Technical Note

How to Review a Technical Paper

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(Received March 27, 1992)

Abstract

Peer review of journal articles and other technical reports is a key element in the maintenance of academic integrity. This article assists the reader in the efficient preparation of constructive reviews. The parts of a typical review are listed, as well as formats for the most common situations. Common defects of technical papers are discussed.

Introduction

At one time or another, every academic is asked to review papers submitted for publication in journals. These reviews play a key role in maintaining the integrity of a journal. In addition, the exercise exposes the referee and the author to new ideas and perspectives. Unfortunately, nascent academics are never formally taught the art and skills needed to referee a technical paper. As a result, most reviews take more time than necessary, while contributing little constructive knowledge to the author. The following text offers some tips to the referee to assist in the preparation of a written review. Learning the mechanics of review writing can never substitute for full comprehension of the material, but it can transform the review into a constructive document. At the same time, there are simple rules for identifying flaws in the paper that greatly simplify review preparation and allow the referee to concentrate on the paper's content. This guide focuses on technical papers, but some of the advice also applies to papers in the social sciences and liberal arts.

Why is a review necessary?

The peer review serves several roles, although the precise combination varies with the type of review. The most important reasons for review include finding deficiencies in:

- technical approach and analysis;

- computation;

- ignorance of related research.

Each of these categories requires a referee with broad knowledge of the topic to recognize these deficiencies. Even simple arithmetic errors need an expert to detect them. Errors of the "2 x 3 = 7" type are rarely spotted directly; rather, a referee will sense that something is wrong with an argument, and then trace it back to the arithmetic error. No self-respecting researcher wants such errors publicized, so the review process limits the humiliation to a much smaller (and often anonymous) circle.

Reviews are useful to detect a second kind of problem. Two examples are:

- style and grammar that confuse the reader;

- patent or legal issues.

These aspects are often addressed by specialists in editing and law rather than the topic of the paper. Unfortunately, most academic journals lack the staff to assist the author, so the referee should alert the author to style and grammar errors, especially if they are serious. Certainly the author will want his or her paper read, understood, and appreciated by as many people as possible; therefore it is in his interest to repair these problems before the paper is published or circulated.

Types of reviews

There are three types of reviews: "anonymous", "friendly", and "internal". In an anonymous review, the editor solicits a referee to review the article. The referee returns the review to the editor who, after removing any identification, gives it to the author. Academic journals typically use the anonymous review, but it is also used for books, articles in proceedings, and some reports.

Many authors send drafts of articles or reports to other experts and solicit their comments. This is called a "friendly" review. In such cases, the reviewer is known to the author. The timid reviewer may be reluctant to harshly criticize a paper, so these are less valued than an anonymous review (although a true friend should be the severest critic in private).

Many laboratories and research institutes require that all papers be internally reviewed prior to submission to a journal or proceedings. The quality of such reviews is highly variable, from extremely rigorous to worthless beyond protecting the author from the most outrageous errors.

In all cases, however, the procedure to review a paper is fundamentally similar. This guide assumes that you are anonymously reviewing a paper for an academic journal.

Most reviews have four parts

Before reviewing a paper, it is useful to consider the desired output. In this way, you can categorize your comments for later inclusion in the best part. The four parts of a review are:

- referee's review form;

- additional comments;

- original paper;

- cover letter to editor.

Most journals ask the referee to fill out a review form. The form consists of a list of questions about the article, and often solicits recommendations. Poorly designed forms allow "yes/no" answers, but more sophisticated ones prompt the referee to elaborate (and provide space for those comments). The form is typically designed such that the referee's name is on the opposite side or on a tear-off portion to protect his identity.

Nearly all forms ask the referee to write additional comments on a separate page. This may include responses to questions on the form that were too long to fit in the allocated space or comments that were not appropriate for any specific question.

The referee often returns the original paper to the editor. Sometimes it is simpler to write comments directly on the paper than to describe them in the "additional comments" section. Editing corrections are particularly easy to show this way. If only a few pages are covered with red ink, you can save postal charges by mailing only those offending pages.

The cover letter to the editor is a useful document in addition to being a civil act. First, it reminds the editor of your review and the associated paper. (Editors receive reviews every day, so it is difficult to remember every paper and referee.) Second, it gives you a chance to summarize the review in one or two sentences. Finally, the cover letter provides a location for you to write any "off-the-record" comments regarding the paper. For example, a referee might write, "I am astonished that the author wasn't aware of the identical research conducted by Prof. X fifteen years ago". More often than not, the referee uses the cover letter to apologize for the tardy review.

What to write if there is no form

There will be circumstances where no review form is provided. Here is a format to use in such cases.

(1) Title and author of paper

(2) Summary of paper

This needs to be only 1-3 sentences, but it demonstrates that you understand the paper and, moreover, can summarize it more concisely than the author in his abstract.

(3) Good things about the paper (one paragraph)

This is not always necessary, especially when the review is generally favorable. However, it is strongly recommended if the review is critical. Such introductions are good psychology if you want the author to drastically revise the paper.

(4) Major comments

Discuss the author's assumptions, technical approach, analysis, results, conclusions, reference, etc. Be constructive, if possible, by suggesting improvements.

(5) Minor comments

This section contains comments on style, figures, grammar, etc. If any of these are especially poor and detract from the overall presentation, then they might escalate to the 'major comments' section. It is acceptable to write these comments in list (or bullet) form.

