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PEER FEEDBACK ENHANCES A "JOURNAL CLUB" FOR UNDERGRADUATE SCIENCE STUDENTS THAT DEVELOPS ORAL COMMUNICATION AND CRITICAL EVALUATION SKILLS

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Abstract

Effective science communication is one of the key skills undergraduates must achieve and is one of the threshold learning outcomes for Science (TLO 4.1). In addition, presenting published research to their peers allows students to critically evaluate scientific research (TLO 3.1) and develop a deeper appreciation for the link between experimental methodologies and the contestable nature of scientific knowledge. Although it is recognised that feedback given to students has positive impacts on student learning, increasing workload pressures may restrict academics' capacity to provide effective feedback. An alternate approach is to facilitate the exchange of feedback between peers, where gaining experience in providing feedback can further develop students' skills in critique, which enhances their learning outcomes. In this study, 3rd year undergraduate biomedical science students were asked to provide anonymous, written feedback on the quality of an oral "journal club" presentation of a primary research article by a group of their peers. Students gave extensive, rich and detailed feedback to their peers. The quality of the feedback given was high, with most students receiving a grade of distinction or higher for the feedback they provided. In addition, the improvement in student learning outcomes was significantly greater with peer feedback than with academic feedback alone, suggesting that performing peer review provides students with additional benefits.

Keywords

Science communication, peer feedback, nature of science, critical evaluation

Introduction

The ability to communicate effectively is one of the key skills expected of science graduates. Its central importance in tertiary science education is reflected in the Science Threshold Learning Outcomes (TLOs) developed as part of the Learning and Teaching Academic Standards project (Jones, Yates, & Kelder, 2011). The communication TLO specifically states that undergraduate science graduates should have science communication skills appropriate to various settings, with diverse purposes, audiences and modes (Jones et al., 2011). Therefore, science educators must design and implement tasks that provide students opportunities to develop these skills, and evidence their acquisition of these skills. Many examples of good practice in this area already exist (Colthorpe, Rowland, & Leach, 2013). However, the science curriculum provides limited opportunities for educators to assess the learning outcomes of students, so each assessment task should aim to address a broad range of learning outcomes, ideally across multiple TLOs. This study describes an example of "value-adding" to a communication assessment task to broaden the potential for students to address multiple learning outcomes.

One of the commonly used communication assessment tasks in undergraduate science education is the oral presentation of a published research article, commonly referred to as a "journal club." Journal clubs are considered particularly beneficial to students in the latter years of their undergraduate studies, encouraging students to engage with primary literature and to interpret and contextualise recent scientific findings (Glazer, 2000). The curriculum described here utilises an oral presentation of this type but with some notable modifications to increase the diversity of learning outcomes for students.

First, in the week preceding the student presentations, students participate in a workshop led by an internationally renowned researcher, who describes their own research and discusses how it is situated within the broader field. The combination of interactive seminars from experts and journal clubs had previously demonstrated benefits for high achieving, research-streamed students (Kozeracki, Carey, Colicelli, & Levis-Fitzgerald, 2006), but here the whole cohort is involved. There were three primary aims of this modification:

1. because the prior workshop addresses fundamental concepts and methods pertinent to that field, students were able to expect this level of background understanding in their audience and use their presentations to extend this knowledge base to specific aspects unique to their article.
2. the expert workshop modelled the approach of relating a piece of research to the broader field, and in their presentations students were expected to show the relationship between their chosen article and the expert workshop, and to situate it in the broader field.
3. in relating many different contributions to a broader field of research, and in dealing with findings from cutting edge research, students began to experience the way in which new scientific knowledge is created, and to recognise the contestable nature of scientific knowledge.

Second, in the 2012 iteration of the course, we introduced peer feedback to the student presentations. It is well recognised that feedback to students is an educational practice that has one of the largest positive impacts on student learning (Hattie & Timperley, 2007). It can deliver information to students about their performance, help them troubleshoot and self-correct, and aid in self-assessment (Lui & Carless, 2006; Nicol & Macfarlane-Dick, 2006). In order for feedback to elicit positive changes in student work, however, it must provide information that is timely, specific and detailed (Colthorpe, Liang, & Zimbardi, 2013). In an oral assessment task with multiple student groups presenting, the demands on academics may include chairing the session, timekeeping, marking and managing audiovisual equipment, with little time remaining for the provision of feedback. The alternate approach used here is to facilitate the exchange of feedback between peers. While feedback is valuable to the receiver, the act of providing feedback can also increase students' understanding of an assessment task through engagement with criteria and standards, and by viewing alternate approaches to its completion (Lui & Carless, 2006; Sadler, 2010). In addition, feedback providers can develop their own skills in critique and in the tactful provision of specific feedback (Lui, Lin, Chiu, & Yuan, 2001; Lynch, McNamara, & Seery, 2012).

