Individual student assessment in team projects: a team charter approach

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structured abstract

context
Innovation in learning and teaching practices for increasing student satisfaction, retention and reducing student attrition are the main keys for the School of Engineering and Technology at CQU. Our School fosters innovative learning and teaching practices in both active learning (student centred - project based learning and hands-on) and passive learning (lecture centred – traditional methods). Both engineering technical skills and professional skills are important and prerequisites for our engineering graduates to be successful in a challenging work place. Motivation in student learning differs in passive and active learning. Industry linked projects with detailed scopes in project based learning mode is more interesting and motivating to students. It is very essential to develop a framework that generates interest and stimulates curiosity of students to learn in higher level engineering units such as Fluid Machinery. The student cohort consists of school leavers, mature age students and students from diverse cultural backgrounds in both distance and multi-campus modes.

purpose
The purpose of this study is to evaluate the effectiveness of implementing a team charter framework in my fluid machinery unit with higher level mechanical engineering cohorts over other student assessment approaches. It focuses on how student satisfaction and motivation link to student learning because of a good individual student assessment strategy in team based project works.

approach
Influential learning and teaching (L&T) practices are the core of the framework for engagement of engineering students in the learning process. The learning process starts with a good industry project with detailed scope documentation and a proper methodology to assess individual student’s learning in team based projects. Along with detailed scope documents relating to industry projects, assessment criteria for team submission and a team charter (TC) document are considered for each individual student’s assessment in a team work environment. The team charter approach is compared to a portfolio based assessment style. The impact of this approach and framework is evaluated using CQU's online evaluations through its Student Experience Survey (SES). With careful consideration and evaluation of these data, the effectiveness and usefulness of the team charter framework and outstanding L&T practices are evaluated and noted. For further refinement, a few recommendations are proposed through an Annual Unit Enhancement Report (AUER) to the program committee of the school with a view to implement improvements in the next offerings.

results
The satisfaction data of my fluid machinery unit obtained by SES from 2012 to 2016 were low and produced much student feedback relating to assessment of student portfolios. With the introduction of the detailed scope document for industry projects, proper assessment criteria for team submission and TC of my unit fluid machinery showed that the student satisfaction improved significantly over the corporate target in 2017. So the articulation of a student motivating framework using TC yields interest and stimulates the curiosity of students to learn and provides them greater satisfaction.

conclusions
The effectiveness of the team charter approach on individual student’s assessment on team based projects is evaluated and compared with the portfolio based assessment type. The team charter approach is evaluated positively though student satisfaction ratings and their learning experience.

keywords
Project based learning, Team charter, Student motivation in learning, Assessment framework.
Introduction

There are two major approaches in teaching: teacher-centred/content-oriented and student-centred/learning-oriented. The latter approach, called the Project Based Learning (PBL) approach of delivery, is becoming more popular in Australian universities (Mandal, 2018a, b; Stewart et al. 2018). Formal examinations in content-based mode are replaced by a few projects in context. Students are the driver in their learning and the lecturers are the facilitators. Students in engineering disciplines under this mode should provide evidence that they achieve both content-based learning such as design knowledge and problem solving skills and professional skills such as time management, communication, presentation skills etc. Atman et al. (2008) pointed out that there was a problem for students in traditional mode to put into practice students’ quantitative knowledge in design because their problem solving skills were not relating to context. In a recent article, Abellan-Nebot (2018) pointed out that many professional bodies responsible for accrediting engineering programs were urging the integration of industrial practices into the current engineering curricula. The author saw the benefits of such integrations through his project-based experience in real manufacturing activities of a unit of mechanical engineering: increased student satisfaction, improvement in exam performances and increased enrolment numbers. In PBL modes, the students complete a few industry related projects in teams to develop project management skills based on a brief scoping document of clients. The students know the steps for completion of a project by a team: how to start, what to do, selecting a suitable method, analysing and evaluating results obtained. Through the facilitators’ briefing session, students identify what knowledge and skills their team need and they finish the project through self-directed learning. However, there is problem when it comes to the question of assessing individual learning in a team based project. It is expected that students’ grades should be based on their learning as an individual in teams. There is an argument that team project outcomes can influence the individual student’s grades, even to the extent that all students in a team are sometimes getting the same grade/mark relating to the project outcomes. There is little or no connection with individual learning. This suggests a good project outcome by a team leads to good individual grades. Howard and Elliot (2012) indicated that a significant individual learning happened from even poor team project outcomes. Then the question arises as to how effectively/accurately we can gauge individual learning in team based projects. There are a few approaches that can be briefly presented here.

