Research Writing

An essential task of research is sharing of the knowledge or insight gained. This may be in the form of written text, oral presentation or both. Success of a research lies in peer recognition, and peer recognition comes through effective sharing of the knowledge or insight gained. The final document of doctoral research is the thesis. But prior to the thesis a student may write departmental research papers, departmental technical papers, departmental working papers, personal notes, papers in conference proceedings and journals.

Broadly, research writings contain description of quantitative methods, theoretical proofs, analysis of experimental results, comparison with competing methods/systems/techniques.

The student should express ideas about complex matters in clear and direct prose. Many investigations deal with complicated subjects; students often feel that their writing has to be equally complicated. Students should be aware that there is an artificiality about complex and overly complicated sentences and paragraphs full of long words that obfuscate rather than foster understanding. Further, such writing all too often is a facade hiding a student's lack of clear comprehension. There is no subject that cannot be made clear in simple words to the average intelligent adult if the writer knows the subject well enough and has good facility with language. Learning to write well helps the student not only with respect to the immediate task, but also in future writing and publishing.

Styles- Section headings, bibliography, captions, references, footnotes, article headings, page headings,
Acknowledgments
Devices- diagrams, graphs of appropriate types, tables

[Meera Subbarao]
Writing good technical articles is indeed a challenge, takes a lot of your personal time, requires doing a lot of research. And you should have a passion for writing and reading as well. 5 tips on good technical writing:

1. **Expertise** on the topic. Never write an article on a topic which you are not confident. Make sure you work out all steps and give fair amount of information to your readers to know what needs to be done when things go wrong. Focus on this one topic, and make sure it is to the point. Include lots of working samples, with clear explanations.

2. Writing Style and Title. In a technical article, make sure the language is as simple as possible. This is to make sure readers who are not native English speakers are also able to get a good grasp of your article without going back and forth to the dictionary. Let your article be reader friendly. Having a catchy title is very important to get the attention. This doesn't mean that you can have a title to grab the attention, and the article itself doesn't even come closer to the title.

3. Write a Rough Draft. Make sure you read it 2-3 times before you actually send it out for publishing. Ask a family member or a colleague to take a look.

4. Comments. Try to respond to readers' questions or difficulties as quickly as possible. Even if the comments are not appropriate, try to convey your message in a polite way, and if you think you can't be polite; just don't respond.

5. Resources: Provide links to all articles you think will be useful for the reader to get additional

information. This should be either at the end of the article or even better is to provide links when and where you are referring to them. If you have referred any books, list them as well. This will give a clear idea to the reader to look out for more details.

[Mohit Arora]

Figure out who will read your article, and what are the key points you want to make.

Try to abide by the following 10 rules-

#1: Always use present tense in writing Technical Article. Furthermore, the use of words like "will" tends to lead to thinking and writing about what will be done. Conversely, when the article is written in the present tense, the language is clear and unambiguous.

#2: Avoid lengthy, complex paragraphs. In case your article will appear in columns, even one or two sentences equal a paragraph.

#3: Avoid use of passive voice.

For example "*Each message includes a time interval*" (active voice) reads better than "*In a message, time interval is included*" (passive voice).

Sentences in active voice have directness and keep the reader interested.

#4: Expand all acronyms on first use, except acronyms that every reader is expected to know.

#5: Avoid "etc." unless it is obvious.

Good Example: "*We shall number the phrases as 1,3,5 etc*"

Bad Example: "*We measure performance factors such as volatility, scalability, etc*"

Also avoid using "that", "this", "these", "such as," "among others" or, better yet, try to give a complete list.

#**6:** Do not refer to colors in Figures. Most people will print the paper on a monochrome (black and white) printer and will have no idea what you are talking about. Make sure that lines are easily distinguishable when printing on a monochrome printer.

#7: Keep your bylines down to 6 lines or less. Publishers will not publish articles that contain excessively long bylines.

#8: Make sure you read your article several times and use spell-check. Though it may be obvious, this is one of the most important tips. If you are careless making silly spelling mistakes, editors will just reject your article.

#9 : Never write an article on a topic which you are not confident. Make sure you work out all steps and give fair amount of information to your readers.

#10: When providing data in form of numbers that include facts, always provide the source of information. For example "20,000 nodes on internet as per XYZ research paper dated .."

Now let's cover what Article Outline should include.

A well written article should include the following Outline:-

- **Title**
- **Abstract**
- **Introduction**
- **The Body**
- **Conclusions/Summary**
- **Future Work /References**

Title

Avoid common phrases like "novel", "performance evaluation" and "architecture", since almost every paper does a performance evaluation of some architecture and it better be novel. Nobody searches for these types of words on the internet.

Use adjectives that describe the distinctive features of your work, e.g., reliable, scalable, high-performance, robust, low-complexity, or low-cost.

Use a powerful headline that demands attention and try to keep it all on one line. Look for keyword combinations that will make a good title, should reflect what the article is about, and should rate fair in a keyword search.

Abstract :

Many people read abstracts *and then decide* whether to go through the rest of the paper.

Well written abstract should be no more than 100-150 words. Highlight not just the problem, but also the results. The abstract must not contain references, as it may be used without the main article.

Avoid use of "in this paper" in the abstract. Avoid equations and math unless your article is about proving an equation.

Introduction:

Should briefly describe the problem along with solutions and alternatives the paper is going to cover. Problem statement should also lay emphasis on why problem is important.

Be sure that the introduction lets the reader know what this paper is about, not just how important your general area of research is. *The introduction must motivate your work* by covering the problem you are addressing and then give an overview of your approach and/or contributions (and perhaps even a general description of your results).

Introduction should answer the following questions :-

- *What is the existing problem and why it is important?*
- *What is the approach to solve the problem (leave the details to be covered in the body) and how is it different than existing approach or solves a known limitation?*
- *What are the Results?*

In this way, the introduction sets up the expectations for the rest of the paper by providing a context and a preview.

Remember: Repeating the abstract in the introduction is bad idea so avoid it.

Body

Describe the problem and the necessary details. Unless there is a separate section on results/conclusion, that should also land up in this section.

Try to tell a story. The story should be linear by keeping the reader engaged at every step. Make a list of your main points. Then progress from one to another (logically), so that they lead to a conclusion.

Along with the text, try to include figures, flowcharts, and tables to support the text. This is what would keep the readers interested.

Summary

A summary of all the main points mentioned in the body may be merged either in the body, in the Conclusions section, or a separate section just after the body.

Conclusions and Future Work

Your paper essentially describes an exercise that you have done. *Conclusions* means what you have learnt from that exercise that may be useful in similar situations.

When an exercise is undertaken, there are certain assumptions, self-set limits and constraints. Also, The results may not be perfect. You should honestly state these at the appropriate places in the body. In the section, you may briefly mention these and point out how addressing these can be useful future work. Apart from this type of future work, interesting conclusions of your work can trigger other newer exercises as future work. Readers can look forward to these.

References

Provide links to all articles you think will be useful for the reader to get additional information. If you have referred any books, list them as well. This will give a clear idea to the reader to look out for more details.

Last but not the least, make sure you follow the publishers' submission guidelines. Make sure your article is properly formatted. Articles submitted to publishers that don't follow the submission guidelines, or are not properly formatted, will most likely be rejected. Publishers will simply delete it and move on to the next article submission.