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The use of self- and peer-contribution assessments within a final year pharmaceutics assignment

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Abstract
This paper describes the experience of introducing student assessment of contribution to a final year pharmaceutics formulation group assignment, using a combined self- and peer-assessment approach. The Contribution Weighting Factors (CWFs) calculated from the student assessments were very tightly distributed, and the resulting adjustment to the overall individual mark received by the majority of the students was small. Very similar contributing factors would have also been obtained if only student peer-assessment had been utilised.

Keywords: *Group assignments, peer-assessment, self-assessment*

Introduction

The use of group work in tertiary education is advocated for a number of reasons, including those of encouraging deep learning (Mills, 2003), developing skills which will help the student in future professional and employment situations (Rafiq & Fullerton, 1996; Topping, 1998), and as a pragmatic approach to coping with increased staff to student ratios (Rafiq & Fullerton, 1996).

Student attitudes towards group projects is often very positive, both in terms of satisfaction with working in a group (Gatfield, 1999; Mills, 2003; Conway & Kember, 1993), and the development of skills by the student as part of working within a group (Lejk & Wyvill, 2002; Mills, 2003).

As with many peer-based activities, assessment of group work is an issue which often arises (Boud *et al.*, 1999; Conway & Kember, 1993). The need for fair and reliable mark distribution is seen as a vital element in the assessment of a group project (Rafiq & Fullerton, 1996), and particular consideration is required to deal with the potential for uneven levels of contribution by group members. For example, in one study in which undergraduate veterinary science students undertook group projects, the issue of poor contributors was found to be the least-liked aspect of working on the project (Mills, 2003). Often, in order to try to address these issues, assessment of group work is carried out using a mix of both group and individual assessment (Boud *et al.*, 1999). A common format for this mixed assessment is for the product of the group work to be marked in the traditional way by the lecturer, and the contribution of the individual to the work assessed by the team members (Orsmond & Merry, 1996; Conway & Kember, 1993; Topping, 1998).

The assessment of individuals by group members is not without its own issues, such as the reluctance of students to mark their peers (Rafiq & Fullerton, 1996). This reluctance can be due to students feeling embarrassed at having to assess their peers (Topping, 1998), the students feeling 'unqualified' to do so (Orsmond & Merry, 1996), or the students feeling that assessment is a staff responsibility (Ballantyne *et al.*, 2002). Other workers noted that some students were skeptical of the value of marks given by other students, and that some students do not take the exercise as seriously as others (Orsmond & Merry,

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1996). In other cases, suspicions arose that a strategy for marking may have been prearranged within some groups (Lejk & Wyvill, 2001).

It is recognized that in order to best engage students in the assessment process, the students should preferably be involved in the development and clarification of the assessment criteria (Topping, 1998). Certainly an expected benefit of students generating their own criteria for assessment would be their greater understanding of such criteria (Orsmond *et al.*, 2000).

The PHARMACY 404 formulation assignment

In the fourth and final year, after having undertaken the Pharmaceutics paper (PHARMACY 404) in Semester One at the School of Pharmacy, The University of Auckland, students undertake a group formulation assignment. The assignment is a virtual exercise requiring each group to work through the semester on possible ways to formulate and develop a hypothetical drug substance. Total assessment for the assignment constitutes 15% of the total marks for the course.

Half of the assessment mark is provided by assessment of the final group presentation. This final group presentation mark is collated from marks provided at the presentations by the course coordinator, other lecturers in the School of Pharmacy and any other invited external guests with expertise in drug development. All members of a group received the same mark for this assessment.

The other half of the mark, the individual contribution mark, of the assessment is intended to address the potential issue of uneven distribution of contribution by the individuals of the group. In a similar assignment undertaken by students in the previous year, individual interviews with each of the students and the course coordinator, plus one other pharmaceutics lecture, had been carried out to evaluate those assignments. As well as being very time consuming and difficult to timetable, it was not felt that the grading obtained by this method provided an adequate level of assessment. Furthermore, student feedback on the course for that year included the recommendation that a more equitable process for assessing individual contribution would be for the students within each group to provide this assessment.

The purpose of this research was to implement and assess a self- and peer-assessment model to evaluate individual contribution in this PHARMACY 404 assignment.

Method

Sixty-six students undertook the formulation assignment as part of PHARMACY 404 in 2004. The students self-selected into groups of four or five within the same workshop stream, of which there were three streams, resulting in 14 project groups in total (four groups of four, ten groups of five). There were three 3-hour workshops (Weeks 1, 8 and 11) within the 12 teaching weeks of the course assigned to the formulation project, as well as the expectation that students worked on the group project throughout the semester.

