AC 2009-420: TWO PERSPECTIVES ON PEER REVIEW

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Two Perspectives on Peer Review

Abstract

Peer review is a professional obligation: most of us have engaged in reviewing articles or textbooks for publication or evaluating professional presentations. In a classroom setting, peer review is a useful pedagogical tool to help students develop communication skills. This paper examines peer review in two different contexts: written communication and group dynamics.

Introduction

Peer review is a versatile tool for the classroom teacher. Creative instructors can use it to improve students’ written communication, evaluate individual student contributions to a group project, improve the quality of student interactions, or diagnose and solve group dynamics problems. Regardless of the application, peer review allows instructors a glimpse into the workings of students’ minds and affords students a preview of a professional practice.

A perusal of the literature about peer review yields information from academic fields as disparate as law, science, medicine, music, and engineering as well as peer review on a professional level; for example, design review in the software industry or general performance evaluations by supervisors and peers. Many sources indicate, as Keith Topping notes, “positive formative effects on student achievement and attitudes. These effects are as good as or better than the effects of a teacher assessment.” Although some researchers may disagree, McGourty, Dominick, and Reilly also conclude that “student self and peer ratings can be consistent with faculty perceptions of student performance.” In essence, students, with a modicum of training, can effectively gauge the work of their classmates and benefit from that type of evaluation, especially in the formative stages.

The technical communication course for engineering majors at Vanderbilt University School of Engineering uses student peer reviews to encourage revision of written communication. Using a checklist to rate required components and to write comments, students offer constructive feedback so that writers can revise the assignment before submitting it for grading. Students’ written analyses of each other’s papers can be used in large or small classes to improve writing. This portion of the paper describes effective procedures for including student peer review of writing assignments in the classroom, provides examples of useful checklists for rating students’ written work, discusses possible issues to avoid, and presents students’ assessment of the process.

The civil engineering senior project at Oregon Institute of Technology combines communication and engineering design in a group intensive, team-taught environment. Student teams, however, are not always serendipitous. The most common problem is conflict, usually the result of “social loafing”: students who either ride the coattails of others or do not perform up to group expectations. Unresolved conflict can fester and result in group dysfunctionality. Peer review, as well as judicious faculty oversight, can help alleviate some of the more typical group problems. This portion of the paper explains some common group problems, offers a peer
review instrument and a process for developing one, and discusses teamwork assessment and benefits.

Narrowed Focus

This paper offers examples for instructors to consider in using peer review and is not a rigorous, scholarly study. Thus, the works cited throughout the paper illustrate what others have done, including benefits or drawbacks. This paper essentially serves as a guide for the professor and a starting point for more rigorous exploration.

Writing Applications

Writing instructors have long considered student peer review an effective method for teaching writing. In recent years, as ABET standards have focused more attention on the need for communication instruction in engineering classes, engineering educators have also begun to promote student peer review of writing. Peer review can be a helpful tool to improve students’ writing. Through peer review, students can understand how to improve their writing and benefit from seeing how other writers have handled the same project.

Background and Rationale

The technical communication course (ES 210w) for engineering majors at Vanderbilt University provides instruction in both written and oral communication. The course has two main goals for students:

1. Communicate effectively in both written and oral reports
2. Communicate effectively in job search communication tasks

Although students conduct peer reviews of both written and oral assignments, this paper focuses on peer review of written assignments. Peer review of first drafts is an important part of this course. Indeed, peer review is listed as an instructional objective, aimed at meeting the two broad course goals (Figure 1).

<table>
<thead>
<tr>
<th>Students will meet the following instructional objectives:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Analyze and target different audiences</td>
</tr>
<tr>
<td>2. Recognize and follow effective technical communication principles of organization, development, formatting, and language use in various writing assignments</td>
</tr>
<tr>
<td>3. Create a resume with power verb phrases describing accomplishments, not just duties</td>
</tr>
<tr>
<td>4. Write an effective three-part cover letter</td>
</tr>
<tr>
<td>5. Write an organized, clearly written memo</td>
</tr>
<tr>
<td>6. Write a proposal according to guidelines in a request for proposal</td>
</tr>
<tr>
<td>7. Edit and simplify wordy passages</td>
</tr>
<tr>
<td>8. Evaluate your own work and that of your peers</td>
</tr>
</tbody>
</table>

Figure 1. ES 210w Instructional Objectives Related to Writing
**Process**

The technical communication course requires peer review for three major writing assignments. For each assignment, a student evaluates two other student writers’ drafts and receives two peer reviews of his or her draft. After considering the comments and ratings, students revise and turn in the final draft for evaluation, along with the original rough draft and the two reviews they received. Failure to turn in the reviews results in a 10 percent grade reduction.

