Helping Students to Provide Effective Peer Feedback

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Abstract

Peer assessment is becoming more common across the curriculum. If it is to be effective, students need to know how to provide meaningful feedback. It is important to construct a rubric that draws students' attention to the important points of the work they are reviewing. But that is not enough; students also need instruction in how to provide comments that their peers can and will use in revising their work. This involves learning how to provide constructive suggestions. It also means understanding the way the author will react to the review, and using gentle enough terminology so that the words do not get in the way of understanding the reviewer's advice. Authors can also help reviewers learn the ropes by giving them feedback on the effectiveness of reviews of their work.

Keywords: peer review, peer assessment, peer feedback, formative feedback, rubric

1. Introduction

Peer assessment is an educational technique that is finding increasing use at all levels of education. It has been shown to improve student learning in disciplines all across the curriculum [1]. Whether in lab sciences, computer science, or engineering courses, as well as other areas of the curriculum, peer review has led to measurable learning gains.

Peer assessment is grounded in the constructivist theory of learning [2]. The basic premise of constructivism is that students "build" their own knowledge and skills [3]. As assessors, it forces students to step back think about their work as others see it. Pondering not only how to do the work—how to analyze a problem, or create an artifact—but also how others might approach the same challenge, results in metacognitive gains, which enhances students' ability to transfer their learning to new environments [4]. As asessees, students benefit from seeing how their peers view their work, and having the opportunity to act on suggestions made to help them improve their performance. More pragmatically, peer assessment provides students with more feedback than they can expect to receive from the instructor or teaching assistants, who need to provide feedback to all class members, not just a few. And it provides it more quickly: it can be conveyed to authors as soon as it is available, without having to wait until all students' work has been graded. Indeed, peer assessment is one of the few *scalable* approaches to assessment: as the amount of work to assess increases, the resources available for assessment increase proportionally.

Perhaps the most frequent use of peer assessment is for teaching writing. Writing for an audience of their peers forces them to explain themselves well enough so that they can be

understood by non-experts. It also gives them the benefit of seeing and responding to their peers' reactions to what they write.

Writing is important in engineering, of course. It is a good way for students to grapple with ethical issues that arise in their professional development [5, 6]. Peer-assessment environments have also been designed for pedagogical code reviews [7] and exam practice questions [8]. A frequent use of peer assessment is for design projects [9], including user-interface design [9]. In group projects, peer assessment is often used to rate contributions of team members to the artifacts produced by the team [11].

The main objective of peer feedback is to provide specific and timely feedback to authors on how to improve their work. Unfortunately, most students, left to their own devices, provide a paucity of feedback that is not focused on helping the student author to improve.

Most instructors have limited experience in teaching students how to review. It is one of the critical-thinking skills that is important for all disciplines, but rarely taught in any discipline. This paper endeavors to help instructors improve their use of peer assessment. The first half of the paper talks about how to design an effective review process, with allusions to the software that might be involved. The second half describes the characteristics of an effective review, and represents advice that instructors might give to their students.

2. The Rubric

The first step in a good peer-review process is a good rubric. It will include detailed criteria, to draw students' attention to important aspects of the work. The criteria should mention the goals and keywords of the assignment, so that students will focus on their goals in their reviewing as well as their writing. The rubric may call for reviewers to assign a score to various characteristics of the work. If possible, the students should be given guidance about the characteristics of a work that merits each score (or "level"). This is called an "anchored scale." The instructor can help the students to visualize what a good review should be, by providing several models of good reviews for them to peruse.

Exhibit 1 displays a rubric that the author has used for review of Wikipedia articles that he assigned to his class.[1] The rubric consists of six ratings criteria, where reviewers were asked to rate characteristics of the article, such as reability, organization, and originality, on a scale from 1 to 5. Reviewers were asked not only to choose a rating, but also to offer a prose comment on why they chose the score they selected. There is a checklist that reviewer are asked to fill out, and finally a set of short-response questions, where re-

[1] This assignment was done in conjunction with http://wikiedu.org, a Wikipedia initiative to engage classes in improving and adding articles to Wikipedia.

viewers are challenged to offer suggestions on how the improve the article. Screenshots of the rubric from our Expertiza [12] peer-assessment system are shown in the Appendix.

