Aspects of Technical Writing for Agricultural and Biosystems Engineering Graduates

Subhashree N. Srinivasagan [*], Sunoj Shajahan [*]

Department of Agricultural and Biosystems Engineering, North Dakota State University, 1221 Albrecht Boulevard, Fargo, ND 58102, USA

Abstract

Writing a good article is both an art and science. For most of the beginners of article writing, the structure and organization may not be clear and confusing. The skill of writing can be acquired with patience, learning, and practice. The major goal of this course is to develop effective technical skills and to help the students to become accomplished writers. To make the students understand the difficulties, ways to overcome them, and expectations in article writing, an interview was arranged among the students and their advisor. Key questions were framed by the students and the responses were obtained from the advisor. An elaborate discussion was held on specific issues to capture the details. Various aspects of technical writing, such as initial struggle as a beginner and the ways to overcome, managing time, organizing ideas, and overall solution strategies were discussed during the interview and presented and summarized in this assessment.

1. Introduction

This general informative article was based on the disciplinary report submitted to the course ENGL 751, Spring 2016. The background of the report is to help the students better understand the writing expectation and norms in the field of Agricultural and Biosystems Engineering, for which an interview was conducted with Dr. Igathinathane Cannayen, Assistant Professor, Department of Agricultural and Biosystems Engineering (ABEN), NDSU. The interview was conducted to obtain information on the following aspects:

- Practice developing useful interview questions, as well as conducting interviews
- Understand writing and rhetorical conventions and expectations in the field of ABEN
- Develop an understanding of the discipline from a writing standpoint
- Practice reporting key information.

In the interview the following questions were asked:

1. What are the struggles that you encountered as a writer during your initial days?
2. How did you overcome all these struggles mentioned above?
3. How do you organize your thoughts and ideas while you start writing?
4. How to avoid framing complex and indirect sentences/how to explain complex ideas?
5. How to do measure the completeness of a section in an article/article as a whole?
6. What are the fields from which students of ABEN can learn from the articles published?
7. How to manage time while writing an article?
8. What are the articles that you consider as the best in terms of technical content and writing?
9. What do you think are the common mistakes that students make while writing an article?
10. How to keep the readers interested?

Responses obtained and the experience of the authors and other graduate students were synthesized and presented in this article.

2. Aspects of Technical Writing in ABEN

2.1. Struggles of a writer in 90's

During earlier days, no formal training was given to the students who aspired to write an article. There were also very few resources for obtaining the published articles. Further, there was no clear understanding of the structure of a research article, for students starting on their own. Self-understanding of the published article was not of much help. Hence, the student had to struggle his/her way to publish an article.

Earlier, writers did not give much emphasis on the graphical component of the publication and they relied mostly on professional drafting services. But nowadays various software like R Studio (R Core Team, 2015), SAS (Institute, 1985), MatLab (Guide, 1998) were available to produce high-quality graphical outputs while doing the data analysis. Now the authors are expected to produce their own graphical material.

[*] Graduate and doctoral students, respectively, under Dr. Igathinathane Cannayen, Associate Professor, ABEN, NDSU as their major advisor.

However, the situation is not the same now, training on technical writing is offered to students, and they are also provided access to many published articles online or print forms. Students are now made aware of many graphical and statistical software required for publishing a good quality article. Students should consider the graphical elements as important, as these offer the readers a quick overview of the results.

2.2. Ways to overcome the initial struggles of a writer

A good writing skill will develop only with years of experience. It may be compared to "learning to ride" a bicycle, which obviously requires a lot of patience. Similarly, learning to write an article requires a lot of patience and perseverance. Students should realize that the article is "theirs" and they should play the lead role, while the advisor provides guidance and review. Students committing themselves to this lead role and "own" the article tend to learn more on the writing aspect than others rely heavily on other supports. Writing is a perfect example of "learning by doing." Students should be ready to learn from the mistakes and experiences.

Once the student is ready with the article draft, they should realize that it will undergo several rounds of revisions. The review comments and mistakes from each revision have to be "documented" for by the students for their future reference. This helps the student from not committing the same mistakes again. Also in a proactive way, the student can learn from published articles and understand the basic rules and way of presentation.