Agreeing assessment categories

In the first workshop for this course (Week 1), the assignment was introduced to the students in each workshop stream, the membership of the self-selected student groups was confirmed, virtual drug case studies were allocated and appropriate categories for self- and peer-assessment of contribution to the assignment were discussed by the students. These suggested categories were recorded by the course coordinator for each workshop stream and collated into one assessment form. The students tried out this form in their workshop sessions in Week 8.

Student completion of assessment forms

In Week 11, each project group presented their assignment to the rest of the workshop stream and their staff and/or guest assessors. The self- and peer-contribution assessment form was completed, in confidence, by each student and handed in to the course coordinator.

Calculation of assessment

Half of the final assessment for each student was a group mark obtained by assessment of the final group presentation by the course coordinator, plus an external expert or other School of Pharmacy staff. The remaining 50% of the assessment was obtained by the same group assessment which had been adjusted by a Contribution Weighting Factor (CWF) for each student derived from the student's self- and group peer-assessment.

The agreed contribution assessment form required students to provide a mark out of ten for each of the seven assessment categories, for both themselves and the other members of their project group. The course coordinator totalled each of these to give a mark out of 70. Each of the contribution scores for each group was then tabulated, and the mean for each group member, as well as the overall mean for the group, was calculated. It was then possible to calculate a weighting factor for each student, according to the formula:

$$\text{CWF} = \frac{\text{Mean of student's self- and peer-assessment scores}}{\text{Group mean assessment score}}$$

Therefore if a student's contribution assessment via this method came out as above average for his or her project group, a CWF of greater than 1 would be expected. A CWF of less than 1 would imply less contribution than the mean for the group. A "group average" contribution would result in a CWF of 1. The CWF for each student was subsequently multiplied by the group presentation score to give a final contribution mark. This individual mark was then added to the group mark to give a final assignment mark for each student.

Further analysis of the student's contribution assessment

Students taking the course received the group mean assessment, CWF and final assignment mark, as described above. In addition, further analysis of the student responses has been carried out to compare other methods of calculating student contribution.

In particular, the effect on the contribution weighting when combined self- and peer-assessment was employed (as used in this study) compared to the use of peer assessment alone was investigated. This was carried out by recalculation of the CWF once the self-assessment scores had been removed.

In addition, normalisation of peer assessment has been previously advocated by Li (2001)in order to eliminate the potential for conscious or unconscious bias when students are assessing their peers. Introduced by Li following discussions with colleagues at City University of Hong Kong, this method of normalisation involves calculation of a bias factor for each student assessor to normalise the impact of assessors being intentionally or unintentionally over- or under-generous when assessing their peers.

Following the method of Li (2001) a peer-assessed, normalised contribution weighting was obtained by first calculating a bias factor for the peer-assessments made by each student, which is defined as:

$$\text{Bias factor} = \frac{\text{Average rating given to the rest of the group by student}}{\text{Average peer} - \text{effort rating for the group}}$$

From which the normalisation factor for each peer-assessor can be calculated as:

$$\text{Normalisation factor} = \frac{1}{\text{Bias factor}}$$

Each rating by each peer-assessor was subsequently multiplied by the appropriate normalisation factor for that peer-assessor and the CWF was again recalculated.

Student feedback

General student feedback on the course was requested using a University of Auckland course feedback questionnaire, which was administered by office staff in the last lecture session for this course. The questionnaire responses were given via a 5-point Likert scale, with additional space for open responses if a student chose to provide these. One question specifically on assessment was included in the 17-question form. Thirty-seven students responded to this questionnaire.

In addition, early in the following semester students were asked if there were volunteers willing to take part in a focus group to discuss aspects of this course in general. One of the topics for discussion by the focus group was that of assessment for the course. The focus group was run by an experienced past member of the Faculty Education Unit, independent of the School of Pharmacy. Seven students participated in the focus group.

Results

The assessment form

Very similar categories for assessment emerged from all three streams during the first workshop. After all workshops in Week 1 had been completed, the course coordinator collated the responses into one assessment form that included seven assessment categories. This assessment form was sent out to all the students electronically for consideration. No subsequent required changes for the form emerged when it was piloted by the students in Week 8, and hence the assessment form shown in Appendix 1 was the one used by the students for their self- and peer-assessment of contribution.