Note that the rubric asks for both quantitative and qualitative responses. Ratings and checklists are quantitative. They draw reviewers' attention to specifics [13], and can be adapted from the learning goals for the assignment. Open-ended comments are qualitative. They can be used by authors in revising their work. They also allow authors (or instructors!) to judge how carefully the reviewer has read and reflected on the work.

A rubric can be more or less detailed depending on how many artifacts students are expected to review. A rubric with twenty separate criteria ("questions") would be overhwelming for an instructor to fill out for each piece of work submitted by the class, but the length might be pretty reasonable for students who are asked to review only two to four peers. The detail in the rubric serves to draw reviewers' attention to aspects of the work they might have missed.

Ratings [Each has a dropdown to assign score, plus a text box where comments can be inserted.]

- List the unfamiliar terms used in this wiki. Are those unfamiliar terms well defined or linked to proper references?
- Rate the overall readability of the article. Explain why you give this score.
- Rate the English usage. Give a list of spelling, grammar, punctuation mistakes or language usage mistakes you can find in this wiki (e.g. ruby on rails -> Ruby on Rails).
- List any related terms or concepts for which the writer failed to give adequate citations and links. Rate the helpfulness of the citations.
- Rate how logical and clear the organization is. Point out any places where you think that the organization of this article needs to be improved.
- Randomly pick some sentences or paragraphs and search for it with a search engine. List any sources that may infringe copyrights.

Checklist [Each has a checkbox.]

- The discussion is appropriate and reasonable, i.e., not too easy or too difficult for your peers to follow.
- Most of the sources are current (less than 5 years old).
- This article is up to date.
- Taken together the sources represent a good balance of potential references for this topic

Short Response [Each has a text field.]

- Please make a comment about the sources. Explain how the author can improve the use of sources in the article.
- What other sources or perspectives might the author want to consider?
- Give compliments for the article. Separate them with line breaks.
- Give suggestions for the article. Separate them with line breaks.

Exhibit 1: Sample rubric

	5. Exemplary	4. Proficient	3. Competent	2. Developing	1. Underdeveloped
Clarity	The prose is clear, easy to understand short and to the point, with very few and specific and relevant examples	The prose conveys most of the meaning and examples help to clarify ideas; few to no grammatical mistakes.	The prose provides a bare outline of the key points and/or a plausible example that could be enhanced with some grammatical mistakes.	Unclear, illogical organization with confusing content and/or poorly chosen examples and multiple grammatical mistakes.	Prose is unclear, confusing and unrelated to the goals and contains many grammatical mistakes resulting in a nearly incomprehensible posting.
Coverage	The work covers the prescribed topic, without omitting any important aspects, and without including any extraneous material.	The work covers the prescribed topic well, but some aspects appear to be overemphasized or underemphasized, relative to their importance to the topic	The work covers the prescribed topic, but there are some omissions or material that is only tangentially related.	The assigned topic is covered, but there are large omissions or large amounts of unrelated material.	The work does not cover the material that was prescribed. It is irrelevant, or addresses another topic altogether.
Definitions	The page has an appendix at the end, or the unfamiliar terms are defined in parentheses next to the term the first time they are encountered.	Most unfamiliar terms are defined, but a few needed to be looked up (e.g., on the Web).	Relevant terms were undefined, but this did not seriously detract from understandabil-ity.	In order to understand the work, it was necessary to consult external sources that were not linked to.	Because of the unfamiliarity of the vocabulary, it is very hard to learn anything from this work.
Examples	Examples appear wherever needed and are easily comprehensible.	Coverage of examples is sufficient to get a basic understanding of the topic.	There are examples, but they are not particularly easy to understand, as if they might have been lifted from another source.	Examples are rare and are not much help to understanding.	No examples are provided.
Links	All surprising, unclear, or controversial conclusions are supported by links to original works. Referenced material is easy to understand.	Surprising, unclear, or controversial conclusions are usually supported by links. Reference material is usually clear.	There are sufficient links, but not necessarily in the places they are needed. Some referenced material may be unclear	Few conclusions are supported by links to original work.	No links to useful information are provided.