The three assignments reviewed are a resume, cover letter, and a short, informational report with abstract. The class can discuss the criteria beforehand and assess how well examples meet the criteria.

One class period is allotted for reviewing the report, but both the resume and cover letter are reviewed together in one class period since these are paired assignments. Students typically use hard copies of review forms in class, but the form is available online. Usually students finish both reviews in a class period. However, they can complete the process outside of class and e-mail reviews to the writer. Having tried a totally online review method, the professor prefers at least one peer review session in class so that she can be a resource for students, answering questions and offering suggestions.

Students use an instructor-designed checklist based on the assignment requirements. Since the checklist is analytical and based on specific assignment components, each assignment requires a different form.

One way to provide consistency is to use a rating system. Table 1 presents the peer review checklist for the first assignment.

*Table 1. ES 210w Peer Review Form for an Informational Report with Abstract*

<table>
<thead>
<tr>
<th>Category</th>
<th>Rating</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Abstract</strong>: Is it present, concise, visually set apart from the rest of the paper? No more than 12 lines? Is it informative (rather than descriptive, merely announcing topics)?</td>
<td>1 2 3 4 5</td>
<td></td>
</tr>
<tr>
<td><strong>2. Length</strong>: Is the report the assigned length? Too long or short?</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>3. Introduction</strong>: Does this section introduce the topic and contain a statement of the purpose? Is it separate from the abstract or does it look like a body paragraph? Is the topic specifically linked to your career (engineering, finance, etc.) so that the audience will know why you are discussing this topic?</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>4. Organization</strong>: Is the paper organized appropriately with headings? Is a main point (thesis) stated? Are the paragraphs divided logically? Are subpoints expressed in topic sentences for each body paragraph? Is the order of</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
subpoints logical?

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>5. <strong>Development of paragraphs</strong>: Are paragraphs developed logically with relevant, specific, sufficient details? Do details stay on the subject? Are they appropriate?</td>
<td></td>
</tr>
<tr>
<td>6. <strong>Audience awareness</strong>: Are points, details, definitions, and language appropriate for the audience?</td>
<td></td>
</tr>
<tr>
<td>7. <strong>Conclusion</strong>: Is it relevant and appropriate? Is it too much like the abstract or should it replace the abstract and another type of conclusion be written?</td>
<td></td>
</tr>
<tr>
<td>8. <strong>Language and Tone</strong>: Is language simple, clear, and direct? Do the tone, mood, voice, and point of view stay consistent throughout? Are language and tone appropriate for the audience? Are terms obvious/defined?</td>
<td></td>
</tr>
<tr>
<td>9. <strong>Overall Appearance</strong>: Does the paper look professional? Does it look easy to read?</td>
<td></td>
</tr>
<tr>
<td>10. <strong>Figures and Tables</strong>: Are these numbered, labeled, introduced, and discussed properly?</td>
<td></td>
</tr>
<tr>
<td>11. <strong>References</strong>: Are sources properly used and cited?</td>
<td></td>
</tr>
<tr>
<td>12. What three things did you like best about the report?</td>
<td></td>
</tr>
<tr>
<td>13. What three major improvements are needed?</td>
<td></td>
</tr>
</tbody>
</table>

Other instructors may wish to use generic criteria applicable to any writing assignment. Figure 2 presents an example of a checklist useful for a variety of written assignments. Both checklists in Table 1 and Figure 2 are used for formative, rather than summative, assessment.

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**Peer Comment Form**

Note: When you submit the final draft of your paper, you should also submit at least one draft and the comment sheets from two peer commentators.

Name of writer: __________________________ Name of reviewer: __________________________

Reviewers should read the paper carefully, annotating it with the writer’s permission and answering all of the questions below. Your job as a commentator is primarily to help the writer with issues of style, clarity, logic, and organization. Do not focus exclusively on spelling and grammar.

1. Is the title of the paper clear? Informative? Comment.
2. Who is the audience for this paper? What is the paper’s purpose? Are these questions explicitly or implicitly answered by the writer? Give examples.
3. What is the thesis of the paper? Write it out here in a sentence or two.
4. What are the three or four main ideas in the paper in addition to the thesis statement? Write them out and then indicate transitions between them.
5. What assumptions does the author make in this paper about his or her topic, thesis, and/or audience?
6. What is the tone of the writer? Is it appropriate for his or her audience and purpose?
7. Does the author anticipate and refute counterarguments? Does the author anticipate and answer questions such as “why?” and “so what?” with convincing logic and evidence? If so, give examples. If not, suggest counterarguments that he or she might wish to address.
8. What did you like best about this paper? Be specific.
9. What one thing could the writer do to improve this paper? Be specific.