Traditional engineering units and PBL-based units are different in delivery and assessments. In PBL modes, the industry projects form the context of student learning supported by laboratory studies and other forms of teaching activities. CQUintroduced PBL mode of delivery in its Bachelor of Engineering Program as early as 1998 with a view to providing work ready graduates. Several other universities in Australia introduced it soon after such as Victoria University, the University of South Australia, RMIT University.

For individual students’ assessment of grade in the team situation, the portfolio system, a holistic approach, was initially introduced. The students’ portfolio of a unit in PBL is a thick document containing a copy of each of their projects with summative/formative feedback given by the facilitators on it along with weekly reflective journals, workbook, laboratory reports, class test documents etc. Students claim a grade within a few pages at the start of the portfolio by demonstrating their learning through evidence (by examples linking different items in the portfolio such as reflective journals, projects and so on) of the unit learning outcome to a particular level set in an assessment criteria sheet. A grade rubric is then used to calculate the individual students’ grade. This will be presented in detail under the ‘Approaches’ Section.

Self and peer assessment (SPA) is another approach which is used widely in educational institutions. At the end of the project, students submit a SPA sheet giving points for himself/herself and other team members in the team following 5-point or similar scales on different categories/scopes (Goldfinch, 1994; Lejk and Wyvill, 2001). When the team report is graded based on an assessment sheet, the information (point/mark) on each SPA sheet is used to calculate individual marks/grades for team members. A detailed description is in the next section ‘Approaches’.

Through reviewing the above literature, it was revealed that the SPA method was used in PBL units to assess individual student’s marks in team based projects in many universities. A clear marking scheme was established and students were familiarised with the approach. A team charter approach, also called holistic peer assessment, as used in this paper to calculate individual marks/grades in teams is based on students’ contribution/share of different elements in the projects. The detailed description is presented later in Section ‘Approaches’. The research question of this study is to identify the effectiveness of the team charter approach in assessing individual students’ marks on team based
projects. The research design is based on the shifting of students’ individual grade in team projects from a portfolio method to a team charter approach. The effectiveness of this shifting of research design is judged by the SES data and feedback given by the program committee of the school through AUER. This study involves 3rd year mechanical engineering courses with the student cohort consisting of school leavers, mature age students and students from diverse cultural backgrounds in both distance and multi-campus modes.

**Approaches**

In this section, different methods of assessing/calculating individual marks/grades are presented along with the team charter method used in this paper. The approaches discussed are: portfolio based criteria, SPA and team charter (TC) methods. All these methods use their own particular way of assessing student’s learning of learning outcomes (LOs) set for the PBL units

**Portfolio Method**

This is one of the oldest methods of assessment of individual grades in PBL units. There are many components integrated in a student portfolio. They are: completed team based project reports, fortnightly reflective journals (done by individual student), reflective papers (done by individual student), team lab reports, demonstrated problems (done by individual student) and individual grade nomination.

The project scopes, demonstrated problems, lab sheets, templates of reflective journal and reflective papers, project assessment sheets and grade rubrics are prepared before terms start. Students are carrying out projects and labs in teams of size 3–5. Technical knowledge related to the projects are delivered to the students through weekly lectures and tutorials. Weekly project workshops, lab and computer sessions are carried out to complete project and lab works. Students upload the completed tasks such as team project reports, individual reflective journals etc. in the Moodle site. The facilitators of the PBL units download and provide summative feedback and allocate indicative grades on it. The facilitators then upload the students’ documentation within two weeks of submission.