Exhibit 2: A rubric with “advice,” or an “anchored scale”

Another way to assist students in completing the rubric is to use an anchored scale providing "advice" on what characteristics of the reviewed work merit what level of credit. An example is shown in Exhibit 2.

It is a useful exercise for students to help create the rubric. Soon after an assignment is announced, the instructor might present a sample rubric (e.g., the previous semester's rubric), and ask students to suggest changes. Then the rubric—or its advice—might be edited to incorporate some of these suggestions. Having a role in creating the evaluation instrument helps give students a sense of ownership of the assignment, and can help pique their interest in meeting its goals [14].

3. Formative vs. Summative Feedback

Peer assessment, like any kind of educational assessment, may be either used *formatively*—to help the student improve, or *summatively*—to assess how well the student has done. Formative assessment consists chiefly of text, while summative assessment is mainly numbers. When used summatively, peer review is often referred to as "peer grading," whose validity is often controversial [15].

Formative peer evaluation is most useful for the student. Students, of course, receive a plethora of summative assessments, but frequently not enough formative assessment. A single individual (the instructor or teaching assistant) is tasked with assessing many students, and thus has only a very limited amount of time to devote to each individual. The beauty of a good peer assessment is that the resources for providing assessment scale directly proportionally to the amount of assessment needed. If the rubric elicits feedback on salient aspects of the assignment, each student receives an adequate amount of feedback, regardless of how large the class is.

[Each criterion has a dropdown to assign score, plus text box where comments can be inserted.]

- Organization: how logical and clear is the organization?
- Originality: If you found any plagiarism in round 1, has it been removed? Then, randomly pick some sentences or paragraphs and search for them with a search engine. Describe any text that may infringe copyrights.
- Clarity: Are the sentences clear, and non-duplicative? Does the language used in this artifact simple and basic to be understood?
- Coverage: does the artifact cover all the important aspects that readers need to know about this topic? Are all the aspects discussed at about the same level of detail?
- Definitions: are the definitions of unfamiliar terms clear and concise? Are the definitions adequately supported by explanations or examples?
- References: do the major concepts have citations to more detailed treatments? Are there any unavailable links?
- Did the authors revise their work in accordance with your suggestions?

Exhibit 3: Summative rubric corresponding to formative rubric in Exhibit 1

Summative feedback is most useful for the instructor. It can point out at a glance where (on which criterion) the peer reviewers think a

particular piece of work is weak, thereby directing the instructor's attention to the aspect that needs to be checked. The instructor can look at text comments the reviewers have made on the weak points, deciding whether their concerns are merited and should be factored into the grade. Thus, even if peers don't directly assign the grades, they can help the instructor do so by pointing out the areas that need attention.

If peer review is done face to face, normally it is done in a single round, after which students revise their work for submission to the course staff. An online system can automate the process to the point where it's possible to have a separate formative and summative round, with different rubrics for each. Exhibit 3 shows the summative rubric that the author has used for the second round of review on Wikipedia contributions whose first-round rubric was shown in Exhibit 1.

4. Guiding Students on How to Write a Good Review

The rest of the paper offers advice on how to write an effective review. It will be phrased as if it were written to the student reviewer.

The reviewer should try to convey to the authors [13]—

- what they have accomplished in their current draft;
- how that compares with what they were asked to accomplish; and
- what changes they can make to improve their work.

4.1 The components of an effective review

A review can provide five kinds of peer feedback [16].

- *Describe* what the reviewer sees in the current work, e.g., by succinctly summarizing it. This is often missed in designing a rubric, but it can be very useful because (i) it makes the reviewer think over the work as a whole, and thus helps to forestall a review directed at minor points that misses the big picture, and (ii) it helps prevent conflict between reviewers and authors, which frequently stem from misintepretation of the work.

- *Clarify* what the author is trying to say, i.e., ask questions about points that remain unclear.

- *Suggest* changes that the author can make to improve the work. This is often the most helpful kind of feedback a reviewer can give.