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Figure 2. Sample Generic Peer Comment Form for Reviewing Various Types of Papers. Reprinted with permission of Jack R. Lohman, editor, The Journal for Engineering Education.
Literature provides other helpful examples of peer review forms.\textsuperscript{7-9} Regardless of the checklist used, the main goal is that students receive feedback from other students to produce a better piece of writing and, paramount in their minds, a better grade.

Moss and Holder’s advice\textsuperscript{10} to faculty to set and make clear criteria applies to designing the checklist. Students need to know what is expected and how to assess writing. The instructor needs to spend time in class explaining these criteria, giving examples of what to do and what not to do. Usually criteria deal in some fashion with three categories: content and organization; mechanics (grammar, style, and punctuation); and visual appeal. It is helpful for the professor to show an example of a paper and use the checklist to rate it. Another method is to have students rate the same example and then discuss it. In this way, the professor is training or “calibrating” the reviewers. For those interested in more intensive calibration of student peer reviewers, Carlson and Berry discuss the Calibrated Peer Review\textsuperscript{TM} online system.\textsuperscript{11}

\textit{Student Feedback}

As part of the course requirements, at the end of the semester ES 210w students rate their knowledge gained in meeting course instructional objectives. The instructor uses this information to plan for the next semester. Students respond to an anonymous self-assessment instrument, rating how much they knew about the objectives when they entered the course and how much they now know after taking the course.

This feedback method is necessarily given post-course so that students realize their lack of knowledge when entering the course. Unlike in some courses, such as mathematics, students must take this course to discover their pre-course weaknesses in certain areas. Students sometimes enter the course thinking they already have the expertise necessary for some assignments and do not realize the breadth and depth of course content. When told they will craft a resume, for example, some already have completed a resume beforehand and think they excel in writing one. After taking the course, they realize their previous lack of knowledge about writing a results-oriented resume, describing achievements rather than job duties only. Likewise, some students think they can write an abstract but discover that the assignment requires an informative abstract.

To gauge effectiveness, relevant student self-assessment data from Fall 2006 through Fall 2008 were compiled and analyzed. Tables 2 and 3 present descriptive statistics for students’ average ratings of six objectives (items 1-4, 7, and 8 from Figure 1) relating to peer review expertise and writing improvement in the three peer-reviewed assignments. Tests of the statistical significance of the changes in the student assessments were conducted using Wilcoxon Signed-Ranks tests. The gains for all objectives were statistically significant (p < .001).
Table 2. Descriptive Statistics of Students' Post-Course Self-Assessment of Pre-Course Knowledge About Objectives. Fall 2006-Fall 2008. N=186.