These modifications to the design of the oral presentation task provided students with opportunities not only to build their communication skills - addressing TLO 4.1 - but also to develop and be assessed on additional TLOs including: (a) developing their abilities to critically evaluate information from a range of sources (TLO 3.1), (b) their understanding of the contestability of scientific knowledge (TLO 1.1), and (c) their skills in the provision of tactful and specific feedback deemed to be invaluable in building skills for effective and cohesive teamwork (TLO 5.3) (Jones et al., 2011). This study describes the extent to which this assessment design was able to meet these goals, and how the learning gains made by students across successive journal clubs were enhanced by the addition of peer feedback.

Methods

Institutional and course context

The course *Molecular and Cellular Physiology* is offered in the first semester annually at the University of Queensland, a research-intensive Australian University. It is undertaken primarily by biomedical science students in the third year of their program. Typically, 80-90 students enrol in the course. Approximately 75% of those are enrolled in the Bachelor of Science (BSc) program majoring in Biomedical Science, 8-10% are from the Bachelor of Biomedical Science program with the remainder are undertaking BSc dual degrees of varying types. Over the 13-week semester, the course is structured in six integrated modules varying between 3-8 lectures in length. There is a strong focus on incorporating cutting edge research throughout the course. Each week, there are three hours of lectures scheduled and three hours of "contact" time

dedicated to laboratory classes, expert workshops and student workshops. The assessment of the course includes an end of semester examination and intra-semester assessment tasks consisting of a laboratory report, two in-class quizzes and two oral presentations. The data used for this study were provided by students from the 2011 and 2012 iterations of the course, with their informed consent.

Workshop structure

Two pairs of workshops took place during each semester. These are referred to, respectively, as the *Expert* and the *Student* Workshop. In the first session, the Expert Workshop, a researcher gave a 90 minute presentation, describing the current findings of their research and discussing how this was situated in the broader field of biomedical science research. This was followed by 30 minutes of interactive discussion between the researcher, students and course teaching staff. At the end of the session, students undertook a quiz of five short answer questions which examined their understanding of the research and explored their responses to the issues raised within the workshop.

In the 48 hours following that workshop, students, in self-selected groups of three, chose a recently published research article related to the research field discussed in the workshop. Each student group then developed an oral Powerpoint™ (Microsoft, Redmond, WA, USA) presentation of that article which they presented to their peers a week later in the second session of the pair, the Student workshop. For these workshops, the cohort was divided so that each session was attended by 24-30 students and two staff members. Each group of three students gave their oral presentation to the attendees of that session and all students attending also presented. Each student group gave a ten minute oral presentation on their chosen article followed by five minutes of questions with the majority of questions generated by the students in the audience. At the commencement of the semester, students were given access to guidelines which provided guidance on the presentation and described expected learning outcomes and a rubric describing the criteria for marking the presentation.

Peer feedback

In the earliest iterations of the course, students received brief written feedback (typically 2-4 sentences) on their oral presentations by the two academics present who were also responsible for the marking of those presentations. From 2012 onwards, students were asked to provide anonymous written feedback on the quality of the oral presentation of one group of their peers. Students providing feedback were assigned to a specific group so that each group received feedback from three peers. Specifically, students giving feedback were provided with double-sided A4 sheets:

- on one side, this asked for their identification details and provided guidelines on effective feedback and the criterion against which their provision of feedback would be graded appeared;
- on the second side was a series of prompting questions with space for the feedback to be written.

These sheets were collected and graded by an academic. Following this, the "second" side was copied and distributed to the corresponding presenters so that the providers remained anonymous. The peer feedback comments were not modified by the academics. This distribution occurred electronically within 24 hours of the completion of the workshop. Importantly, students were not asked to grade the oral presentations of their peers; that task was still performed by the two academics in attendance. Feedback provision was graded against a single criterion, on a standard of 0-4, with the top standard (4) described as "Feedback highlighted major strengths and weaknesses of the presentation, and provided constructive and specific advice for improvement." With the exception of the addition of peer feedback and reduction in academic feedback, all other elements of the workshop structure and performance remained unchanged between 2011 and 2012.