Students should get themselves familiarized with the "expectations" of the scientific articles in their field of specialization. Reading more technical articles and writing more will help the students to improve their writing skills. For example, if there is an equation to be inserted into an article the student must look into other published articles to understand the basic rule followed to write an equation. A similar approach can be adopted for figures, tables, references, and other elements of a technical writing. Good approaches followed in articles of journals of repute can be adopted by the students as well, while understanding clearly what plagiarism is and how to avoid it.

2.3. Organizing thoughts and ideas

Writing of an article should start with a good outline, where students will demonstrate and capture the essence of the article. Such outlines should be discussed initially with the advisor for directions and approval of the concept. With the outline serving as the skeleton, the students will have a head start in developing the article. Organization of ideas and thoughts starts with deciding on the research need/problem which the student (article) set out to address.

The standard framework for scientific paper include sections, such as introduction, methods, results, discussion (sometimes these are combined as results and discussion), suggestions for future research, conclusion, acknowledgments, and references. One of the simple ways is: once the outline is complete, the students should fill each section with a sketchy points (e.g., bulleted points) that comes to their mind. These points should be further developed into cohesive text paragraphs. Tables and figures (e.g., pictures, graphs, flow charts, diagrams) supporting these points should be included in the article. Sometimes these graphical elements, generated from the analyzed results were inserted first along outlined points.

Each section should convey the information clearly and follow the standard exceptions. For example, in the introduction, the importance of the problem/need should be discussed. The student should synthesize and acknowledge the past reported efforts for solving the same or similar problems. This will allow the readers to realize what was available knowledge and appreciate the "research gap" addressed by the articles.

The student should also discuss the novelty of the present study's approach to solving the problem and the overall significance of the work. Usually, the introduction section ends with a list of clear objectives of the study, which actually serve as a guide the other sections of the paper, namely methods, results, and discussion.

Each section should be divided in into subsections and paragraphs, as appropriate, in such a way that each division deals with only one overall idea. Paragraphs help to divide different aspects of the overall idea and they also signal a "jump" or "transition" of ideas. Every sentence in the paragraph has to be paid attention to see if it is properly connected. There should be a proper connection between sentences and the paragraphs might start with thesis sentence. A linear style of writing, that does not make the reader refer back to the material presented earlier. This linear style of writing will be easy on the readers and, if possible, should be followed throughout or most parts of the paper. Overall, the organization should follow the "story-telling" (what happens next — all sections tied together — sections playing a definite role in the story) concept to hold the readers' attention.

2.4. Writing style and approach

If the student feels that a sentence is complex, breaking the sentence into two or three sentences must be done for better understanding, as the aim of the article is to make it simple and understandable for the reader. In technical writing, the motto should be "Not write to impress, but inform." This idea again ties with the "expectations" of technical readership. Sometimes breaking into smaller sentences may not sound better, but it should be followed if it helps the reader to understand better. The current trend is to use more direct sentences (active voice), wherever possible then indirect (passive voice). However, a balanced mixture is acceptable.

Earlier, the articles were "author-centric" where the writer used convoluted ideas and complex sentences in the article with no effort to simplify them for the readers. The readers had to struggle to understand the ideas and concepts; amplified by the technical nature of the material, but the trend has changed. Now, the author has to write "reader-centric"

article in such a manner that it is easy for the reader to understand and process the ideas quickly — in a linear fashion.

For the article to be published, it has to be approved by several established reviewers and the editor. It will only be published if the majority of the reviewers have accepted the article, therefore the article has to be understandable and less objectionable to all the reviewers. Furthermore, if the article has to reach to a wide range of audience (e.g., extension publications, local dispersal of scientific information) then the student should explain the concepts in a much simple language.

2.5. General nature of article sections

An article in two-column format should ideally be six to seven pages, and the reader will always appreciate an article of this length. The time available to the student and the suggested page length in the journal also determines the length of the article. For example, in the introduction section, the background need not be elaborate but has to cover the essential information specific to the article's topic.

For the review of the literature that also goes into the introduction, as the availability of the literature corresponding to a particular topic is a finite number, the text should also be succinct. In materials and methods, all the instructions required to repeat the experiment should be presented so that if the readers were to repeat the same experiment/research they should able to do it. This addresses the concept of "research repeatably." This section should follow the order outlined in objectives.

The results and discussion section presents the results that were described in the methods in the same order. Presented results should be technically discussed using observation, previous literature, and statistical analysis. Technical implications, recommendations, and suggestion for future work may be outlined.