<table>
<thead>
<tr>
<th>Obj. No. from Fig. 1</th>
<th>Instructional Objective Pertaining to Assessing Peer Review</th>
<th>Mean Rating Pre-Course Knowledge</th>
<th>Median</th>
<th>STD Dev.</th>
<th>IQR 25th %ile</th>
<th>IQR 75th %ile</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Analyze and target different audiences</td>
<td>2.60</td>
<td>3.00</td>
<td>0.884</td>
<td>2.00</td>
<td>3.00</td>
</tr>
<tr>
<td>2</td>
<td>Recognize and follow effective technical communication principles of organization, development, formatting, and language use</td>
<td>2.81</td>
<td>3.00</td>
<td>1.020</td>
<td>2.00</td>
<td>4.00</td>
</tr>
<tr>
<td>3</td>
<td>Create a resume with power verb phrases describing accomplishments, not just duties</td>
<td>2.43</td>
<td>2.00</td>
<td>1.203</td>
<td>1.00</td>
<td>3.00</td>
</tr>
<tr>
<td>4</td>
<td>Write an effective three-part cover letter</td>
<td>1.99</td>
<td>2.00</td>
<td>1.151</td>
<td>1.00</td>
<td>3.00</td>
</tr>
<tr>
<td>7</td>
<td>Edit and simplify wordy passages</td>
<td>3.22</td>
<td>3.00</td>
<td>1.166</td>
<td>3.00</td>
<td>4.00</td>
</tr>
<tr>
<td>8</td>
<td>Evaluate your own work and that of your peers</td>
<td>3.23</td>
<td>3.00</td>
<td>1.172</td>
<td>2.00</td>
<td>4.00</td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>Obj. No. from Fig. 1</th>
<th>Instructional Objective Pertaining to Assessing Peer Review</th>
<th>Mean Rating Pre-Course Knowledge</th>
<th>Median</th>
<th>STD Dev.</th>
<th>IQR 25th %ile</th>
<th>IQR 75th %ile</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Analyze and target different audiences</td>
<td>4.51</td>
<td>5.00</td>
<td>.505</td>
<td>4.00</td>
<td>5.00</td>
</tr>
<tr>
<td>2</td>
<td>Recognize and follow effective technical communication principles of organization, development, formatting, and language use</td>
<td>4.55</td>
<td>5.00</td>
<td>.576</td>
<td>4.00</td>
<td>5.00</td>
</tr>
<tr>
<td>3</td>
<td>Create a resume with power verb phrases describing accomplishments, not just duties</td>
<td>4.59</td>
<td>5.00</td>
<td>.567</td>
<td>4.00</td>
<td>5.00</td>
</tr>
<tr>
<td>4</td>
<td>Write an effective three-part cover letter</td>
<td>4.37</td>
<td>4.00</td>
<td>.666</td>
<td>4.00</td>
<td>5.00</td>
</tr>
<tr>
<td>7</td>
<td>Edit and simplify wordy passages</td>
<td>4.42</td>
<td>4.50</td>
<td>.641</td>
<td>4.00</td>
<td>5.00</td>
</tr>
<tr>
<td>8</td>
<td>Evaluate your own work and that of your peers</td>
<td>4.24</td>
<td>4.00</td>
<td>.734</td>
<td>4.00</td>
<td>5.00</td>
</tr>
</tbody>
</table>

Because the sample was large, a paired t-test was also done to determine if the differences in mean scores from knowledge before and after the course were significant. The analysis, presented in Table 4, indicates significant differences, showing learning gains for all instructional objectives.
Table 4. Paired T-test Analysis Showing Significant Differences in Students' Post-Course Self-Assessment of Pre-Course Knowledge and Post-Course Knowledge About Objectives. Fall 2006-Fall 2008. N=186.

<table>
<thead>
<tr>
<th>Obj. No. from Fig. 1</th>
<th>Instructional Objective Pertaining to Assessing Peer Review</th>
<th>Difference Mean Post-Pre</th>
<th>Difference STD Dev.</th>
<th>95% Difference Lower Bound</th>
<th>Paired t value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Analyze and target different audiences</td>
<td>1.911</td>
<td>.983</td>
<td>1.792</td>
<td>26.52</td>
<td>0.00</td>
</tr>
<tr>
<td>2</td>
<td>Recognize and follow effective technical communication principles of organization, development, formatting, and language use</td>
<td>1.745</td>
<td>1.036</td>
<td>1.619</td>
<td>26.52</td>
<td>0.00</td>
</tr>
<tr>
<td>3</td>
<td>Create a resume with power verb phrases describing accomplishments, not just duties</td>
<td>2.161</td>
<td>1.251</td>
<td>2.010</td>
<td>23.56</td>
<td>0.00</td>
</tr>
<tr>
<td>4</td>
<td>Write an effective three-part cover letter</td>
<td>2.382</td>
<td>1.175</td>
<td>2.239</td>
<td>27.65</td>
<td>0.00</td>
</tr>
<tr>
<td>11</td>
<td>Edit and simplify wordy passages</td>
<td>1.201</td>
<td>1.133</td>
<td>1.063</td>
<td>14.45</td>
<td>0.00</td>
</tr>
<tr>
<td>13</td>
<td>Evaluate your own work and that of your peers</td>
<td>1.009</td>
<td>1.083</td>
<td>.878</td>
<td>12.71</td>
<td>0.00</td>
</tr>
</tbody>
</table>

These results indicate that students thought their writing skills and peer review skills had improved. Students did not think their pre-course knowledge in the six areas was high. Interestingly, their highest mean ratings for knowledge before taking the course were for editing (3.22) and peer review (3.23), possibly due to prior experience in other courses or in high school. Although the lowest mean score for knowledge exiting the course, 4.24, was for peer review, it represents a substantial increase. This lower score may also result from the fact that peer review was limited to three writing assignments.