Assessment of students' presentations and peer-reviews

The marking criteria for the presentation assessed the form, content and quality of writing in the presentation slides, for which all group members received the same marks. For each of these aspects, there were up to three criteria, for example, content was comprised of specific criteria for the (a) critical evaluation of the article, (b) information clarity, consistency and organisation, and (c) impact and utility of the images. Each individual student was also marked on the quality of their part of the oral presentation, their engagement in discussion and, from 2012 onwards, the quality of the feedback they provided. This resulted in ten separate criteria with varying weightings. Each of the criteria were graded across five standards, on a scale of 0-4, with 4 representing the highest standard achievable. Students received a mark for each criterion and the overall grade.

Analysis of learning outcomes

The marks students received for each criterion, overall (excluding feedback in 2012), and for the peer feedback they provided in 2012, were compared between the first and second presentations in each year to determine whether students improved in their presentations and/or their provision of feedback. To determine if there was an impact of introducing peer feedback on the degree to which student improved between Presentations 1 and 2, the gains or losses in marks between Presentations 1 and 2 (excluding feedback) were calculated, and *t*-tests with Welch's correction were used to compare changes in 2011 with those in 2012. Throughout this study, all quantitative analyses were performed using GraphPad Prism 6™ (San Diego, CA, USA), results are expressed as mean and standard error of the mean (SEM) and were considered significant if $p<0.05$.

Analysis of the content of peer feedback

The original feedback sheets produced by all participating students (N=77) from each of the two student workshops in 2012 were retained and an inductive thematic analysis was used to determine the major categories and types of

feedback present in the data. There were two phases for the analysis: (i) a coarse analysis of the entire corpus of feedback from all 77 students, and (ii) a fine grain analysis of each of the feedback comments provided by 20 students (25% of cohort) randomly selected from the whole cohort by a third party.

For the *coarse analysis*, all of the feedback provided by each student was scanned to determine whether students addressed (a) presentation style, for either the visual or oral components; (b) the content or explanation (i.e. what the presenters said); and (c) provided advice. Each student was allocated a score for the most detailed feedback comment they provided in each of these categories, for example an individual student may have provided detailed feedback on style, a low level of detail in their feedback on content, and no advice. This analysis provided a broad picture of the categories students were addressing and their capacity for providing detailed, specific comments in each category. The scores were subjected to repeated measure, one-way ANOVA, with Sidak's multiple comparisons to determine if the number of students who provided detailed feedback differed amongst the categories.

The *fine-grain analysis* involved the detailed categorisation of each individual feedback comment provided by a sample of 20 students across several parameters as follows. The feedback was transcribed, imported into NVivo 10^{TM} (QSR International, MA, USA) and each feedback comment was coded for topic and detail as previously described. In addition, based on the themes that appeared within the data, each feedback comment was further coded by affect (i.e. as either positive, negative or neutral) and by voice. Voice was categorised as:

- comments in the first person, e.g., "I want to make ours simple like that";
- comments in the second person, directed to the students presenting, e.g., "You guided us through the gene expression figure very well";
- comments that referred to the presenters in the third person, e.g., "The speakers gave confident, clear answers to all questions"; or,
- de-personalised comments, e.g., "Good highlighting of purpose for current medicine."

This resulted in 357 feedback comments characterised across four categories (i.e., topic, detail, affect and voice). Each individual student provided feedback for the same group of students in both workshops. Therefore, comparisons were possible and were made using two-way, repeated measure ANOVA to identify differences between the workshops in the nature and detail of feedback and thus evaluate the development of students' feedback provision skills.

Analysis of course evaluations

At the end of each semester, students provided a handwritten institutional evaluation of the course (SECaT). These consisted of eight Likert-scale questions on various aspects of the course including the statement "I received helpful feedback on how I was going in the course." There were also two open-ended questions, "What were the best aspects of this course?" and "What improvements

to this course would you suggest?" The responses to the open-ended questions were collated (2011: *N*=51, 42% of the cohort; 2012: *N*=37, 44% of the cohort), transcribed and coded in NVivo 10™ as either positive or negative and analysed to identify topics within the responses.

Cohort and sampling variation

To identify any potential variation between the 2011 and 2012 cohorts, entrance scores (GPA prior to the semester) and exit scores (performance in the course end of semester summative examinations) were compared between cohorts using unpaired *t*-tests. To determine whether the sample of 20 students included in the fine-grain analysis were representative of the cohort, the feedback marks, presentation marks and examination results of the 20 students were compared to the remainder of their cohort.

