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Writing skills: An effective way of communication

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Abstract
Research in common parlance refers to a search for knowledge. It may be noted in the context of planning and development that the significance of research lies in its quality and not its quantity; so says E.R. Kothari in his book 'Research Methodology (Research and Techniques)'. It is through interpretation that the researcher can well understand the abstract principle that works beneath his findings. Through this he can link up his findings with those of other studies having the same abstract principle and consequently formulates the concrete one. The findings of exploratory research study often results into hypothesis for experimental research since the task of interpretation is not an easy job, and requires a great deal of skill and dexterity on the part of the researcher; this can be learnt through practice and experience. Process Writing is such a part of Research Methodology through which the writer/researcher takes down, modulates, modifies, reviews, and rehearses his work leading towards finality, thus preparing for an error-free work. This is more so in case of scientific, engineering and medical research papers because in these cases there is no scope for multivariate techniques as are possible in behavioral and social sciences. Hence, Process Writing plays a vital role for effective Scientific and Technical Communication.

Keywords: information, report, communication, language, technical, scientific

1. Introduction: Process Writing for Effective Scientific and Technical Communication

Process Writing for Effective Scientific and Technical Communication

Writing is a communication skill through which a writer translates his thoughts into words and tries to give a clear message from his brain to the reader's brain. After the completion of the project, the investigator tells others why he started the research (introduction), what he did (subjects and methods), what he found out (results) and what he means (discussion). In scientific writing, the writer analyses the results obtained from a study, relates the results to previous knowledge in the field, finds out what is new, and then writes it to communicate with others; hence preparation of papers for presentation, communication or publication are one of the most important ways for scientific communication.

With the information revolution and socio-economic changes in the new millennium, the importance of effective technical communication skills has considerably increased. In fact, technical communication skills are crucial to professional success. Today, since success is communicating in the technical environment, it not only depends just on effective style but also on the ability to analyze, organize, and present essential information effectively. The process is certainly cumbersome and not just involves the statutory method of 'encoding' and 'decoding'. As far as the issue of language proficiency is concerned, the writer may lack adequate linguistic competence to engage in the composing process. They may not be able to generate ideas, carryout peer evaluation and edit their own texts without sufficient knowledge of vocabulary, syntax, grammar, and the mechanics of writing. Though the technical writers are tolerably comfortable in the idea of planning, focusing and reviewing; being uncomfortable in the language dynamics, the writers face difficulties in adequately expressing in English. The most obvious difficulties are linguistic ones, particularly, an inadequate grasp of vocabulary and grammar.

2. Research Papers and Articles

Even if one is not in the profession in which he wants to carry out a research, he may do so with his individual effort as a member of a research project team of the organization he is associated with. The findings can be presented in a professional gathering or by publishing them in a journal to reach a wider audience. It is obvious that the knowledge from research should be quickly published both to avoid wasteful duplication of work and to establish the researcher's claim to the priority of discovery. That is why, to accord a permanent value to the effort the results must be published in a research journal of repute. These journals invariably control the urge to publish by a rigorous referring system which ensures the rhythmic language and grammatical handlings apart from ensuring the originality and quality of contribution.

Much like the general research papers, where the treatment is scholarly and is supported by evidence, the scientific and technical communications exhibit a relatively high order of concentration on certain writing techniques such as definition, classification, interpretation, and abstraction or description of a process, procedure or a mechanical device.

3. Scientists and Engineers have to communicate their Findings to Others

They may need to have a paper published in a reputed journal. This task is not easy. A well-known scientific paper must reflect certain technicalities, including a specified format, which cannot be ignored. They are aware of the benefits that they can derive if this paper gets published in a well-known scientific journal. To have their work published in a reputed scientific journal to receive the widest attention is as important as their discovery or new finding. According to a news paper report, the first scientific journal was published in France in 1665. Since then, the numbers of scientific journals have grown enormously. An estimate on the website of The Hindu (08.11.2003) showed that more than a million scientific papers are published annually by over 20,000 journals.

4. Process Writing involves Meticulous Revision Work

We usually make most of our writings 'a one shot affairs'. Whatever comes to our mind we put them down and send off seldom reviewing or modifying what we have written; technical writings also do not escape from this 'rough mentality' and many times lose the seriousness as it was primarily contemplated. If any changes are made at all, they are only at the surface level. Changes in the content of communication usually go unheeded or not attempted.

This superficiality in communication level takes place either for lack of sincerity or lack of knowledge in 'Process Writing'. A good writer should never be satisfied with the first draft of the serious presentation that he contemplates but should read and review it critically to see whether the contemplated ideas by the presenter have really been reflected in the communication verbation. When a piece of writing is reviewed by the writer, he will almost invariably want to enhance a word, a sentence intermittently or sometimes rearrange or replace an entire paragraph. The process of reviewing and editing the first draft should be continuous. One should also not wait until the first draft has been completed; the read-review-rewrite process should go on all the time as one writes. This undeterred writing process or 'process writing' should be completed through a 'three-step' process: i) planning, ii) drafting and iii) re-drafting. Generating ideas or ideating: brainstorming and idea-mapping. During this stage, the writer tries to generate as many ideas on the subject/topic as possible. The subject is thrown wide open to incorporate and accommodate anything that comes to mind. They are admitted to the labyrinth of mind generously and no attempt is made, at this stage to reject any ideas. In a teaching situation, these writing activities should be undertaken in small groups, since ideas generated by a group stands in a better stead than an individual contributor. Each group should have 'scribe' or 'writer' who undertakes to jot down the ideas contributed by the individual members of the group.