**Implications for Further Research**

From the data above, can one conclude that peer review helped the writing? Possibly but not definitely. Students thought their writing improved and their peer review skills improved. A more rigorous study is needed to constitute a definitive assessment. More data are needed to assess whether the two correlate. For future assessment, a questionnaire asking students for specific feedback on whether or not the peer review was directly responsible for writing improvement would be helpful. In addition, a sample of student papers to assess improvement shown by the finished papers compared to the rough drafts would further answer the question. Other options would be to evaluate, in a more structured way, the quality of the peer reviews and/or to evaluate the quality of peer reviewed versus non-peer reviewed papers.

**Possible Problems**

Professors using the draft peer review process should be alert for possible problems. In this course, students wrote appropriate comments about the papers. However, the instructor’s reading of these students’ peer reviews indicated that students sometimes gave inflated ratings, mismatched to their comments. That is, even though their comments indicated flaws for certain aspects (such as audience awareness, for example) the reviewers sometimes rated these aspects with a 5, the highest rating. A writer, therefore, might see a high score, think no problem existed, and skip reading the comment. Student reviewers in this course needed reminders to avoid giving high ratings that did not match their comments.
This problem may result from a concern about hurting the writer’s grade since some students questioned whether or not their numerical ratings would be calculated in the grading process. The professor needed to explain carefully that their ratings were to help the student earn a better grade and would not count in the professor’s grade. The professor also noticed that sometimes writers merely skimmed the reviews but did not carefully read them. The instructor, however, who does not have time to carefully read all the peer reviews should not feel guilty. Peer review is essentially for the student, not for the instructor.

Another issue is that students may become accustomed to peer review and be uncomfortable if all papers are not peer reviewed. One student, for example, complained that his grade was lower on the final paper because no peer review was required. With a form available online, however, a student can request a peer review on any assignment.

Some students may feel rushed when using class time, particularly if they are reviewing more than one paper. However, students have the option of finishing the second paper after class by downloading the online version of the review form and e-mailing the finished review to the writer. This method seems to work well. Other professors may prefer using totally online options or reserving more than one class period for review.

Students occasionally may neglect turning in the peer reviews with the final paper. In this course, the professor has had success by reducing the score of papers unaccompanied by reviews.

Sometimes students may be more critical of their peers than the professor is. Consequently, comments may too harsh, causing anger and frustration. Discussing types of acceptable comments beforehand, training students to assess sample papers, and attempting to build a sense of community and helpfulness can alleviate these tendencies.

**Benefits of Peer Review of Writing**

In seeing their peers’ drafts, students get a different view of the assignment, seeing different ways to reach the same goal. Excellent papers serve as models. William J. Wolfe notes several other important benefits of peer reviewing:

1. In seeing their peers’ drafts, students see things from the professor’s point of view.
2. Students increase their ability to respond critically to a piece of writing and they may be less apt to take offense at the professor’s grading or their peers’ critiques.
3. Students may “build community” and increase a sense of professionalism.
4. Students receive a quick response to their writing and do not have to wait until the instructor returns the graded papers later.
5. Students may get a better idea of a superior paper by looking at the range of papers.
6. Better writers are able to influence novice writers.
7. The peer review process allows the professor to become more of a coach or resource and less of a judge.
8. Students may expend more effort to earn respect from their peers than from the professor.
Sullivan, Brown, and Nielson agree that students may work harder to impress other students. In addition, by improving final drafts, peer review can help professors receive a better paper that is easier to grade.

In this course, students benefit from seeing how others have approached the three technical communication assignments. They frequently comment in class about the value of seeing differences in resumes and in the abstract for the informational report. Many make changes based on their peers’ evaluation, and virtually no student has objected to the peer review process. In fact, one student recently asked if he could request peer review for an in-class writing sample. It is gratifying to see students concentrating on the review process and even more gratifying when peer evaluators make the same comments as the instructor.

**Group Dynamics Applications**

Since group work is becoming ubiquitous in engineering classrooms as a method to prepare students for professional work groups, peer review of the teamwork aspect of education is important as a way to circumvent potential problems and measure general productivity. Particularly in a group-oriented senior project class, peer review is necessary for accurate evaluation.

**Background and Rationale**

At Oregon Institute of Technology, the civil engineering senior capstone project is a group affair. Even the faculty function as an interdisciplinary team, with 1 communication instructor and 4 civil engineering instructors, representing the distinct subfields of that discipline (geotechnical, environmental, transportation, and structures). The faculty assign students to groups that last for the 20 weeks of the project, and each civil faculty member serves as a project manager for a group. The communication instructor serves as a general consultant, available for assistance in group dynamics, oral presentations, and technical writing.

