

Self and Peer Assessment in Engineering Students Group Work

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***Abstract:** The current practise in engineering education increasingly entails team work and group projects. The ability to work effectively in teams is considered by many to be an essential skill required of today's engineers; some claim that such ability is one of the most desired qualities of a graduate engineer. Group projects are frequently used to improve and develop students' team skills. Other reasons for using team projects include better simulation of industrial conditions, improvement of interpersonal and leadership skills and communication enhancement. Assessing individual students in a group or team activity is a challenge. This paper presents results from the preliminary study of a peer assessment instrument for awarding marks to individual members for a group project. The tool employs both quantitative and qualitative methods to assess the role and contribution of individual team members. The results indicate that the instrument provides an accurate measure of the student's participation in teams. Results can also be used as a model to extend project based group work to other courses in the programme.*

Introduction

The use of group based project work (GBPW) is becoming increasingly popular in higher education due to sound pedagogical reasons. Group learning achieves deeper learning and students retain information longer, and are also more likely to attain higher grades. Using GBPW can enable students to develop personal transferable skills of teamwork, communication, presentation, problem solving, delegation and organization. They also acquire better understanding of the environment in which they would be working as professionals as group work better simulates industrial conditions (Cheng and Warren, 2000).

Although the concept of team-oriented project-based learning has been generally validated, the assessment in such condition is considered to be subjective, not usually repeatable and generally questioned. The common criticism of group work by both teachers and students is related to a situation when the same assessment or grade is given to all group members irrespective of the contribution or efforts individual members of the group have made (Kørnøv et al, 2007). This drawback can however be overcome by using a tool which provides for the assessment of students' individual contributions.

Assessment is normally used for at least one of the following reasons: to improve, to inform and to prove the curriculum. These reasons contribute to making the assessment a decisive motivating factor in the learning process. Ramsden (2003) maintains that '*from our students' point of view, assessment always defines the actual curriculum*'. Assessment in most engineering courses is usually summative

in nature i.e. the assessment is carried out periodically during the teaching period. For example, quizzes, tests or exam provide information about students' understanding of knowledge and ability to carry out essential course learning outcomes. It also provides for individuals to receive formal credit for their activity in the form of a grade. The process is often feared by students since there is always a possibility of error and loss of deserved grade (Biggs, 2003).

There are two main problems with group work, namely, the existence of so called free-riders in the team and the work submitted being a collection of individual contributions rather than a consolidated team effort (Fink, 2004). The solution to both problems would be to intentionally and actively involve students in assessing their own, and their peers' contribution to group work by using some form of peer and self-assessment tools. Such an approach has been advocated for by a number of researchers (Goldfinch and Raeside, 1990; Conway and Kember, 1993). Self and peer assessment is a particularly useful method to award marks because it is difficult for the lecturer to know what individual contribution has been made by students outside the normal class time. Students are in a unique and privileged position to assess individual contribution by group members to the agreed milestones and the final work product. Also, non-conventional assessment can empower the students (Leach et al, 2001) in that they become actively involved in the learning and teaching strategy. Both peer assessment and self-assessment provide an opportunity to learn critical evaluation skills. Although, this approach is also criticized for not being reliable it is arguably the only pragmatic method of assessing group members. The reliability can be improved by using multiple ratings (Falchikov and Magin, 1997).

It has been suggested that students should be involved in the assessment process of the group work at an early stage, i.e. in the development of the assessment criteria and the decisions about what can be used as a proof of the contribution. Students would then own the process, support it and be realistic in assessing themselves and others. However, there are also several studies in which the criteria are set by the assessor with no input from the students (e.g. Conway and Kember, 1993; Goldfinch, 1994).

There are mainly two categories of peer assessment methods within group project work; holistic and category-based. In holistic type each student awards only one grade to each of the other group members, which summarizes overall contribution to the group effort. In category-based method which was used in this study, students assess each other in a number of categories and these scores are incorporated as a percentage contribution for each group member.