Contribution weighting factors

The 66 CWFs calculated for this assignment were analysed statistically. The student results showed a fairly tight distribution with a mean CWF assigned at an average contribution effort of 1.00, with a standard deviation of 0.048. The highest factor assigned was 1.07 and the lowest was 0.82. These results are summarised in Table I, along with the values obtained when peer-only assessment was used (with and without normalisation).

The CWFs were further analysed by recalculating the student contribution mark, group average contribution mark and the corresponding ratio without the self-assessment values. A comparison between the original combined self- and peer-assessment CWFs and those based on peer-assessment alone could then be made. The corresponding statistics for the peer-assessment corresponded very closely with those found when combined assessment was employed.

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Table I.   Summary of the Overall Analysis of Contribution Weighting Factor (CWF) Using Three Alterative Methods.

	Combined Self- and Peer-assessment	Peer-assessment	Peer-assessment with normalisation
Mean CWF	1.00	1.00	1.00
Standard Deviation	0.048	0.056	0.052
Minimum CWF	0.82	0.82	0.83
Maximum CWF	1.07	1.10	1.08

The mean value remained at 1.00 (standard deviation increasing slightly to 0.056). The highest factor assigned increased to 1.10 and the lowest factor remained at 0.82.

The student with the lowest contribution factor was the same using either approach. In the self- and peer-assessment, three students received the highest factor of 1.07. When only peer-assessment was used, two of these three students remained with a contribution factor of 1.07; the other dropped slightly to 1.06. The student who scored highest in the peer-only assessment method (with a CWF of 1.10) was one who had previously scored 1.06 in the combined contribution assessment.

Overall, 18 of the 66 students had a lower contribution factor when self-assessment was removed, 27 students had a higher value and the contribution factors of 21 students remained the same regardless of whether self-assessment was included or not. In general the changes observed were small. The highest percentage shift for any one student was a 4.5% reduction in contribution factor if peer-only assessment was used, compared to a combined peer- and self-assessment.

When the peer-only assessments were further manipulated to produce a normalised CWL (Li, 2001), the resulting analysis again returned a mean contribution factor of 1.00 for this group of 66 students. The minimum factor obtained was 0.83 and the maximum was 1.08. If the original CWFs had been used, 15 students would have received a lower contribution factor and 17 would have received a higher factor. Again, the quantitative change in the value of the contribution factor was small (in most

cases less than 1.5%, with a maximum shift being a reduction of 4.4% for one student).

Table II shows a comparison of the change in CWF when peer-only assessment (both with and without normalisation) with those values obtained with the combined self- and peer-assessment.

Student feedback

The University of Auckland Course Questionnaire contained a general statement on assessment for the whole course; *"The assessment measured my learning fairly."* The response to this statement was almost evenly split, with 27% of students either agreeing or strongly agreeing with the statement, 30% disagreeing or strongly disagreeing and 43% of respondents selecting the neutral category. Concerns for assessment expressed in the open-ended sections of the questionnaire tended to concentrate on the relative distribution of available assessment marks. There were no comments made by the students either to express support or concern with regards to the self- or peer-contribution assessment carried out as part of the total assessment for the formulation assignment. However, it should be noted that the questionnaire was completed before the assessments for the assignment were available.

In comparison, there was a specific question posed to the seven students taking part in the focus group held at the beginning of the following semester with regards to the self- and peer-assessment process; *"A self- and peer-assessment element was tried for the first time this year - please comment on the value or usefulness of this?"* In response, one statement in the feedback

Table II.   Comparison of Student Contribution Weighting Factors (CWF) Calculated Using Peer-assessment (With and Without Normalisation) With Those From Combined Self- and Peer-assessments (n = 66).

	Peer-assessment	Peer-assessment with Normalisation
Number of students with:		
No change in CWF	21	34
A lower CWF compared to the CWF obtained from combined self- and peer-assessments	18	15
A higher CWF compared to the CWF obtained from combined self- and peer-assessments	27	17

report prepared by the independent facilitator of the focus group was that the self- and peer-assessment was seen as negative in that

> " it was worth so little and distracted the group from what was far more important - the final presentation."

In a later statement, the facilitator noted that the self- and peer-assessment element was not seen as useful or fair by most of the students. Interestingly, it was also found that a number of students in the focus group who were not born in New Zealand appeared to dislike assessing each other, stating:

> "even if I was the best I wouldn't say so"

Discussion

It can be seen from the above results that assessment of the contribution by group members allowed some level of discrimination in the total marks received by the individuals of each group undertaking this pharmaceutics assignment. The spread of the CWF calculated for the assessments were relatively small; subsequently, the final combined mark for individuals in most groups remained dominated by the assessment of the group presentation by the lecturing staff and guest assessors. The tight distribution of CWFs seen in this study is in line with findings of Stefani that self- and peer-assessment by students tends to lead to a more restricted range of marks than those given by tutors (Stefani, 1994).