When a sufficiently large number of ideas are round the corner the writer(s) has to evaluate, select and retain the exact idea needed by him for development. Not all the generated ideas deserve to be retained. At this stage he has to be extremely punctilious and spruce and selective. If the writing activity is being done in groups, discussion can help to decide whether an idea should be retained or discarded. For effective technical communication this activity Bears primacy, since this type of communication is more centripetal and focused. In contrast to general communication they are more subjective and fact-based. Stage-III, re-drafting imitating through 'ideating' and 'brain-storming' are carried through idea-mapping in the ultimate stage of the final draft, successful writers make extensive changes to their first drafts. The piece of writing is ready for submission only after the writer(s) feel completely satisfied with it.

5. Aspects of Technical Communication

Technical communication is the process of communicating a specific message to a specific audience with a specific purpose. It is this specific nature or special quality that has made it need based and made it different from general or literacy communication. In the emerging knowledge society, technical communication has become a central factor. Here the participating technocrats and professionals in different areas are facing new communication challenges. In order to be an effective technical and scientific communicator one needs to understand the process of scientific and technical information from an 'individual' or from a 'group' to another. This exchange of professional information may involve simple definition of tools, complex description of machines or sophisticated explanation and interpretation of scientific principles. English for scientists and engineers gradually evolved to make technical developments intelligible to the scientific community as well as the wider public. It included carefully chosen words or scientific vocabulary and thoughtfully constructed sentences and paragraphs. Since language is dynamic and evolves continually, the development of modern technology fuelled the need for a specialized form of English to cater to its distinctive communication needs.

Scientific papers follow a standard format. In a typical medical original article also, a particular pattern is followed. This structure is known as IMRAD structure. Introduction, method, results and discussion, the four parts of the paper have four questions that have to be answered by the author.

Introduction: It should answer the question 'why did I start?'

Methods: It should answer the question 'how did I do?'

Results: It should answer the question 'what did I find?'

Discussion: It should answer the question 'what does it mean?'

Introduction: It describes first the accepted state of knowledge in a specialized field and then it focuses more specially on a particular aspect, usually describing a finding or a set of findings that led directly to the work described in the paper.

Methods: Its purpose is to describe the materials used in the research and the methods by which it was carried out.

Results: In some journals the results are presented without extensive discussion and the details are reserved for discussion section. In other papers, results are given and then they are interpreted and discussed with other findings.

Discussion: Apart from the data in the paper are analyzed to show limitation to the interpretation be acknowledged, what the authors believe in the data and facts clearly separated from speculation. The findings of the paper are the title, author's summary or the abstract, acknowledgements, references, tables and figures.

As would be seen from the above analysis, writing is a scientific and technical communication (Medical Paper),which

is a cumbersome process that needs the application of 'Process Writing' and careful reviews to arrive at the rightful reflection of the content of the author's mind. In other words, authorship is not a 'gift voucher' but an intellectual responsibility of propagating the findings arrived at, through an acceptable means of communication process.

6. Technical Guidelines for Scientific Communication

Apart from being concise, precise, and error free writing, there are some unique technicalities that are part of scientific and engineering communication. These technicalities may be part of any general technical communication amongst the scientific or engineering community and communication of key scientific or engineering results to a broader technical community.

While communicating with their peers, engineers or scientists must take note of the following:

Hyphenated words: If the word is used as an adjective, no hyphen is necessary, as in 'first draft'. If the first word is a noun in a compound adjectival phrase, then the same must be hyphenated. Example: 'rock-bottom price', 'short-term view', well-known author', or 'middle-class values'.

Ending to verbal form (-ment, -dge, -ise, -ize): When a verb ends with –edge, retaining the final 'e' is preferable when both spellings are in use. For example: acknowledge-acknowledgement, judge- judgment. Likewise, when both –ise and –ize are possible, verbal endings –ize is preferred. For example, crystallize, characterize, hypothize, etc.

Use of Apostrophe: An apostrophe should be used only to indicate possessiveness. For example: Mona's office. However, in plural forms, the apostrophe must not be used. For example: 1990's, VIP's, etc. fractional numbers are considered to be plurals. Thus, they should be written as '1.5 meters'

Integers less than ten are spelled out. For example: five miles integers larger than ten and fractional numbers are written in Arabic digits, as 15, 8.5 etc.

Articles before symbols: In scientific or engineering communication, deciding which article to use before a symbol can prove confusing. The rule here is the same as in general writing. The use of an article before a symbol depends on the pronunciation of that symbol. In the case of a symbol which begins with a vowel sound, 'an' must be used; in other instances, a symbol should be preceded by 'a'.