Assignments include both group products (progress reports, engineering reports, oral presentations, plans and profiles, and calculation notebooks) and individual efforts (self-assessments, group dynamics memos, peer reviews). Individual assignments are weighted to ensure that performance can make a difference in final grades, and project managers’ comments account for about 15% of the final grade.

Course objectives (Figure 3) include items from both fields, the goal being to impress upon students the symbiotic relationship between the two fields—a good engineer must also be a good communicator—and help students develop ways to work congenially and productively with others. As a faculty, we agreed that periodic peer review, at least two per 10-week term, would help students understand the importance of communication to engineering as well as allow us to peek into the workings of their groups. It would also introduce them to professional performance evaluations.
Upon the successful completion of this course, students will be able to

1. function as engineers within their civil engineering consulting firm
2. design specified components of the project as detailed in the proposal
3. communicate effectively: orally, graphically, and in writing
4. prepare final reports, plans, and other documentation for submittal to the client
5. present final designs to client in a formal setting
6. function effectively in multidisciplinary engineering design teams
7. diagnose and solve group problems and conflicts
8. demonstrate appropriate professional and ethical behavior

Figure 3. Senior Project Course Objectives, 2008-2009

Process

While dozens of peer review forms from a variety of fields litter the Internet and could be adapted to suit our class, we decided to follow Robert Martinazzi’s lead and conduct a workshop dedicated to peer review, with students responsible for developing the criteria. It is a simple and effective process, starting with ventilation: we ask students, in their project groups, to develop a list of things they dislike about group work. This is followed by a very spirited discussion.

Our students’ list of undesirables mirrors those behaviors identified in the literature about peer review as the top common problems in groups:

- Social loafing: students who ride coattails on the group or are very reluctant contributors; also called “couch potatoes” or “hitchhikers" 
- Scheduling: group has difficulty finding a common time to meet and efficiently using that time
- Lack of leadership, floundering: no one steps forth to take care of administrative functions, such as calling meetings, developing agenda
- Lack of goals: group has ill-defined or very general goals, lack of direction
- Lack of communication: group has little two-way communication; individual members may dominate discussions and work

After discussing past problems, we then ask students to work on criteria that they think would be appropriate for evaluating the work of others and having others evaluate their own work. Although the wording varies from year to year, the general categories remain consistent: work habits, attitude, and professionalism. Figure 4 shows this year’s peer review form, developed during the second week of class. It is posted on the class Web site in a downloadable form.
Oregon Institute of Technology  
Civil Engineering & Communication Departments  

*CIV/COM 401. Senior Project*  

Peer Review  

Please take some time to complete these forms and return hard copies to M. Dyrud’s box by these due dates (both are Tuesdays): **November 4, December 2.** Please refer to “Peer Review Guidelines” for scoring information.  

*Person reviewed:*  
*Reviewer’s name:*  
*Team:*  

<table>
<thead>
<tr>
<th>Actively participates in meetings</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comments:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Completes quality work by deadline</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comments:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Demonstrates overall professionalism</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comments:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Shows initiative</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comments:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Exercises effective communication skills</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comments:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Average Score:  

Figure 4. 2008-2009 Peer Review Form  

Peer reviews occur twice during an academic quarter: midway and near the end. To alleviate the “You scratch my back; I’ll scratch yours” syndrome, the actual grade each student receives for the peer review is a combination of scores from other students and a score reflecting form completion, based on the review guidelines in Figure 5.
You will receive two scores for your peer reviews: one for how well you complete the forms and one reflecting group members’ assessment of your performance. Below are suggestions for completing the forms and scoring guidelines.

General Guidelines

1. **Please allow plenty of time for completing the forms; do not do them in class at the last minute or try to squeeze them into a 10-minute break.**

2. **Be honest and objective; remember that only your project manager (and I) will read your comments.**

3. **Be tactful in your comments. The point of peer review is to give honest, objective, and constructive feedback, not to make people feel bad.**

Scoring Guidelines

<table>
<thead>
<tr>
<th>Form completion</th>
<th>Performance assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructive comments</td>
<td><em>Exceeds expectations:</em> behaving as a professional; cooperative in each area and supportive; going the extra mile</td>
</tr>
<tr>
<td>Limited but useful comments</td>
<td>Cooperative and supportive behavior, but not exemplary</td>
</tr>
<tr>
<td>Occasional comments</td>
<td><em>Meets expectations:</em> competent performance but nothing extra; doesn’t take much initiative</td>
</tr>
<tr>
<td>Very limited or no comments</td>
<td><em>Does not meet expectations:</em> lack of cooperation; not fulfilling agreed-upon tasks; may impede group progress</td>
</tr>
</tbody>
</table>