Results

Improvements in learning outcomes

For the overall presentation mark, and for the majority of the criteria on which student presentations were assessed, student performance improved between Presentations 1 and 2. Furthermore, the extent of this improvement in overall mark was significantly greater in 2012 than in 2011 with an average gain across the whole cohort of 7.84% ± 1.15 (mean ± SEM) in 2012 compared to a gain of just 4.95% ± 0.67 in 2011 (Figure 1). It was also interesting to note that although the proportion of students who improved their marks did not differ between the 2011 and 2012 cohorts, with approximately three-quarters demonstrating improvement each year, the extent to which this subset of students improved was significantly larger in 2012, with a gain of 12.47% ± 0.99 compared to 7.84% ± 0.57 in 2011 ($p<0.001$).

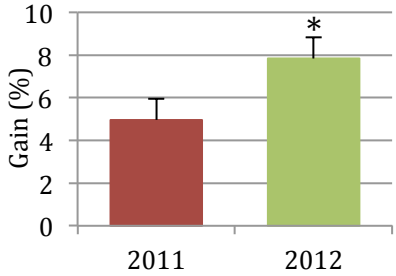

Figure 1. Mean and SEM of percentage gain in marks for the whole cohort from Presentation 1 to Presentation 2 in 2011 (red bars; *N*=113) and 2012 (green bars; *N*=83). *unpaired t-test indicates significantly different to 2011 ($p<0.05$)

Peer Feedback

All students provided written feedback comments to their peers. The feedback was focussed around three major topics: the style of the presentation, the content or explanations provided during the presentations and discussion, and advice for improvement. The maximum level of detail provided by each student was found

to vary substantially across these three categories of feedback. Most students provided some detailed feedback on presentation style. However, far fewer students reached the same level of detail for any of their comments on content or advice (Figure 2). Furthermore, all students provided comments on style while a small proportion of students did not provide any comments on content for Presentation 1 and a larger number of students did not provide any advice for either of the presentations. Between Presentation 1 and 2 there was a significant shift toward more students providing feedback on the content and at higher levels of detail ($p<0.01$). A trend ($p=0.13$) was noted toward more students providing advice with more detailed advice being given (Figure 2) on Presentation 2. The grades students received for the feedback they provided ranged from 1-4 (on a scale of 0-4) with a mean and SEM of 2.96 ± 0.09 and 3.05 ± 0.08 for Presentations 1 and 2 respectively but these marks did not differ significantly between presentations.

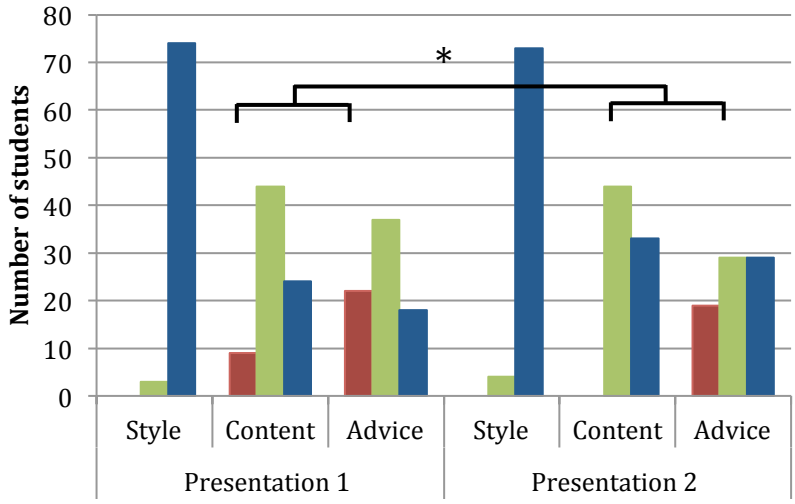

Figure 2. Number of students (N=77) who provided feedback to their peers on the style and content/explanations of their presentation or gave advice for improvement, with extent given as none (red bars), or maximum level of detail provided as low (green bars) or high (blue bars) for Presentation 1 and 2 in 2012. *Repeated measure, two-way ANOVA with Sidak's multiple comparison showed feedback on content for Presentation 2 was significantly different from Presentation 1, $p<0.01$.

