

How to write good papers.

Notes from discussion meeting at University of Agder
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I do not know the right answer. Let's think about how to write a good paper – a scientific paper. What is a good paper? Not easy to define. In my mind, it has to have good technical content. There are two ways to achieve this:

- 1) Introduce a good problem formulation – the low fruit. Being the first one in the field. To show a theoretical discussion, show the important aspects of a particular problem. A good introduction to that field. Requires a lot of luck and vision. You are ahead of the pack for 6 months – a year – good for you. People cite that a lot.
- 2) A good closer which gives the final answer. Have chewed on the problem for a while, paper takes up key issues and you introduces an innovative technique to solve it – it gives technical insight.

In other words: either first one to the game, or the one that finishes – these are good, influential papers. However, the vast amount of papers are incremental. People get training on writing these papers - good education. But people do not get an career out of writing these.

Other papers are major stepping stones for others. You solve a key problem – you often find that this technique can be used in many related or not related fields. This means that the research front can be pushed forward.

I was graduate student, working on complexity theory – writing thesis 1989. Student upheaval in China – could not concentrate on thesis. It was boring, did not have any funding, did not have any pleasure writing... A good friend saw that I was not very productive – quietly posted an open question to me related to convergence analysis of a well known algorithm which was not done by then. A lot of people was working on it. He posed open question on it and gave me this problem. It looked simple – we should be able to solve it. I was very wrong... Frantic work for 3 months – even painful... I was fresh to the field and did not know the history of how hard it was. Eventually I solved it! This technique was powerful, I ended up writing 20 papers. Worked non-stop. I experienced this only once/twice in my lifetime – ended up writing good papers together, innovating in terms of technical content.

Then, I was a terrible writer for presenting content. A Friend helped me. Got a free ride with him. He asked me to write the first draft, I was only piggybacking on him for a while. Was not taking writing seriously. You should spend the time and be responsible. Take it word by word, letter by letter, spacing, punctuation etc. I learned in a painful way to write, but number one is the technical content. Just as important as writing, is how you expose an idea. You must have a good problem, either new or a central/core problem in a developing or mature field. One central problem in my research is multi-user – how to solve interference. This is a fundamental bottleneck of future communication systems. Noise, channel coding, decoding etc.: Shannon gave information theory – can get very close to the Shannon capacity. Every communication system is developed for multi-user communication. You need to address the central problems in your field. If you want your work - to have impact, then work on the important issues in the scientific field. Either introduce new techniques or solve an open problem.

Many problems are open, and I do not know how to solve the majority of them. Writing means time invested, persistence, perseverance and patience. You walk around, have a brilliant idea. Then

writing – sit in the office for hours and hours. The amount of time used for technical solution and time used for writing: 1 day for technical solution – 15 days for writing.

Major attributes of a good writing: Have a good title, abstract and introduction. Just scan the vast majority of the papers. Need to have a good title to attract the audience. If the abstract is good enough, then they will take a closer look at it. Need to make your story interesting. Need to organise your thoughts carefully. Need to do your homework and cite other people's work properly. People complain about your paper. Half the time this is because you did not present a balanced view of the field. Need to be very careful: cite necessary key references; put your work into perspective; cite relevant papers and make appropriate remarks. Need to develop your ideas step by step. My observation of a good paper: contains mathematical notation presented in small pieces sandwiched with friendly discussion in between. Give your audience a chance to refocus.

A map of future steps and why we eventually get somewhere is not enough. Write the way you are teaching. Need these transitional discussions from one major step to another to make your paper readable. Otherwise you just stop any appetite from the reviewer. Let the reviewers chew one step at the time. For a complicated idea: break it down to smaller pieces with transitional, friendly discussions between, presented one at a time, otherwise the reader loses interest. If you have a space limitation, then you need to keep a high-level discussion. Need to summarise. If you really understand something, then you should be able to extract essential ingredients. If not, then you probably have not understood your own work properly. Then tell the audience what the essential ingredients are and inspire them. Need to avoid detail if you have space limitations.

Simulations

Add sufficient details so that people can *replicate or repeat* the experiment. As a rule of thumb: always keep your readers in mind when you write. What kind of questions will the reader have at this part of the paper? Should I discuss here? Is the reader confused? Does he have a question? Need to guess – almost like talking to the reader, but that person is not responding to you. What will the reader be thinking?

Notation

Keep the notation simple! If the notation is defined well, and is consistent with what others are using, then this will greatly simplify the understanding for others. Try to define compact notations that are suggestive and consistent. Be consistent and simplify the notation. If the notation is simple, then the expression will be simple and clean. Your paper should really read and view like a piece of art – with the shape and design. Every single sentence need to be well thought off. Use your words carefully, do not repeat yourself. This is common sense.

Biography

Pay great attention to the writing of the biography. Every Journal has their own style in terms of capitalisation punctuation etc. Ordering: everything must be entirely consistent. The first thing I check of the first draft to read from a Ph.D. student, is the bibliography. If that is well written, then the student has been very careful. This can easily go unnoticed – but you need to pay attention to these details. Need to do the bibliography right before he is willing to review the contents. Need to put in effort and time – no short cuts – including bibliography and style.