At the end of the term, each student prepares a thick file called a portfolio and submits for assessment. At the start of the portfolio, the students put a short section (maybe ten pages long or so) for nominating an individual grade of the unit with evidence. The facilitators supply a template on how to write a good grade nomination document based on an assessment tool targeting learning outcomes of the unit and grade rubric. There are various levels set in the unit assessment tool such as fail, pass, good, very good and excellent incorporating a set of descriptors in each level relating to each learning outcome (LO). Students use keywords from the learning outcomes and descriptors of assessment tool to determine a level of his/her leaning for the particular LO of the unit. They support the nominated level using examples and evidence from team works (team projects, lab reports) and individual works (reflective journals, reflective papers, demonstrated problems and workbook). Students demonstrate their skills and learning by three or four examples as evidence to support a claim. The students use a hyperlinks system to allow an assessor to see quickly the validity of each student’s claim. The students then nominate a grade, either an HD or any other grade satisfying conditions set in the grade rubric. After careful consideration/reading of the claim and examples and evidences, the markers allocate a grade considering both grade assessment tool and grade rubric. The grade given by the assessor can be the same or different to that nominated by the students; the student’s nominated grade can be upgraded or can be downgraded. The final student grade is allocated by a moderation meeting among the teaching team members. A main focus is given to those grades that are on the borderline between two grades. This portfolio approach was used recently in PBL high level units in 4th year (Mandal, 2018a) and 3rd year (Mandal, 2018b).

**SPA**

In SPA, category based peer assessment is popular (Lejk and Wyvill, 2001). In this approach, there is a peer assessment sheet (printed or on-line version in the Moodle site). The assessment sheet has questionnaires on various categories. Leik and Wyvill (2001) pointed out some useful categories such as:

- general team skills
- communication skills
- technical skills
- motivation/responsibility/time management
- adaptability and
- creativity/originality

Students complete the peer assessment sheet secretly, answering all question set forth focusing on these categories for an example. This allows them to quantify the contributions made by all team members including himself/herself. As such, the students award marks for themselves and their peers as per a set marking rule (5 for excellent, 4 for very good, 3 for good, 2 for casual help and 1 for no help). A table can be formed by collating all the marks given by the students in a team. From these data, total marks of individual team member and the whole team are calculated. Average marks of the team are also calculated. When the team submission is graded as per the project assessment criteria, the individual mark of the team members is calculated using team submission marks, total individual mark and average team mark.

**TC**

This approach also focuses on individual contributions in % to calculate individual marks in team based projects. A direction initially is provided to the students to make it clear the meaning of contributions in % in different scopes of the project. It is expected 100% contributions are distributed among the team members. Two methods can be used: mutual understanding and individual % contribution distributions of students and team members. The first method is used in this paper to calculate individual marks in team projects. For the latter method, the facilitators collect all the individual marks/contributions in % and can average all of them for each team to produce a final team contribution table to calculate individual marks.

The mutual understanding method is also called the TC method. In this method, the facilitators produce a table and students input contributions data in % into that table and they sign it. It is expected that students are contributing to the project scopes as per the contributions in the table. A typical table (Table 1) can be used for this purpose. As this is an agreed and signed document, it can be easily used to calculate the individual marks in team projects.

Although this TC approach looks like a holistic approach, it has some clarity in % distribution. It is shown that total 100% is distributed in four sub-sections and each sub-section has some specific project scopes to be completed (Column 2 of Table 1). Based on student’s contributions and activities, they are putting numerical figures in each row a, b, c and d (Table 1) to manage % in sub-section. As a result, total individual % contribution data present a representative value.