Fine-grain analysis of the feedback provided by the 20 students revealed that they provided on average 126 ± 7.73 words of feedback in an average of 8.93 ± 0.69 comments. Analysis using t-tests showed that there was no overall significant difference in the number of words or comments provided between Presentations 1 and 2. The amount of feedback provided by different students was quite variable (ranging from 73 to 280 words) but individual students were very consistent in their feedback provision with a large significant correlation ($r=0.837$, $p<0.05$) between the number of words of feedback provided for Presentations 1 and 2 by each student. A two-way repeated measure ANOVA demonstrated that within this subset of students there were no significant differences between the first and

second presentation in the number of comments that addressed style, content or provided advice, nor in the level of detail, affect or voice of those comments. As expected from the analysis of the cohort, detailed analysis of this sample of 20 students demonstrated that they gave significantly fewer total comments on advice than on content or style ($p<0.05$, Figure 3). Looking at the level of individual students, this difference came about for two reasons. Firstly, all 20 students provided feedback on content and on style, but there were far fewer students giving advice, with one student offering no advice for either presentation, and a further nine giving advice on only one of the presentations. Secondly, each of the students who did give advice typically only offered 1-3 pieces of advice whilst students commonly gave several comments about content (1-8) and even more comments on style (1-17).

This sample of students provided an equivalent number of comments with high or low levels of detail (Figure 3), with all students providing comments of each type. Each student provided significantly more positive comments than negative or neutral comments ($p<0.05$, Figure 3), but all students included a mix of positive and negative comments in their feedback. Students also provided a significantly larger number of comments in a de-personalised voice than other forms ($p<0.05$, Figure 3). Again, this was consistent across the sample with all students using de-personalised comments. While one student exclusively used de-personalised voice, the majority of students used de-personalised and one other voice:

- 10 students included comments in the third person;
- 5 students addressed comments directly to the presenters (second person); and
- 6 students made comments referring to themselves, e.g., "I like your pacing and clear speaking" (first person).

Two students used all four forms of voice in their feedback comments. The length of comments varied widely with de-personalised (10.2 ± 0.6 words) and second person comments (8.6 ± 1.2 words) being significantly shorter than other forms of voice (first person comments, 18.2 ± 2.1; 3rd 15.9 ± 1.1 words). Despite the brevity of the de-personalised comments, 75% were six words or longer suggesting that this was not simply due to abbreviation.

Approximately half of the advice given was of neutral affect whereas the comments on style and content were twice as likely to be positive than negative with just a few neutral comments. In terms of detail, there were an equivalent number of comments that had high and low levels of detail for content or advice but almost three times as many comments on style had a low rather than high level of detail. Therefore, even though more students offered at least one detailed comment on style compared with the number of students who provided at least one detailed comment on content or advice (Figure 2), the total number of comments with low levels of detail was far greater for style than for content or advice. Thus, students give advice or comment on content less frequently than they comment on style but these comments are more likely to be detailed. There were no differences in the use of different forms of voice for any topic.

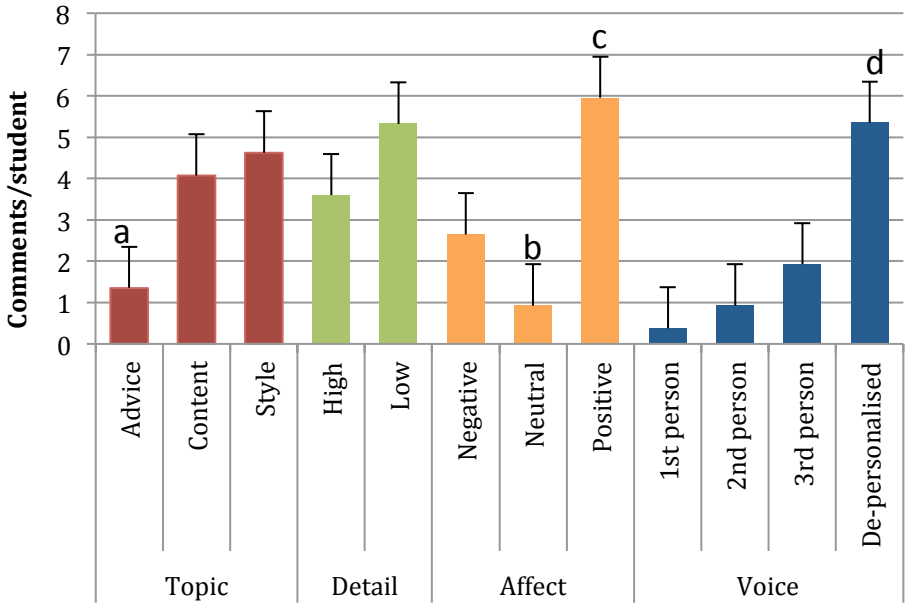

Figure 3. Average (mean ±SEM) number of feedback comments provided by students (*N*=20) on the topics of advice, content/explanation and style (red bars), with level of detail (green bars), affect (orange bars) and voice (blue bars) of those comments. One-way ANOVA showed significant differences: a, between advice and both content and style ($p<0.001$); b, between neutral and negative affect ($p<0.05$); c, between positive and both neutral and negative affect ($p<0.001$); d, between de-personalised and any other voice ($p<0.001$).