Gold standard

The gold standard of a good publication, is that you can look from one sentence to the next sentence without having to look back.

Want to develop your ideas in a friendly and logical manner. Have tables explaining experiments, discussions, what happens. Need to have intelligent discussions, but be careful about sequence - what to discuss first. Experiments must be repeatable by the reader. Using Bibtex with different style sheets can be used in order to work smarter instead of harder by maintaining different bibliographies.

Similarity, plagiarism and self-plagiarism

Similarity – need keep it lower than 30 percent in certain journals. Important issue of plagiarism or self-plagiarism. Plagiarism or self-plagiarism is *wrong* – you need to write your own things. From conference to journal paper: check how much overlap you can have with the previous paper.

Good language

I do not want to read bad writing. You really need to take on the responsibility for the language yourself. I can show you how I review papers and then you carry on the revision yourself. Tell the student why I am not happy and then think how this can be done in a better way. Even the same idea can be written in a different way. There are multiple ways of saying things. Tells my students – I want to see your own writing. You need to communicate with people in the future. You need to write reports, pattern files etc. – everybody need to know technical writing. Copying is no good. In related work you need to present your own ideas. The writing gives you your own perspective on your own contribution. What are the really important things? This is a good time to move around and summarise things. It is a good process to go through to write down your own thoughts.

Need to balance the quantity and quality. Rather write a good paper than an average or lousy paper. What makes you stand out is not the number of papers, but the number of important *or interesting* papers you write. In my university it is not required with X publications to graduate. No, you do not have to follow that path. Write a good, solid paper - a paper by which you will be remembered.

Citations

Cite your own relevant work, but have a balance to other areas. Cannot be justified to just cite your own papers.

Writing process

The writing process is a zero sum game: the amount of time put into writing and the amount of time the supervisor has to put in is fixed. If you are sloppy and quickly ships everything to the supervisor, then he needs to work like crazy. You need to take on the responsibility of your own

and do the bulk of the work. Put in as much effort as possible into your own work. Your sloppiness means work for me – be fair with me. If you do, then I think highly of you. If you do not take it seriously, then I have to prepare all this stuff. With ten Ph.D. students: x10 work load is impossible. It is not in my job description to correct bad English from students – it is to teach and research. You never should have to correct bad writings of your own students. Put yourself in the supervisor's position, multiply that by 10. This destroys the whole day if you are in a bad mood. I do not need to write another Ph.D. thesis. This is fundamentally wrong - unfair. Be gentle with your supervisor.

Even native English speakers do not necessarily write good papers – they often write colloquially. Page after page with sloppy discussions. Be patient with yourself – spend the time and effort to learn. This skill will benefit you for life. Cannot overemphasise the process of writing and also presentation. Keep your audience in mind – be mindful. Think of your audience when you are writing a paper. Will the audience be stuck? Have I confused them now? Do I need to stop and summarise a bit now?

Reviewer's can also be sloppy. However, if the associate editor is reasonable and responsible, then you can get a good outcome. It is very seldom that paper get poor/unfair treatment. Get the student to review the papers, then check their report and check that the points are valid and fair, and then send it away. This is a positive experience – how to be objective and critical and still fair and balanced at the same time.

Repetitions in your writing: strike a balance. Emphasise, but do not repeat the same statement. If necessary summarise some of the main ideas and then summarising the potential. Underscore the importance. It is an art. Not a fixed recipe.

Similarity score for papers

EDAS – uses a similarity score between papers. If the editing director is responsible, then this should not be a problem, as long as the similarity is necessary quotations (e.g. To Shannon etc...). If the editor is not responsible – then go somewhere else.

Journal papers extended from conference papers

Journal papers are substantially different from conference papers. The introduction is more thorough, discussions, simulations are more complete, biography is complete and much longer. At least 80% should be different in the extended journal paper compared to the conference paper. Maybe reuse 1-2 short paragraphs. Abstract will be revised, results strengthened as well. Very different style. Unethical to submit the same work to different publications. Unfortunately people treat this as a game. Very unfortunate. Nothing of that kind in his group.

Monograph (book) vs. Collection of papers

In Minnesota, there is a lot of questions about how to write a thesis. Personally, the students need to link papers, and the notation needs to be consistent. The thesis needs to be a coherent document. Not sure if Minnesota allows them to stack up papers. Never seen one there. Do not recommend just to stack up papers. This is 4-5 years of your work - the defining document for an important part of your life. It should be nicely done. Put effort into developing it.

In Minnesota, we try to stop poorly performing students early on – 6-8 months before defence. I have stopped people – this is not good enough. Do not want to prolong the agony – just stop here.

Increasing your language skills

To increase language skills, read good scientific papers, magazines, newspapers. Listen to national public radio – their style is very professional. Learn words and expressions. Learn English that way. A related aspect: whenever I felt I was struggling with expressing an idea, that problem could be solved by expressing a mathematical expression. If you struggle with language, use symbols – try that way.