Self-assessment of work performed by individuals has a longer history than equivalent peer assessment. It has been reported (Lejk and Wyvill, 2001) that more experienced or senior students tend to be more accurate and reliable in their self-assessment (and, incidentally, in peer assessment) than less experienced or junior students. Interestingly, students studying scientific type courses tend to be more accurate than those from the arts or humanities. Also, good students tend to under-rate themselves and weaker students tend to over-rate themselves in comparison to lecturers assessments (Lejk and Wyvill, 2001). There are also reports on using students self and peer assessment to adjust summative teamwork marks into individual summative marks for team members. Contributions are rated by all students in a team (Goldfinch and Raeside, 1990; Goldfinch, 1994).

Methodology

The structure of the questionnaire used in the current study was patterned after sample instruments that were collected from a variety of sources including engineering education, communication, engineering practice, and teacher education (Johnson, 1997; Vilson, 1997; Kaufman et al, 2000; Freeman et al, 2006). The goal was to generate a concise, easy to complete instrument that would inform team efforts to target deficiencies which impact on teamwork abilities. The questionnaire was also used as a self and peer assessment instrument.

Students were asked to respond to the questions using five-point Likert scales from (1) strongly disagree to (5) strongly agree. The questionnaire consisted of 5 categories with 35 items. There were also open ended questions about the assessment in general. All students were asked to complete the questionnaire individually and confidentially.

There were 18 final year students taking part in the self and peer assessment exercise of whom 17 and 1 were respectively from mechanical and electrical engineering undergraduate programmes. The group project work was undertaken in a course entitled Production and Operations Management (POM) which, like many courses in the mechanical engineering programme, did not normally use peer and self assessment method. The group project was an assessed piece of assignment within POM course and contributed 40% towards the continuous assessment of the course. At the beginning of the course, the students formed themselves into groups of three to carry out a group project which had the following three assessable components or milestones:

- A seminar group presentation at the beginning of the project
- An oral presentation at the end of the project
- A written report.

Each of the above components was carried out as a collaborative group activity.

The group mark was a combination of the lecturer's mark and that by the remainder of the class i.e. the presenting group did not award marks to its own group. Each class member was asked to rate each group project presentation, other than their own using the following qualities or criteria:

- Informativeness
- Achievement of group tasks
- Members contribution to the project

Presentation mark was weighted with 25% for peer mark and 75% for lecturer's assessment.

Mathematically, the individual seminar mark, p_i , was calculated from:

$$p_i = 0.25 \frac{\sum_{i=1}^{n-1} a_i}{n-1} + 0.75 b_j \quad (1)$$

where:

- a_i = seminar assessment mark by each member of class for the presenter (the presenter did not score himself/herself),
- b_j = supervisor mark for individual seminar presentation,
- n = total number of students.

Similarly, the individual final oral presentation mark, q_i , is:

$$q_i = 0.25 \frac{\sum_{i=1}^{n-1} c_i}{n-1} + 0.75 d_j \quad (2)$$

where:

- c_i = oral assessment mark by each member of class for the presenter (the presenter did not score himself/herself),
- d_j = supervisor mark for oral presentation.

The final presentation mark was a simple average of the results from equations 1 and 2 above. Only the lecturer assessed the written report.

Total mark was calculated by using weightings of 30% and 70% for final presentation and written report respectively, i.e:

$$f_i = 0.3 \frac{p_i + q_i}{2} + 0.7 s_j \quad (3)$$

where:

- f_i = individual final project mark,
- s_j = written report mark from supervisor.

Results and Discussions

Students were asked to rate themselves and their peers according to the categories in the questionnaire. The responses from items within a particular category have been combined and the results are discussed in this section.

Students were asked questions about group task including sharing the work, willingness to consider other ideas, valuation of diverse opinions, engagement in discussion during the processes, delivery of work in time, communicating ideas clearly, and working with team to resolve conflicts. In that respect, 33% of the students (i.e. 6 out of 18 students) rated themselves higher than their group members, Figure 1. The evaluation implies that the group members had contact with other team mates frequently and sharing of ideas might have improved making work more effective. This also suggests that, for at least some students, the formative evaluation did help to reinforce the need to work co-operatively and the assessment promoted high-quality learning.