Institutional course evaluation

In 2011, 42% of enrolled students responded to the university's SECaT surveys and 51% of those students agreed with the statement "I received helpful feedback on how I was going in the course." There was no significant change in response to this question in 2012, of the 44% of enrolled students who responded, 49% agreed with this statement.

In the open-ended questions, 21 students (42% of respondents) made 29 comments on the workshops in 2011 with a small increase in 2012 to 22 students (60% of respondents) making 34 comments on the workshops. As can be seen in Figure 4, of the 13 positive comments students made about the workshops in 2011, only two referred specifically to the student workshops and one referred to both Expert and Student Workshops. The majority of positive comments were either directed at the Expert workshops or did not specify, e.g. "I liked the workshops." In direct contrast, of the 16 negative comments in 2011, 14 were directed specifically at the Student Workshops. The majority of the negative comments related to either the timing of the workshops in relation to other assessment tasks or the amount of time provided to complete the task. Two students made negative comments on feedback saying "shocking feedback" and

suggesting "better feedback on presentation and how we can further improve" in response to the request for suggestions to improve the course.

There was a dramatic positive shift in student evaluations of the workshops in 2012. In this instance, there were 20 positive and 14 negative comments (Figure 4). In addition, almost three quarters of the positive comments referred to the Student Workshops either specifically (*N*=9) or in conjunction with the Expert Workshops (*N*=5) with the majority simply offering that "I like the student workshops." The negative comments directed at the Student Workshops in 2012 were more detailed but the majority echoed the themes from 2011: (a) students wanted more time to complete the task, e.g., "you needed way more time than was given to put together the presentation"; or (b) an easier standard, e.g., "the workshops were marked too hard." Importantly, in 2012, there were no negative comments about feedback or a lack thereof. Instead, there were four positive comments where students specifically highlighted the value of the feedback they received.

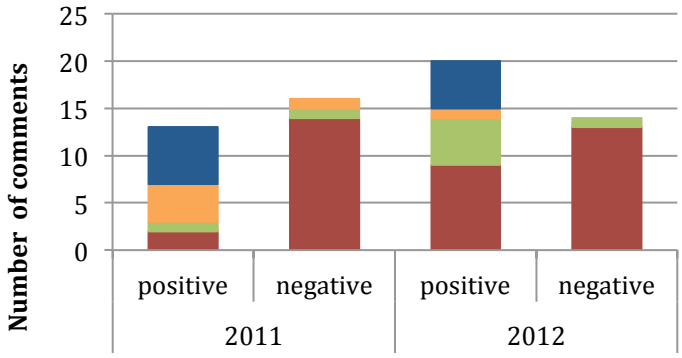

Figure 4. Student responses on SECaT to statements "What were the best aspects of this course?" and "What improvements to this course would you suggest?" in 2011 and 2012, making either positive or negative comments in reference to student workshops (red), both expert and student workshops (green), expert workshops (orange) or unable to be attributed to specific workshop (blue). In 2011, 42%, and in 2012, 60% of respondents made comments related to the workshops.

Cohort and sample variation

There were no significant differences between the 2011 and 2012 cohorts in either the entrance scores or performance on the end of semester examinations confirming that the cohorts were comparable for this study. In addition, the subset of students from 2012 chosen for in-depth analysis of peer feedback were representative of the academic standards of the 2012 cohort because there were no significant differences between these students and the remainder of their cohort for the presentation grades, feedback marks or end of semester examination grades.

Discussion

Evidence from students' assessment performance demonstrates that the journal club model described here not only provides an effective mechanism for assessing the standards students have achieved across a range of TLOs (Jones et al., 2011) including communication skills (TLO 4.1), critical evaluation of information from a range of sources (TLO 3.1), and an understanding of the contestability of scientific knowledge (TLO 1.1), but that the combination of two pairs of expert and student workshops improves these skills across the semester. When peer feedback was added to this model, the learning gains between Presentations 1 and 2 were significantly enhanced and students were able to demonstrate skills in the provision of tactful and specific feedback to peers deemed essential to effective teamwork (TLO 5.3). The findings demonstrate that the provision of feedback by multiple peers appears to have benefits for oral presentations just as it does for written work (Cho & MacArthur, 2010).