The conclusions should follow the similar order and be based on the results. No new information that was not discussed before should not be included here. The reference section has its unique format based on the journal and should be strictly followed. Automatic software based formatting (e.g., BibTeX, EndNote) or manual method may be used following the instructions are given or latest publications in the journal.

It should also be noted that the sections of the article can be written in any random sequence based on the available information. Most often, after preparing the outline (skeleton of the article), the students find it easy to write the materials and methods section. Also, the hypothesis and objectives should be clear to the students.

2.6. Avoiding redundancy

Redundant information should never be presented in the article. For example, a data can either be presented in a table or graphical form, but not both, and this also goes into textual material. These constitute redundancy and should be avoided. An article can be compared to a machine, where every component (e.g., nuts, bolts, levers) in a machine has its own purpose, similarly, every word should contribute to the article and extra words/information should be removed from the article. The journal space is always considered very precious, hence should be filled with only relevant information and redundancy should be eliminated.

2.7. Making the article interesting for readers

The article has to be written in the form of a story. The student should be well aware of the expectation of the reader. In this aspect, the article can be compared to a "movie." A movie is successful only if it satisfies the expectation of the viewers. Similarly, the article should satisfy the expectation of the targeted readership. For example, a reader will usually have questions/concerns on the significance, impact, and application of the research. The student should have addressed these questions in the introduction and provided answers in the discussion section. In short, the expectation of the reader should be met by the student.

2.8. Managing time while writing an article

An article is an evolving document and highly involved undertaking. Students should understand and accept that writing an article deserves quality time — a lot of it. However, the student should fix a target (period) to complete the article, and such target help to assess the progress.

Students should start writing the article as early as the commencement of the project, for writing is a continuous process. They should realize that there is no good time to start working on a paper, but anytime NOW is the one. When the student gets an idea/information regarding their research that could be added to the article, it should be jotted down immediately (bullet points should be fine) without worrying about the format or the semantics, as there are chances that these points will be forgotten soon enough. During the actual writing process, the grammar and logical flow of the article can be looked into at a later stage. Updates to the article and review can be done at any time, without waiting for the draft to be finalized.

2.9. Good example articles for ABEN students

Every year the American Society of Agricultural and Biological Engineering (ASABE) awards the best papers (about 5-10 in number out of 1000 papers that has been submitted) in different specializations. These awarded papers might have been strong and attractive in areas such as novelty of the concept, technical content, or presentation. Therefore, such award-winning papers as well as papers from native speakers of the language from reputed journals may serve students as good examples for producing good quality papers. Nahar et al. (2014) is one of the ASABE award-winning articles of 2015.

In agriculture and related specializations, agronomy and soil science articles can serve as better examples to the students as most of these writers are native speakers of English. The way the writers structure the sentences is something that the student can learn from for better quality of writing.

3. General Comments

"A good story is not written, it is rewritten." Hence, soon after writing the first draft, the students should review their own article many times before submitting it to their advisor. The students should always ask themselves "Is this my final draft?" The student has to redraft several times until he/she reaches a stage where they should be convinced that there is no more scope for improvement from their side. The best "final version" should be forwarded to the advisor for their comments and review on the paper. A well-written paper, even though takes a lot of effort and time, gives immense satisfaction and highly rewarding to the students and helps them to learn the art of technical writing, and goes a long way in help shaping their career.

4. Conclusions

Aspects discussed in this article will serve as a guide to help students understand the do's and don'ts in writing a technical article. Some take-home points are presented hereunder and we feel these suggestions would be of great value for ABEN graduates for writing a research article.

- Have an outline before starting, which can be populated with contents later
- Students lead the writing effort and feel the article belongs to them
- Writing can only be improved by practice and it takes time
- Break complex ideas into two to three sentences and active voice must be used as much as possible
- Learn from mistakes and document them for future use
- Follow story-telling and linear style of writing
- Avoid redundancy in writing and strive for smooth transition of ideas
- Graphical elements are equally important as text
- Know the expectations of the readers/reviewers/editor on each section of the paper
- Start writing earlier and allot time for revision
- Award-winning papers and articles in reputed journals by native speakers may serve as good examples
- Always ask yourself "Is this my final draft?" before submitting or review
- A well-written paper is highly rewarding and career boosting.

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