The communication instructor receives and collates the forms, creates a summary sheet for each group with notes on emerging or existing problems, and passes everything to the project managers. Students then meet with their PMs to discuss results. At the beginning of a new term, the class revises the form in a workshop setting and makes any changes they deem necessary; the entire class must agree to proposed changes. Figure 6 presents this year’s revised form.
In addition to written evaluations, groups formally meet twice a term with their project managers and the communication instructor to assess progress on group dynamics, consisting of an hour-long discussion involving problem identification and solutions. Faculty score each student, using a rubric designed to gauge attitude, engagement, and honesty. As a follow-up, each student writes a memo discussing the meeting, the problems, and actions that he or she can take individually to facilitate the group’s functioning.

Since the students themselves discuss, develop, and refine peer review criteria each term, performance expectations are clear. Furthermore, by the end of the first week of senior project, each group is responsible for creating a set of group “operating guidelines,” which generally dovetail the formal review criteria. Coupled with the meetings with faculty, these documents provide an accurate snapshot of how groups function.
Teamwork Assessment

Teamwork is an assessment point in the civil curriculum, and in 2007-2008, the department assessed two facets of the senior project class: peer reviews and group dynamics. Tables 5 and 6 present data from both assessments. As Table 5 illustrates, students met minimal acceptable performance standards, and, in fact, surpassed those standards. In the eyes of their peers, they are, overall, meeting expectations in areas essential to their careers as professional engineers.

Table 5. Assessment Summary, Peer Reviews

<table>
<thead>
<tr>
<th>Performance Criteria</th>
<th>Assessment Methods</th>
<th>Results*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability and responsibility</td>
<td>Peer review forms</td>
<td>Average: 4.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>93.1% ≥ 3.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>69.0% ≥ 4.0</td>
</tr>
<tr>
<td>Accountability</td>
<td>Peer review forms</td>
<td>Average: 4.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>96.9% ≥ 3.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>75.9% ≥ 4.0</td>
</tr>
<tr>
<td>Professionalism</td>
<td>Peer review forms</td>
<td>Average: 4.2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100% ≥ 3.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>69.0% ≥ 4.0</td>
</tr>
<tr>
<td>Form completion</td>
<td>Evaluation by communication expert</td>
<td>Average: 4.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>93.1% ≥ 3.0</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60.0% ≥ 4.0</td>
</tr>
</tbody>
</table>

*Minimum acceptable performance: average of 3.5, with 90% performing at or above 3.0

The data in Table 6 suggest that, overall, students are also progressing in their abilities to function within an engineering group. To assess this item, two or three faculty members met with each group to discuss successes, diagnose problems, and brainstorm solutions.

Table 6. Assessment Summary, Group Dynamics

<table>
<thead>
<tr>
<th>Performance Criteria</th>
<th>Assessment Methods</th>
<th>Results*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participate effectively in a group meeting</td>
<td>Evaluation by criteria; 2-3 faculty members</td>
<td>Average: 3.8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>87.0% ≥ 3.0</td>
</tr>
<tr>
<td>Write a plan for improving group dynamics</td>
<td>Evaluation of paper by rubric; 2-3 faculty members</td>
<td>Average: 3.4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>91.3% ≥ 3.0</td>
</tr>
<tr>
<td>Follow through with written plan</td>
<td>Evaluation by rubric; 2-3 faculty members</td>
<td>Average: 3.6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>90.5% ≥ 3.0</td>
</tr>
</tbody>
</table>

*Minimum acceptable performance: 85% of students achieving at least 3.0

Benefits

Using peer review yields a number of benefits, as explained below. Overall, both students and faculty are satisfied with this approach.
Early alert. For groups that have a social loafer or a member who consistently misses meetings, peer review can help circumvent friction by letting that member know how his or her behavior is affecting team morale. A review followed by a team meeting, with a faculty observer, can help to alleviate ill feelings, assuming, of course, that the errant member is receptive to constructive feedback.\textsuperscript{15} Furthermore, as Aggarwal and O’Brien note, several reviews can “help students develop clear expectations of contribution responsibility and give underperformers an opportunity to improve individual efforts.”\textsuperscript{16}

Improved involvement and responsibility. When students know that they will be undergoing peer review as well as faculty evaluation, they can respond by increasing their contributions to the task at hand and assuming more responsibility within the group, thus enhancing the educational experience.\textsuperscript{21} Instructors can contribute to the group’s functionality by providing clear expectations for group contributions and shepherding the review effort, either by giving clear guidelines or facilitating students’ criteria development efforts.