The design of the student workshops meant that each student group received feedback from multiple peers. This approach thus provided each student with far more feedback than an individual academic could provide. In addition, the availability of the feedback sheets for rapid online distribution meant that feedback was received by students in a timely manner. The extensive, rapid provision of feedback from peers has previously been described as a key benefit of peer feedback on students written work (Lui & Carless, 2006). This design demonstrates that similar benefits can be bestowed within oral assessment settings and therefore conforms to the principles of good practice for feedback (Boud, 2010; Nicol & Macfarlane-Dick, 2006).

Other benefits of peer feedback include that, unlike academics, peers provide feedback in language that is from the student perspective and which is particularly accessible for students (Cho & MacArthur, 2010; Connors & Lunsford, 1993). Analysis of the feedback provided here demonstrated that many students gave personal perspectives in their feedback with nearly a third making comments referring to their own ideas or personal experiences. While the feedback provided was extensive, specific and often detailed, there was variability in the quality of the feedback across the different topics that the students addressed. Initially most students provided detailed feedback on style with far fewer providing detailed feedback on content or advice (Figure 1). However, by the second presentation, more students provided detailed feedback on content and there was a trend toward more detailed provision of advice. Our previous analysis of the impact of feedback on written work indicates that very brief comments from academics are frequently misunderstood by students leading to either no change or a decrease in the quality of their work (Colthorpe et al., 2013). Therefore, the increase in detail of the feedback provided here suggests that this model benefits both the feedback providers who improve the quality of their feedback and the feedback receivers, who gain detailed critique and advice.

A surprising finding from the feedback analysis was the variation in the student use of voice. Ideally, it is preferable that feedback providers critique the work presented rather than the individual presenting it (Black & Wiliam, 1998; Nicol & Macfarlane-Dick, 2006). That is, they should provide primarily de-personalised feedback and personalise it only by relating their own views or experiences. While all students provided de-personalised comments, half also made comments referring to the presenters in the third person, appearing to direct the comments toward the marker. Initially, this was attributed to a misunderstanding of the purpose of the feedback attributed to an assumption that student comments would be summarised by the marker. However, interestingly, there was no decline in the frequency of these types of comments for the second presentation despite all students having experienced that feedback was received as a direct copy of the handwritten comments from peers.

While the benefits of peer feedback for its recipients are well described, it has also been suggested that students benefit through being the providers of feedback because it enhances student engagement with learning outcomes, criteria and standards (Price, O'Donovan, & Rust, 2007; Sadler, 2010). Students who provide feedback have the opportunity to make judgements about the work of others against standards and criteria, and apply that experience to their own work facilitating the development of self-assessment in learning (Boud & Falchikov, 2006; Nicol & Macfarlane-Dick, 2006; Price et al., 2007). While this skill may benefit students immediately, it also has the potential to have a longer term impact because critical self-judgement is seen as central to the development of lifelong learning (Boud & Falchikov, 2006).

One of the considerations for choosing peer feedback rather than peer marking for this learning design relates to the challenges that peer marking presents. There have been extensive reviews of the benefits and challenges of both peer feedback and marking performed over an extended time period. Many of these studies raise issues regarding the validity, fairness and accuracy of peer marking with inconsistent results reported for peer marking across these factors (Dochy, Segers, & Sluijsmans, 1999; Van Zundert, Sluijsmans, & Van Merriënboer, 2010). Students often report a reluctance to mark the work of their peers and are more generous than academics (Falchikov, 1995). In addition, students need adequate preparation for peer marking which was not feasible in this context (Vu & Dall'Alba, 2007). The findings regarding peer feedback tend to be more positive and consistent with widespread support for the benefits of peer feedback (Cho & MacArthur, 2010; Falchikov, 1995; Lui & Carless, 2006). Peer feedback is seen by students as challenging and hard work but they report becoming more critical and confident as a result of providing it (Falchikov, 1995). However, one possible drawback of this design is that it has the potential for disconnect between feedback (from peers) and grades (from academics) (Falchikov, 1995; McMahon, 2010). This may have been reflected in the comment on the course evaluation that one student gave - "Students gave good written feedback, but tutor still mark [sic] down the grade."

Conclusion

While essentially a communication task, situating the "journal club" presentations in a particular field of research and allowing students to draw links both to the expert workshop and other published literature increased the opportunity for students to develop skills in evaluating and synthesising scientific information and developing a deeper understanding of the contestable nature of scientific knowledge. The inclusion of peer feedback further increased the students' opportunities to critically evaluate not only the communication skills of their peers but the information they were presenting.