**Table 1: TC method for identifying student’s contribution in %**

<table>
<thead>
<tr>
<th>Items</th>
<th>Load of scopes in %</th>
<th>Agreed contribution share of team members in %</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Name M1</td>
<td>Name M2</td>
</tr>
<tr>
<td>a</td>
<td>For scope nos. 1, 2, 3, and 4: 25%</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>b</td>
<td>For scope nos. 5, 6, 7, and 8: 30%</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>c</td>
<td>For scope nos. 9, 10, and 11: 30%</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>d</td>
<td>For scope no. 12: 15%</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>25%</td>
<td>30%</td>
</tr>
<tr>
<td>Signature</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Grade assessment of this method has two steps: grading of a team submission and an individual grading of each of the team members. When grading of a team submission is completed using the team assessment criteria sheet, then the individual grade will be determined based on his/her...
performance and contribution to the team submission (Table 1). Each student’s contribution will be determined by a team charter (above) signed by the team members and submitted to the unit Moodle site. The individual marks of the team submission can then be determined using some equations. An example is given below. It is possible that an individual mark may be higher, lower or equal to the team submission mark. However, a maximum individual mark can be capped at the maximum mark allocated to the assessment. We can consider a team of four team members: M1, M2, M3 and M4. If this team receives a team submission mark of 20 out of 25 (25 is the total mark allocated of a Project), and if the final team charter (signed) presents the following individual contributions in percentage, the individual marks will be calculated as: individual contribution/share in (%): M1 25%, M2 30%, M3 20% and M4 25% as per submitted team charter (total is 100% and fair share is 25% for a team of 4).

Individual Weighting Factor (IWF) (Cheng and Warren, 2000) is included in the following calculations. This factor is in brackets, given below. The IWF overcomes the possibility of unfairness of giving same marks to all team members carrying out a project. The IWF can be redefined as:

$$IWF = \frac{\text{individual contributions to projects}}{\text{fair share of contributions}}$$

The individual rating can be obtained differently by following marks/efforts from seminars, oral and seminar presentations, individual awards. The average of fair share or rating for each team is obtained by summing all individual ratings/contributions for the team and dividing by the total numbers of team members.

Individual marks: 
- M1 = 20 x (25/25) = 20 out of 25; 
- M2 = 20 x (30/25) = 24 out of 25; 
- M3 = 20 x (20/25) = 16 out of 25; 
- M4 = 20 x (25/25) = 20 out of 25

**Results and Discussions**

Many professional bodies for accreditation of engineering programs require that both fundamental engineering core knowledge and professional skills are necessary. The following professional skills are essential for industrial project works:

- Interpersonal relationships and individual responsibilities
- Personal transferable skills of communication
- Presentation and problem solving skills
- Leadership and time management skills
- Delegation and organisation skills
- Learning through discussion and debate
- Justification of ideas

It had been noted that there was low ability of engineering graduates to apply knowledge to industry problems (Abellan-Nebot, 2018). To develop student’s skills in both areas and to make engineering graduates ready to work, some active learning approaches are required through BPL methods. Initial approaches allocate equal marks/grades to all team members and this was not a correct method (Willmot and Crawford, 2007; Cheng and Warren, 2000). A particular form of peer assessment can be employed to meaningfully factor individual contributions in collaborated team works. If a particular SPA or TC is employed, many of the students receive a grade that can be different from the grades if the same grade is awarded to all team members (Cheng and Warren, 2000). The authors showed clear benefits and drawbacks of group works.

It is the responsibility of the coordinators/lecturers to give proper grades/marks. It is not fair to the students whose contributions are higher than the corresponding marks they are getting. Assessing individual students in a team is problematic. To overcome these problems and to ensure a fair grade to a team member, assessments must reflect the individual contributions and learning from the projects. Various methods for assessing individual grades in team based projects are employed. Some of these methods are portfolio, SPA and TC based. The TC approach has recently been used in my higher level PBL units for postgraduate and undergraduate engineering. Previously the portfolio based approach was used to assess individual grades. My student cohort consists of school leavers, mature age students and students from diverse cultural backgrounds in distance and multi-campus modes (Rockhampton, Gladstone, Bundaberg, Mackay, Cairns, Melbourne and Perth). When team project assessment is completed by the use of good assessment criteria, the calculations of individual marks in a team project is straightforward using an equation. An Excel sheet is prepared to calculate all students’ individual marks quickly. As the steps of a TC approach are populated in the unit Moodle.
site, there is no confusion regarding individual marks in team project marks. The equation used for calculating the individual marks is different for different teams. It is based on the data provided by the team using the template (Table 1).