(6) Recommendations

Some referees will shower papers with invective even when they like it. An editor may not recognize this habit, and interpret the criticism as grounds not to publish the paper. For these reasons, it is worthwhile to tell the editor if the paper should be published. Three major categories of recommendations are: "publish as is", "publish after corrections have been made", and "reject". Sometimes the recommendations fit better in the cover letter.

Do not write your name on the comments pages because the editor may forget to conceal your name.

What makes a good paper?

Good papers contain something of merit. You, an expert in the subject, should be able to find it (if it exists). However, the item of merit may be poorly presented, which can undermine the paper's value. A logical structure is the first element of a good presentation.

A standard structure for technical papers has evolved as follows:

(1) Abstract

(2) Introduction

(3) Body of the Paper (technique, results, discussion)

(4) Conclusions

(5) References

(6) Tables

(7) Figures (and captions)

Naturally there are minor variations in these sections depending on the topic and the journal's requirements, but the concept is always the same. If the author did not follow it, then it should be quickly obvious to a reader why a different structure was necessary.

Even if the paper was written in the standard structure, major problems may exist. (The standard structure simplifies identification of the defects.) Here are some common errors encountered in each of the above sections.

Read the *Abstract* before and after the whole paper. Does it actually summarize the paper? Does it include the conclusions as well as the statement of the original problem? Is there information not presented elsewhere in the paper? Keep in mind that abstracts are often written in haste, sometimes not by the principal author, and occasionally with knowledge of information not discussed in the paper.

The *Introduction* should explain why the topic is important. The audience for the paper will determine the scope of the Introduction. If the paper is about a new chemical reaction to be published in the *Journal of the American Chemical Society,* then it is probably not necessary to explain to the reader why organic chemistry is important in everyday life. Many technical papers suffer from excessively broad introductions; usually the first few paragraphs can be excised. Does the author cite only his own papers for examples of past work?

The *Body of the Paper* is the part most requiring the referee's expertise. Here you are on your own. As you read it, decide if the approach and analysis are clearly described. Has the author integrated discussions of errors and uncertainties in his analysis at suitable points? Authors also have difficulty identifying what parts of their papers are central and which are either irrelevant or of lesser importance. (Sometimes the author has not carefully considered his audience.) Therefore, look for material that could be deleted. Is the level of detail reasonable? Are too much data presented? Many journal articles are

condensations of much longer and detailed internal reports. It is perfectly acceptable to refer to the internal reports for details, especially when only a few readers will be interested. (If they want the details, they can write the author for the report.) When the paper has a page limit, the author may fail to insert enough detail. As a referee, you need to identify these cases and suggest areas where offsetting deletions could be made so as to remain within the limits.

While reading the Body of the Paper, consider the topic as a whole. Is this the right amount of work for a paper? Is the paper premature? Alternatively, should the paper be divided into two papers? Few referees seriously consider these issues.

The *Conclusions* should follow directly from the Body of the Paper. There should be no surprises and, most important, no new material introduced. Some authors try to broaden their conclusions by "reaching" for results produced elsewhere. This is unacceptable.

The References provide many clues to the author's approach. The paper is immediately suspect (but not necessarily wrong or obsolete) if all of the references are old. A reference list containing papers only by the author deserves special, and skeptical, scrutiny. Beyond this, however, the referee should be able to spot omissions. Has the author forgotten important references? Help the author if possible by supplying the citations.

Tables, Graphs, and Figures are vital components to a paper but only when thoughtfully used. Tables are particularly abused. Is every table and graph necessary? (Perhaps a citation to an internal report would suffice.) Do the tables contain more digits than are actually significant? This is a common problem when computers calculate values and the programmers fail to suppress insignificant digits. Worse, these nonsense numbers clutter up a table, thus making it more difficult for the reader to extract the significant numbers. Zero suppression also removes table clutter. For example:

1.3732145 -> 1.4

0.00045 km -> 45 cm

Substitution of graphs for tables avoids both of these problems.

Table? <- DATA => graph?

Can the table data be presented better in a graph? With the advent of computer plotting programs, graphs are wonderfully easy to create. There are now several guides to the preparation of effective displays of quantitative information. Unfortunately, some treat a graph as a piece of art and refuse to acknowledge that most graphs will be computer generated. You must recognize that a compromise may be required.

Check that all figures and tables are appropriately captioned and are referred to in the text. Journals differ in their policies regarding captions, but it is good practice to have one sentence in the caption

summarizing the results.

When to decline

Most editors ask the referee to finish a review within a specified time. Unfortunately, a good review takes many hours to prepare and it must compete with other obligations. Therefore, you can (and should) decline to review a paper if you cannot devote the necessary time before the deadline. But tell the editor immediately so that he can find a substitute referee.

Upon inspection of the paper you may realize that you are not competent to review the paper. This is nothing to be ashamed about because editors cannot perfectly match papers and referees. Once again, you should notify the editor immediately.

When you decline to review a paper, the editor will be particularly gratified if you suggest an alternate referee, with the relevant address, and telephone number. Some editors will encourage you to pass on the paper directly, while others want full control of the review process.

Good editors keep lists of referees. One goal is to avoid asking people to review papers too frequently, but the lists often include information about the quality of the reviews and how often one declines. It is sometimes believed that a good referee gets preferential treatment when he submits his own paper. This belief may have some justification.