- *Alter* (or point out changes) that should be made to correct errors, e.g., terms used incorrectly, typos, grammatical errors, mis-punctuation. This should not be the main goal of a review, and the review should not lead with it, but correctness is

still important, and the reviewer is in the best position to make or suggest corrections.

- *Evaluate* how well the work meets its objectives, i.e., summatively assess it.

Feedback should consist of *sharing* information with an author [17], rather than directing changes. The author should be left free to act for him/herself on using the information, depending on the situation. If the author has received multiple reviews, for example, they may give conflicting advice. Or, the author may not have the necessary background or sufficient time to make involved changes suggested by a reviewer.

Good feedback provides the amount of information that the author can use, rather than the amount that the reviewer would like to give. A reviewer who gets carried away describing what (s)he knows about the topic may overload the author with more information than can easily be used. Voluminous feedback may confuse or discourage the author. The motivation should always be to help the author rather than to get something off the reviewer's chest.

The writing process. A good reviewer will start by reading the assignment handout [17], including goals. If the handout is lengthy, it may be helpful to take notes on what is being asked for. It is also helpful to read through the rubric, to get an idea of what to be on the lookout for while reading the student's work.

It is always a good idea for the reviewer to read the work at least twice: once to gain an overall perspective on the work, and once with a critical eye for detail. Which reading should be first will depend on the individual reviewer. Some people skim for comprehension, and need to force themselves to notice the fine points. Others find themselves drawn to minutiae and need to reread to get the big picture. It is helpful to make notes of questions that come to mind, points that should be explained, and ideas on how to improve the work. If possible, these should be tied back to the goals of the assignment.

Note-taking is important. One reads a piece of work from beginning to end, whereas the rubric calls attention to aspects that may relate to any part of the work. Notes need to be organized as a response to the rubric. For example, grammatical errors may jump out of the page at the reader, but it would not be wise lead off a review with them. Some criteria, e.g., organization, cannot fairly be evaluated until one has looked at the whole work. Taking notes may save the reviewer from having to peruse it a third time while filling out the rubric.

The discussion up to this point assumes that it is a prose document that is being reviewed. That is not necessarily the case. It may be a software program, a design drawing, or even a piece of art. But the same principle applies: the work should be viewed as a whole,

before or afterwards the details are inspected. Notes should be taken while doing so, then pieced together in answer to the questions (criteria) in the rubric.

4.2 The psychology of an effective review

Writing an effective review has almost as much to do with psychology as it does with assessment. The review should begin with comments on what is good (or improved, in the second review round). Research demonstrates [18] that communication is most effective when positive comments outnumber negative by a large margin ("5 to 1," in popular parlance). It is sometimes challenging for students to think of what to say. They often ask, If I think the work measured up, what am I supposed to say about it? The answer is that they can elaborate on *why* they think it is good. That gives authors positive reinforcement to help them emulate their success later on.

A good review should proceed from the general to the specific. Larger issues (purpose and organization, for example) should be tackled before specifics, such as diction and phrasing. Suggestions need to be specific, calling out not only what needs to be done, but giving an idea of how to do it.

Suggestions should be realistic in scope. It does no good, really, to tell the author to start over. No student author is going to throw away work that is already done just to please a single peer reviewer. The reviewer should ask for only what the author seems able to deliver.

The review should be a review of the content, not of the author. Ad hominem remarks are out of bounds. Not only might they demoralize the author; they also make it less likely that the author will read or reflect on the rest of the review. When the author sees the review sticking to business and attempting to be helpful, (s)he will be much more likely to give it more than a passing glance and take its advice to heart.

As a corollary, the reviewer should try to avoid words like "always," "never," and "worst" [19]. Those are generalizations that probably cannot be supported by a careful reading of the work, and thus come across as exaggerations that reveal hostility toward the author. Similarly, the reviewer should not presume to know the author's motivations [17]. There is a very good chance the reviewer will be wrong, and engender resentment or suspicion in the author. The reviewer could *ask* why the author has made a particular decision, if the review is face-to-face, or if the online tool allows it, and it can be done in a nonthreatening manner. But in most cases, it is probably best to avoid the issue.