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References

Black, P., & Wiliam, D. (1998). Assessment and classroom learning. *Assessment in education, 5*(1), 7-74. doi: 10.1080/0969595980050102

Boud, D. (2010). Assessment 2020: Seven propositions for assessment reform in higher education . Sydney, Australia: Australian Learning and Teaching Council. Retrieved from http://www.olt.gov.au/system/files/resources/Assessment%202020_final.pdf

Boud, D., & Falchikov, N. (2006). Aligning assessment with long-term learning. *Assessment & Evaluation in Higher Education, 31*(4), 399-413. doi: 10.1080/02602930600679050

Cho, K., & MacArthur, C. (2010). Student revision with peer and expert reviewing. *Learning and Instruction, 20*(4), 328-338. doi: 10.1016/j.learninstruc.2009.08.006

Colthorpe, K., Liang, S., & Zimbardi, K. (2013). Facilitating timely feedback in the Biomedical Sciences. *International Journal of Innovation in Science and Mathematics Education 21*(3), 60-74.

Colthorpe, K., Rowland, S., & Leach, J. (2013). *Good Practice Guide (Science), Threshold Learning Outcome 4: Communication*. Sydney, Australia: Australian Government Office for Learning and Teaching. Retrieved from http://www.olt.gov.au/resource-learning-and-teaching-academic-standards-science-2011

Connors, R. J., & Lunsford, A. A. (1993). Teachers' rhetorical comments on student papers. *College Composition and Communication, 44*(2), 200-223. doi: 10.2307/358839

Dochy, F., Segers, M., & Sluijsmans, D. (1999). The use of self-, peer and co-assessment in higher education: A review. *Studies in Higher Education, 24*(3), 331-350. doi: 10.1080/03075079912331379935

Falchikov, N. (1995). Peer feedback marking: Developing peer assessment. *Innovations in Education & Training International, 32*(2), 175-187. doi: 10.1080/1355800950320212

Glazer, F. S. (2000). Journal clubs - A successful vehicle to science literacy. *Journal of College Science Teaching, 29*(5), 320-324.

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research, 77*(1), 81-112. doi: 10.3102/003465430298487

Jones, S. M., Yates, B. F., & Kelder, J.-A. (2011). Science learning and teaching academic standards statement. Strawberry Hills, Australia: Australian Learning and Teaching Council. Retrieved from http://www.olt.gov.au/resource-learning-and-teaching-academic-standards-science-2011

Kozeracki, C. A., Carey, M. F., Colicelli, J., & Levis-Fitzgerald, M. (2006). An intensive primary-literature–based teaching program directly benefits undergraduate science majors and facilitates their transition to doctoral programs. *CBE-Life Sciences Education, 5*(4), 340-347. doi: 10.1187/cbe.06-02-0144

Lui, N-F., & Carless, D. (2006). Peer feedback: The learning element of peer assessment. *Teaching in Higher Education, 11*(3), 279-290. doi: 10.1080/13562510600680582

Lui, E., Lin, S. S., Chiu, C. H., & Yuan, S. M. (2001). Web-based peer review: The learner as both adapter and reviewer. *Education, IEEE Transactions on, 44*(3), 246-251. doi: 10.1109/13.940995

Lynch, R., McNamara, P. M., & Seery, N. (2012). Promoting deep learning in a teacher education programme through self- and peer-assessment and feedback. *European Journal of Teacher Education, 35*(2), 179-197. doi: 10.1080/02619768.2011.643396

McMahon, T. (2010). Peer feedback in an undergraduate programme: Using action research to overcome students' reluctance to criticise. *Educational Action Research, 18*(2), 273-287. doi: 10.1080/09650791003741814

Nicol, D. J., & Macfarlane-Dick, D. (2006). Formative assessment and self-regulated learning: a model and seven principles of good feedback practice. *Studies in Higher Education, 31*(2), 199-218. doi: 10.1080/03075070600572090

Price, M., O'Donovan, B., & Rust, C. (2007). Putting a social-constructivist assessment process model into practice: Building the feedback loop into the assessment process through peer review. *Innovations in Education and Teaching International, 44*(2), 143-152. doi: 10.1080/14703290701241059

Sadler, D. R. (2010). Beyond feedback: Developing student capability in complex appraisal. *Assessment & Evaluation in Higher Education, 35*(5), 535-550. doi: 10.1080/02602930903541015

Van Zundert, M., Sluijsmans, D., & Van Merriënboer, J. (2010). Effective peer assessment processes: Research findings and future directions. *Learning and Instruction, 20*(4), 270-279. doi: 10.1016/j.learninstruc.2009.08.004