, evidenced through the mark and the grade received, improved significantly when compared with the student performance in an equivalent unit in the previous years. Having observed this, it is important to note that each student cohort is different and the way they learn are also different. Therefore, the findings presented in this paper need to be treated accordingly. Additional long-term longitudinal study is required to come to a definitive conclusion. One observation made by the teaching team, during in-class oral presentation was that the need to defend their solutions in-front-of their peers necessitated the students to re-think through the tasks they have completed, resulting in better understanding of their own work.

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