It is a good idea to start and end with the positive. That helps avoid the impression that hollow praise was simply prepended in front of the critical comments that the reviewer really wanted to make.

In summary [20], when writing a review, one should remember to—

- *focus feedback on specific improvements*, since praise, per se, will not help an author to improve, nor will general comments that the author does not understand how to apply.
- *focus feedback on the artifact*, rather than on the person, because the author can improve the artifact a lot more easily than they can change who they are.
- *be aware of the needs of the receiver*, and try to help, rather than writing in a way that allows oneself to feel superior to the student who is being reviewed.

5. How to Read a Review Well

Just as the reviewer needs to appreciate the author's perspective, the author needs to read a review understanding where the reviewer is coming from. The author should realize [21] that reviews will vary in quality, that some are worth paying more attention to than others. When reading a review, the author should make an effort to digest the comments. The feedback is provided for the author's benefit, so it should be read carefully. The author may not have intended the meaning that the reviewer has absorbed, but that does not mean that the feedback should be disregarded, since the same issue could arise in other readers' minds. Comments that may seem "off the wall" at first glance may later seem right on target, after the author has taken time to read them from the reviewer's perspective. As an author, be grateful for the time that others have taken to help you improve your work, and use the help that they provide. Though the feedback may seem intimidating at first, if the author keeps an open mind and uses it to improve the document, it will help build confidence and attain a feeling of accomplishment.

If there is a way to communicate with the reviewer, either face-to-face or through an online system, the author might let the reviewer know specifically what kind of comments or clarifications would be helpful [17]. The feedback should be taken as an invitation to interaction.

Pearce [21] gives the following checklist for receiving feedback:

- ✓ Don't panic!
- ✓ Read **all** the comments & make notes
- ✓ Take time to **reflect**
- ✓ Address the **major** issues
- ✓ Tackle the smaller points
- ✓ **Proofread** the final document

6. Learning from Reviewing

Students can learn from being reviewers as well as from reading reviews of their own work. Several studies suggest that students actually learn more from being reviewers than they learn from having their work reviewed [22]. In this study, a class was divided into two groups, with the students in Group A providing feedback to students in Group B. At the end of the semester, it was found that students in Group A (the "givers") improved their writing more than students in the "receiver" group. This was confirmed by Shah-Nelson [23], who found that 1040 students taking a MOOC (Massive Open Online Course) ranked the educational value of "grading other students' papers" at 3.17 on a scale of 1 to 4, exceeding the value that they found in "feedback from other students" (2.92 on a scale of 1 to 4).

Similarly, Kulkarni et al. [10] found that students in several Coursera MOOCs said they learned more by assessing their peers (4.97 on a scale of 1 to 6) than they did by assessing themselves (4.51). These results should be no surprise to academics, who learn more by being on panels for funding agencies than they learn from the reviews they receive of their own grant proposals [24]. Indeed, one of the aspects of peer review that students value is the opportunity to examine others' work, and thereby gauge whether they are directing enough effort to the right parts of the assignment. Students embarking on a peer-reviewed assignment should be told this, as a way to increase their buy-in to the process.

7. Conclusion

In-class peer review can be a rewarding experience, but to realize its promise, it requires careful planning and instruction. First, the instructor should create a detailed rubric, possibly with suggestions from students. Students should be shown what a good review looks like. They should understand the benefit of providing specific, actionable suggestions to the authors. They should endeavor to put themselves in the authors' shoes, and think carefully about the effect that their feedback will have on the authors' knowledge and feelings. Students will learn from the feedback they receive from others, but as careful reviewers, they may well learn even more from engaging in the peer-review process themselves.