Other authors have since suggested that a holistic assessment of contribution, in which students provide just one mark to assess the contribution of each of their peers instead of the multiple-category-based system used in this case, may lead to a greater proportion of students receiving a larger gain or loss of marks (Lejk & Wyvill, 2001). In the study undertaken with students taking a Business Systems Analysis module, the holistic peer-assessment approach also resulted in a larger number of groups awarding each member of the group equal marks (Lejk & Wyvill, 2001). In a further paper investigators suggest that students were also more supportive of a holistic, rather than category-based, approach (Lejk & Wyvill, 2002).

The assessment system described in this paper was introduced following the suggestions from previous students, who said that assessment of contribution was fairer if carried out by the students themselves. However, the students who took part in this assessment exercise did not appear to be particularly positive about the experience. Perhaps one reason could be that the resulting discrimination in the final marks observed was small and therefore the perception was that the student assessments did not influence the outcome to sufficiently overcome their concerns over this unfamiliar process.

In review of investigations comparing self- and peer-assessment, Topping (1998) noted that some researchers found self-assessment more reliable than peer-assessment, whereas others found peer-assessment more reliable. In the current study, the comparison between the CWF when both self- and peer-assessment was included, and the use of peer-assessment alone, indicated little change in the mean, standard deviation and minimum and maximum values obtained overall for this group of 66 students. This finding is supportive of Mills' (2003) work with veterinary students, in which it was observed that the difference between the assessment of contribution by either self-assessment or peer-assessment was less than 20% for most students.

Similarly, recalculation of these peer-only CWFs with the introduction of a normalisation factor as described by Li (2001) did not result in a significant change in these values. The number of student CWFs that would have been changed by these two manipulations if these alternative methods were used is summarised in Table III. These results would suggest that, with this group of students, the effect of trying to remove student bias by this normalisation procedure has tended to move the CWFs of peer-only assessment closer to those obtained by a combination of self- and peer-assessment. This observation could imply that the use of self-assessment in combination with peer–assessment does, in effect, provide an inbuilt mechanism to counteract potential bias by students when assessing their peers. In her investigation using first year undergraduate biochemistry students, it was noted by Stefani (1992) that over-marking by students compared to tutor assessment occurred more frequently with peer–assessment compared to self-assessment.

Conclusion

This article describes the experience of introducing student assessment in order to calculate an appro-

Table III.   Overall Comparison of Contribution Weighting Factors (CWF) Using Peer-assessment and Normalised Peer-assessment Compared to the CWF Obtained Using Combined Self- and Peer-assessment (n = 66).

	Number
No change	12
Change with peer-assessment AND normalised peer-assessment: Same change	6
Same direction of change, but different value	10
Different value and direction of change	7
Change with peer-assessment, but no change with normalized peer-assessment	22
No change with peer-assessment, but change with normalized peer-assessment	9

priate contribution factor within a group assignment. The driving factor behind including a contribution factor in the assessment was to counter concerns over fairness and the potential uneven distribution of contribution of individuals within a group assignment. In this group of final year pharmacy students the CWFs derived for most students resulted in only a relatively small adjustment to the mark that was based on assessment of the student group presentation by lecturing staff or an invited expert. The level of adjustment would not have been significantly altered if peer-only assessment (with or without normalisation) had been used rather than a combined self- and peer-assessment approach. Possibly as a result of this low degree of discrimination in the final combined assessment mark student response to this approach, requiring them to assess themselves and their peers was not particularly positive. Students raised concerns that carrying out this assessment was a distraction from the main objective of the project.

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Appendix 1: Student Assessment Form

. *PHARMACY 404:* Formulation Assignment Self- and Peer-assessment

Assessor's Name:

Group:

NB: All gradings are out of 10
1 = poor
6 = average
10 = excellent / outstanding

.

Assessment Criteria:	Self-:	Other team members:			
		Name:	Name:	Name:	Name:
A. Meetings:					
Attendance and punctuality at pre-arranged meetings					
Attitude: (to include respect, cooperation, motivation and participation in group work)					
Appropriately prepared and organized at team meetings					
B. Work Contribution:					
Input and effort into work required					
Quality of work produced for the group					
Meeting agreed timelines and group deadlines					
Contribution to group decision making					