Table 2 shows student satisfaction scores obtained by the university Moodle system for several years in the recent past. The students satisfaction score is produced following a 5-point Likert scale where 4.0 is a corporate target. It is clear from Table 2 that SES data for student satisfaction is very good from 2017, being in the green zone of the university colour code system.

<table>
<thead>
<tr>
<th>Year/unit</th>
<th>2012</th>
<th>2013</th>
<th>2014</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
</tr>
</thead>
<tbody>
<tr>
<td>A PBL unit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student numbers</td>
<td>25</td>
<td>35</td>
<td>22</td>
<td>34</td>
<td>37</td>
<td>60</td>
<td>133</td>
</tr>
<tr>
<td>Student satisfaction</td>
<td>3.7</td>
<td>3.0</td>
<td>3.8</td>
<td>3.3</td>
<td>2.4</td>
<td>4.1</td>
<td>4.4</td>
</tr>
<tr>
<td>Student feedback rate (%)</td>
<td>44</td>
<td>57</td>
<td>68</td>
<td>67</td>
<td>58</td>
<td>74</td>
<td>55</td>
</tr>
</tbody>
</table>

In the portfolio approach, a direction on individual grade nomination was provided to the students that the nomination must be sensible. Although student’s claims are based on evidence, they are generally over-estimated and some dissatisfaction prevails among the students when they get their results. Unit coordinators then get many e-mails relating to student’s enquiries of lower grades. This type of enquiry is less in the TC approach. The author of this paper did not get any enquiries at the end of the term and the students are generally happy due to the clarity in individual assessments in team projects.

Although the main focus of this paper is individual assessment in team projects, additional innovative L&T practices such as good scripting of industry projects, clear requirements, feedback etc. are important. The SES provides student ratings on the 5-point Likert scale with 4.0 as the corporate target on various aspects of the projects such as assessment task, assessment requirement, assessment return etc. The data on these descriptors are presented in Figure 1. The data set illustrates clearly that, with proper assessment of industry team project outcomes, the student satisfaction score can be improved significantly over the corporate target. The corporate target is considered for benchmarking of my unit’s performance. If the students’ rating is over the target, the unit is considered to be in the green category (Mandal, 2018a) and no further critical interventions are needed.

On the other side of these approaches, a question may arise about % contributions; is it representative? If there is a teaming problem, contribution data can be manipulated although they are signed. Some team members can be in disadvantaged positions. A team combination can play an important role here. If the TC approach can be done in a way that each team member can populate team members’ contributions and upload this in the Moodle site independently so that the unit coordinator can average all data from all team members, this modification can result in more representative contribution data.

The novelty of this paper relies on the fact that the moderation happens separately on different parts of the assessment rather than doing it for whole portfolios. The steps of TC are clearly presented and it removes the confusion of different students’ grades in a team. As the objective is to present the effectiveness of the TC method, final results/grades of the students of the unit from two projects, a laboratory study and a quiz, are not presented. It is true that TC alone cannot improve students’ learning and satisfaction – it is based on class and tutorial activities, laboratory and project activities etc. However, it definitely helps to improve students’ satisfaction. From 2017, the number of student queries about their final grades after the certification day have been reduced. Previously, I received many e-mails and telephone calls from students in relation to their dissatisfaction of different marks compared to other team members in the Portfolio approach. They often fail to realise that their final grades were based on evidence they put into their Portfolios, not based on the amount of team work.

Conclusions

The TC approach was used in my PBL unit for individual assessment of team based projects from 2017. Up to 2016, it was done by a portfolio method. It is assumed that student contribution data is a genuine reflection of their contributions to team work. Calculated grades are based on % of team work

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contributions, not their individual learning. From the results and discussions, the following conclusions are made:

1. individual marking assessment process in TC method is clearer
2. there are less queries at the end of the term for clarity of students’ grades
3. it positively influences student satisfaction
4. it yields interest and stimulates curiosity of students to learn

Figure 1: SES data for various Moodle descriptors

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References