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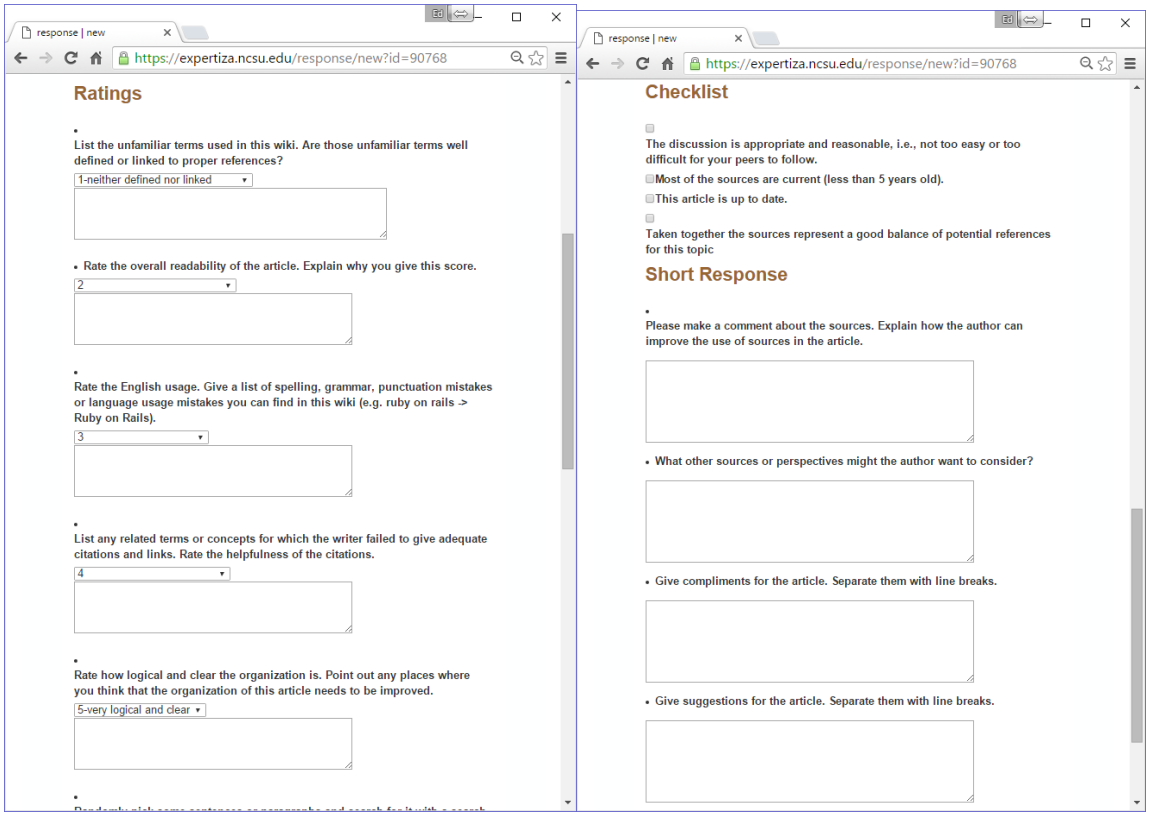
Appendix.

A formative rubric as shown in the Expertiza peer-assessment system


response | new
https://expertiza.ncsu.edu/response/new?id=90768
Ratings
List the unfamiliar terms used in this wiki. Are those unfamiliar terms well defined or linked to proper references?
1-neither defined nor linked
Rate the overall readability of the article. Explain why you give this score.
2
Rate the English usage. Give a list of spelling, grammar, punctuation mistakes or language usage mistakes you can find in this wiki (e.g. ruby on rails -> Ruby on Rails).
3
List any related terms or concepts for which the writer failed to give adequate citations and links. Rate the helpfulness of the citations.
4
Rate how logical and clear the organization is. Point out any places where you think that the organization of this article needs to be improved.
5-very logical and clear
response | new
https://expertiza.ncsu.edu/response/new?id=90768
Checklist
The discussion is appropriate and reasonable, i.e., not too easy or too difficult for your peers to follow.
Most of the sources are current (less than 5 years old).
This article is up to date.
Taken together the sources represent a good balance of potential references for this topic
Short Response
Please make a comment about the sources. Explain how the author can improve the use of sources in the article.
What other sources or perspectives might the author want to consider?
Give compliments for the article. Separate them with line breaks.
Give suggestions for the article. Separate them with line breaks.

A summative rubric as shown in Expertiza