In the civil engineering senior project class, groups are responsible for developing operating guidelines for anticipated performance. If a group member is non-receptive to suggestions and continues to be a non-contributor, the group may fire that individual, based on a faculty-developed dismissal protocol. Fortunately, in eight years of senior project, we have not yet had to implement the protocol; we attribute this to the general commitment of our students and the efficacy of the peer review process, although we have not developed formal measurement procedures. However, the primal urge to graduate seems sufficiently seductive to help ensure at least minimal productivity by all group members.

Improved performance. The literature is replete with articles indicating that collaborative activities enhance student learning. According to Oakley et al, “Students taught in a manner that incorporates small-group learning achieve higher grades, learn at a deeper level, retain information longer, are less likely to drop out of school, acquire greater communication and teamwork skills, and gain a better understanding of the environment in which they will be working as professionals.”\textsuperscript{22}

Senior project faculty have discovered, over the eight years of the project, that groups tend to perform at a higher level than individuals. We attribute this, in part, to a natural socialization process that takes place during the first term; that is, student groups start meeting away from campus: for pizza, movies, outdoor activities. These social encounters tend to strengthen group bonds and create a congenial atmosphere.

Meeting employer expectations. According to employer ratings included in the National Association of Colleges and Universities’ 2008 \textit{Job Outlook} report, the top 10 desirable skills for job seekers include the following, listed in order of importance:

1. Communication skills
2. Strong work ethic
3. Teamwork skills
4. Initiative
5. Interpersonal skills
6. Problem-solving skills
7. Analytical skills
8. Flexibility/adaptability
9. Computer skills
10. Technical skills\textsuperscript{23}
Students can develop most of these in an academic group setting, and including peer review can certainly enhance their interpersonal, teamwork, communication, and problem-solving skills. Moreover, academic peer review allows students to practice for performance reviews in the workplace.

**Conclusions**

Studies in the literature of student peer review indicate that peer review can be a valid and valuable tool.\textsuperscript{13, 24, 25} Based on our experience, we heartily agree.

In technical communication courses, requiring students to evaluate their peers’ rough drafts can be an effective teaching method that students value.\textsuperscript{26} Student self-assessment feedback for meeting course objectives for the Vanderbilt course indicates that students see improvement in both their writing and peer review expertise. Further data are needed to determine if students taking this course think the peer review method has improved their writing. Furthermore, a comparison of the final drafts to the first drafts would show whether or not students followed their peers’ recommendations and improved the papers. Experience with students’ peer reviews in this course and with professional peer review for publication indicates that future results will agree with this preliminary assessment and with the literature.

Peer review in regards to teamwork is equally valuable, allowing students to learn important lessons about responsibility and accountability. Professionally, teamwork is required in civil engineering, due to the distinct sub-fields of the discipline, and we would rather our students learn these lessons in the relatively comfortable environment of academia, rather than waiting until their first job. Encouraging students to develop peer review criteria seems to be, at least based on the OIT experience, more effective than giving them a pre-fab format, as they “own” the criteria and must perform to meet mutually agreed-upon expectations.

Whether a peer review process is used to evaluate writing or teamwork, it is effective in helping students improve in those areas. Side benefits include enhancement of critical thinking and editing skills as well as developing sensitivity to interpersonal issues and an active engagement in the educational process.

In an article discussing the future of engineering education, Richard Felder has stated: “The social environment in a class, the nature and quality of interactions between the students and the instructor and among the students, can have a profound effect on the quality of learning that takes place in the class.”\textsuperscript{27} Peer review can be an excellent method of achieving a congenial, non-threatening classroom ambience that can both enhance the quality of learning and help prepare students for their lives as professional engineers.
Acknowledgments

We are grateful to statistical consultants, Mary Anderson-Rowland, Arizona State University, and Mary Dietrich, Vanderbilt University, for their assistance with statistical analyses.

References


5. Held, Julie A. Unpublished peer review form, Technical Communication Course (Tech Com 220), Indiana University, Purdue University, 1991.


10. Moss, Andrew, and Carol Holder. Improving Student Writing: A Guidebook for Faculty in All Disciplines. Pomona, Calif.: California Polytechnic University, 1982.