In the qualitative response for overall contribution to the project with respect to members' ability to perform effectively in the team, and how effective the team has been at working together, 44% (i.e. 8 students) rated themselves higher than others; 56% of the students (i.e. 10 students) rated themselves lower than the group members. The results seem objective as it is not lop-sided. The results also indicate that the students fully understand the assessment process and were able to evaluate their contributions more clearly. The results are shown in Figure 2.

To assess each team member's performance members were asked to distribute 100 marks to the three members in the group, i.e. including self. Marks awarded by each student were different from marks awarded by other students in the class which confirms independence of assessment and also improves reliability of results. In that instrument 50% (i.e. 9 students) awarded 40 marks or more to themselves; 11% (i.e. 2 students) awarded themselves less than 33 marks and only one student awarded equal marks to everyone in the team. The results are depicted in Figure 3.

The component marks (i.e. seminar, oral and written) and the final marks are compared in Figure 4. It was observed that students awarded high marks to their peers during the seminar and oral presentations. However both the seminar and oral presentation marks shown in Figure 4 were calculated using equations (1) and (2) respectively, i.e. individual mark was a combination of the supervisor assessment and peer assessment with 75% and 25% weighting. Written report component was completely assessed by the supervisor. Using these three components the final project mark was calculated by using equation (3). The final mark is juxtaposed in Figure 4. It can be observed that for most students the final mark is almost equal to supervisor written report assessment.

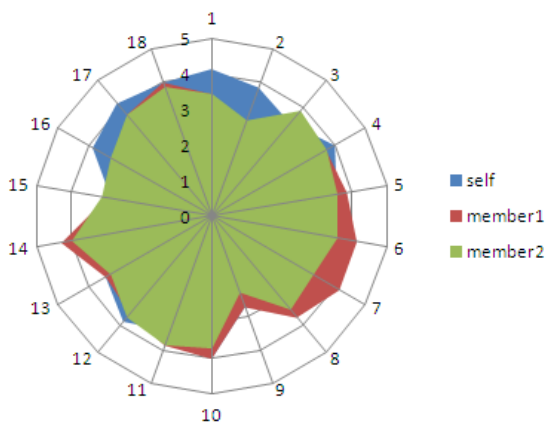


Figure 1: Response to Group tasks

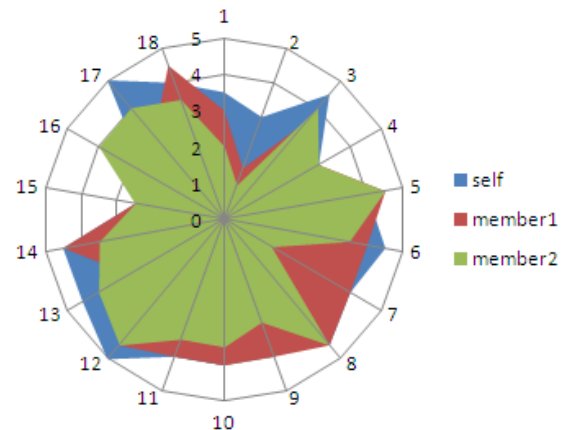


Figure 2: Overall contributions of group members to the project

At the end of the group project, each individual member was awarded a final project mark which was determined by a combination of marks given by both the teacher/supervisor (70%) and the rest of the class (30%). Figure 5 shows the comparison of individual final project mark in the course and overall mark obtained in the course. The results show that one student who has good project mark has failed

(i.e. less than 50%) the course and 4 students (i.e.22% of the students) got almost same marks in project and final.

