Advice on Technical Writing

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Good communication skills are essential for success in your career. Every presentation gives you an opportunity to work on improving these skills, whether you are writing a single paragraph or a whole thesis.

1   Start by writing a specification

Technical writing is a complex skill. Even after years of practice there is always room for improvement. Programming is analogous: it takes years of practice to make the transition from "first learning how to program" to being an effective and versatile software designer.

It is good programming practice to start with a *specification*, a clear description of what the program is supposed to do. The same is true for technical writing and oral presentations. As a first step, write a specification:

- Describe the audience: "graduate students in the School of Computing", or "readers of journal X" or "attendees at conference Y". Describe the technical background that you expect the audience to have. The easiest situation for a presenter is when everyone has the same background. In more complex cases the audience is mixed: some audience members know this, others know that, some are interested in this, some are more interested in that. Make a list of the concepts that you assume the audience is already familiar with, and a list of the concepts that you have to introduce/explain in your writing.

- List the main points you want to convey in the paper/presentation. The following general questions should be answered in any technical presentation. What is the topic of your talk? Why should anyone care about this topic – what is the motivation? What is challenging about this topic? What is the state of the art?

Once you have written the specification, you can plan your oral or written presentation. What topics do you have to include in order to effectively present the main points, given the audience background? Find a good order for presenting the topics. This is often difficult because of circularity: it would be good to for the audience to know about B when you explain A, but also knowledge of A would help when you explain B. Sometimes the best way to break this circularity is by making two passes: first explain A and B in general terms, and then explain both in greater detail.

When you have finished writing your report or preparing your oral presentation, compare it to the specification. For a written report, make sure that the first paragraph touches on all the main topics, that the rest of the report elaborates on those, and that the whole document is comprehensible and engaging for your "model audience". Similarly, for an oral presentation make sure that you introduce the main topics in the first few minutes, and that you then elaborate on these in a way that is understandable for your model audience.

2   Technical writing should use a block structure

Aim to make your document skimmable, so that a hasty reader gets the main points. Don't blame the hasty reader: this might be a very busy person who is your boss or a grant reviewer or a thesis examiner. Your job is to make a great impression on this reader; give this reader lots of reasons to think highly of you and your work. Put extra effort into making the very first sentence of the document informative and interesting.

A skimmable document has a clear block structure. The first paragraph of each section provides an overview of that section. The first sentence of each paragraph states the topic for that paragraph. *Your text should be comprehensible to someone who reads only the first sentence of each paragraph.* A long document (thesis or book) should be comprehensible to someone who reads only the first chapter and the first paragraph of other chapters.

Abstracts are critically important! If your abstract is engaging and convincing then the reader is motivated to read on. Abstracts are often distributed much more widely than the full paper or thesis. For example, PubMed provides free access to abstracts for more than 26 million papers in biomedicine. Writing a good abstract takes a lot of time, so write a first draft early in your document preparation. Show drafts of your abstract to many different people to get feedback about comprehensibility and effectiveness of your text. The abstract should be comprehensible to a non-expert, and should impress an expert in the area.

Budget your time. If you don't have time to fuss over and perfect every sentence in the document, then pay particular attention to writing the best possible abstract and introduction. Often these overview sections are the weakest part of a thesis or conference paper because authors write them last, when they are under time pressure due to a looming submission deadline. This is an unfortunate situation! If the abstract and introduction don't make a good impression on the reader, then the reader won't look at the rest of the document, or will do so reluctantly if acting as a reviewer or thesis examiner.

3   Dealing with a page limit

If you find the page limit confining, start by writing a very short document: maybe only a few sentences or half a page of text. This forces you to state the most important ideas concisely. Then expand to the luxury of a whole page. And then expand further to whatever the page limit.

The ability to write convincing summaries (for grant proposals, paper abstracts, theses, etc.) is essential in academic work. Writing a good summary is hard; the shorter the summary is, the more challenging it becomes.

4   Oral presentations

Be enthusiastic. Choose a topic that you find interesting, and project this interest and enthusiasm to the audience. You don't have to force yourself to show noisy cheerleader type enthusiasm; quiet enthusiasm will do. Sometimes you have to present on a topic that is assigned to you, and you might initially not be very enthusiastic about the topic. In that situation, you have to find some reason to like the topic! That might be an interesting application, a theoretical or practical challenge related to the problem, a glaring flaw in existing approaches.

Identify two to four ideas that are most important for you to convey to the audience. The audience should remember these points a week later, a year later, when they have forgotten other details of your presentation. If you are presenting on a topic that is unfamiliar to the audience, then you have to spend most of your time on introduction, motivation and high-level description.

Don't show too many details. For example, there is no use showing a big table of results full of information about "this method gets 72.4% correct and that method gets 69.1% correct". The audience does not have time or motivation to understand all these details. Most likely, audience members are unclear about the differences between the methods being compared in this table. So focus on presenting the gist of the various methods, and briefly summarize performance results in words (for example, "method A generally outperformed method B in the tests done by the authors").

Avoid presenting a lot of equations. If you define a bunch of symbols on one slide, it is unrealistic to expect that audience members will remember this notation when you show the following slides. Keep in mind that audience members have attention lapses where they briefly think about an unrelated topic like "Gosh, I have to remember to buy laundry detergent later today". Make it easy for an audience member to rejoin the thread of your presentation: make your slides as self-contained as possible, and frequently restate the main points of your presentation in various ways. Limit your use of acronyms and symbols and try to include the definition of an acronym or symbol on every slide that uses it.

Don't try to present all the details of a complicated method -- there isn't time. Instead, provide a brief overview: "The authors solve this problem using the following 8 steps [list of steps, with a short phrase describing each one, ideally include images to illustrate]. In my talk I am going to focus on steps 2 and 5 because [I found those most interesting... or whatever reason]".

Rehearse your presentation! This is extra important if you have problems with feeling nervous during presentations. I strongly suggest that you rehearse in front of a mirror. At first you might feel awkward and have unwanted negative thoughts about "that idiot in the mirror", but keep rehearsing and those thoughts will fade away as you get used to seeing and hearing yourself speak confidently and enthusiastically about your topic.