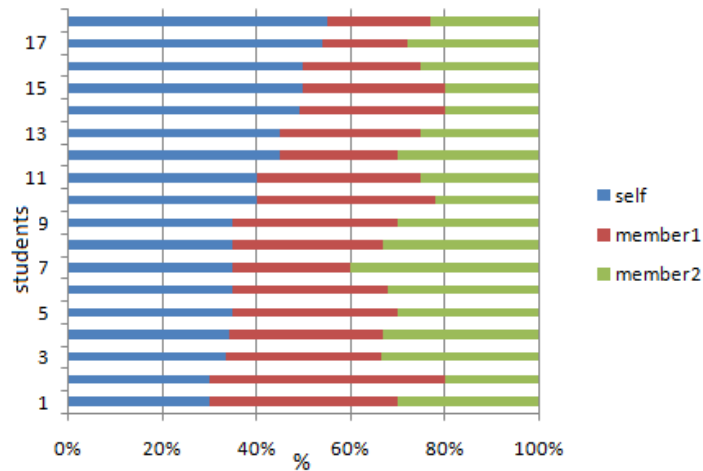


Figure 3: Assessment of each team member’s performance distributed over 100%

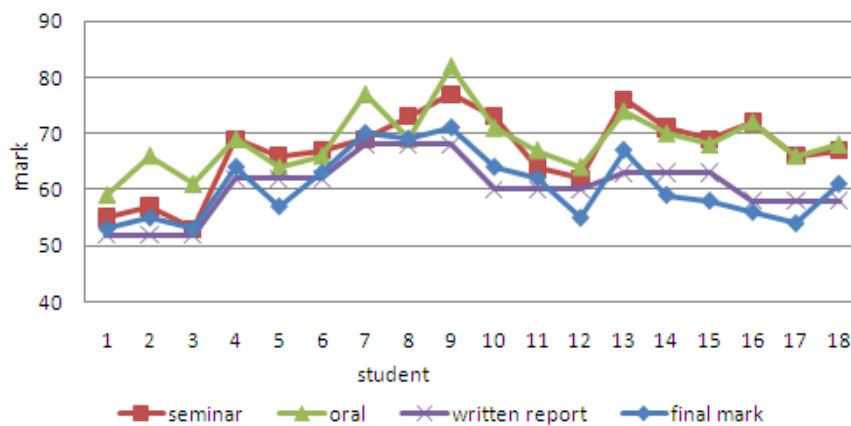


Figure 4: Comparison of components of the individual project mark

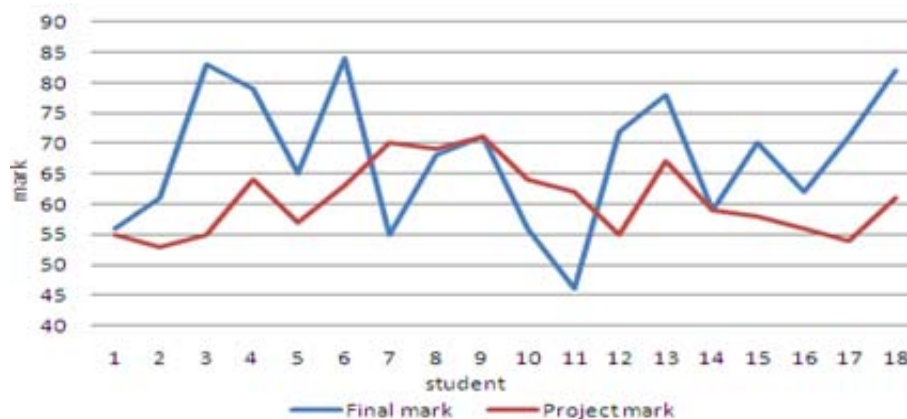


Figure 5: Comparison of final mark in the course and group project mark

The students were generally satisfied with the assessment method because they participated in the group project assessment. This type of assessment can enhance high-quality learning because students participated in various tasks and learning outcomes of the groups.

Conclusion

Assessment of students’ performance in engineering courses is usually based on summative method. The formative type of assessment has several advantages including students’ participation as

assessors. A self and peer assessment instructional tool was designed and used in a group project which contributed 40% of the continuous assessment to the overall mark in a mechanical engineering course. Each group achieved the targets of the project to the overall satisfaction of the lecturer as shown by the high pass rate in the course. The mark obtained in the group project is considered to be a true reflection of the individual student performance in the course. The questionnaire was used as the instrument for collecting the student's opinions and assessment proved to provide an accurate measure of the student's participation in teams. As the evaluation was reliable and students were satisfied to have participated in the process, group based project work can be extended to other courses in the programme. In particular the final year degree project which has for several years been run on individual basis may now be considered for a changeover to group work.

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