A comma, referred to as the Oxford comma, should be used before 'and'/ 'or', when three or more items are referred to like, copper, iron and zinc, synchronous, asynchronous or both.

Abbreviations and expanding forms: When abbreviations are used, the full form of the abbreviated phrases must be written in the first instance, followed by the abbreviated from within brackets. Subsequently, the abbreviated form can be used in the text. In a text the first reference should be Indian Institute of Technology, while subsequently it could be as IIT.

Full stops should not be used in abbreviations that consist of initial capitals, like IIT, MIT, USA, GDP, etc. But full stops should be used when small letters are used and when the abbreviation is not used with the last letter of the word like, a.m., Prof.

Similarly, instead of using the abbreviated form 'don't', the expanded form 'do not' should be used, likewise instead of '&' the expand form 'and' should be used.

7. Scientific and Engineering Terms

All foreign words, uncommon phrases, names of journals or books, should be in italics. In a scientific text certain words or phrases may be in italics.

For all chemical terms, the guidelines of the International Union of Pure and Applied Chemistry (IUPAC) should be used.

Punctuation Marks Inside and Outside a Question: The general guideline is to use the punctuation mark outside the quotation mark if only, a part of a sentence is the quotation, or if the punctuation mark is solely related to the sentence (not the Quotation). This is a common dilemma encountered by scientists and engineers. For example:

Numbers**:** Numbers less than ten should be spelled out. They should be written as numerals when they are greater than ten. 'Six elements','125 instances'. They should also be written as numerals when some unit of measurement, like 5m.m, 2g.m, 6p.m. follows the number.

When one list includes numbers both over and fewer than ten, all numbers in the list may be written as numerals, for example: 17 analog, 13 digital, and two radio chips.

A sentence must never start with a numeral, '15 products were released last year' is an incorrect way to start a sentence.

Similarly, large numbers, such as those in millions, should be expanded, but the number of millions may be written as numerals for example: 30 million.

Commas must be used in numbers with four or more digits, after every three digit from the right. For example: 2,500,340. This makes it easy to co-relate to thousands, millions and billions. When referring to the Indian currency, the comma is used to indicate crores, lakhs, and thousands. For example: Rs. 14, 46, 82, 200.

To describe ranges in pages, the least number of digits should be used (except in ranges in the group 10-19 in each hundred where the penultimate digit should be included). For example: 46-8, 3245-69, but 10-14, 1216-19. The penultimate digit is also used when referring to a range of years, for example: 2006-10.

Standard Error of the Mean: Standard error of the mean (SEM) should be used in place of standard deviation (SD). This is because SEM reports the precision of an estimate of the mean in relation to its unknown value; SD measures the distribution of individual results around an observed mean.

An important aspect of a scientific and engineering or medical paper is that the hedging should be avoided. Hedging refers to the uncertain use of expressions such as may be, perhaps, probably, suggest, etc. In every scientific writing care must be taken to avoid confusion, and the findings must be in finality.

Algorithms: A new algorithm should be described accurately and lucidly. It should give the reader an opportunity, if necessary, to compare the algorithm with other algorithms. An algorithm approximately optimizes some measures of performance. This performance measure should be explicit, especially is a new algorithm. It is always better to define the space of hypothesis that the algorithm searches when optimizing its performance measure. In the event of introduction of a new algorithm, the state-of-the-art measures

must be taken into account and the performance criteria should be properly defined and explained.
Not only all the limitations of the algorithms should clearly be described, but a study of the cases where an algorithm is ineffective may clarify the range of its applicability.

8. Writing Technical Reports
A technical report is a special form of business or technical communication which is a statement of fact. Its purpose is to provide authentic information about a particular subject. A technical report not only focuses on new facts and presents new analysis, but provides a fresh insight on a particular subject.
A technical/ scientific report is not a sequence of text written in an unstructured manner. The purpose of a technical/ scientific report has to be stated at the very beginning. This objective can vary depending on the subject of the reports.
Irrespective of the structure of the report, the criterion of a good technical/ scientific report is its accuracy. While presenting the information, a technical report should be objective and accurate. Information provided in such a report is extensively used in management and men of science while taking a decision. The accuracy of information depends on the sanctity of the data used.

9. Guidelines for Writing a Technical/ Scientific Report
The quality of any technical/ scientific report can be enhanced by adhering to some important guidelines. The scholar must have a clear idea of the type of report to be prepared, object of the report, plan of the section and sub-section, content specific and ambiguity less and reader friendly. The headings of the report must be in bold letters, and jargon free. Diagrams, flowcharts and graphs to enhance content result, clarity should be placed at appropriate places. A proper layout with examples and illustration as needed be used to drive home the message.
In addition to the above requirements for the preparation of a technical report some more fundamental aspects of the report must be adhered to. The title of the proposed report should be descriptive of the problem, crisp and clear.
Since 'keywords' help readers to identify the actual domain of the report a list of keywords should be embodied in the report. It should also provide an organizational plan for the gradual and logical development of the thesis. A technical report should be technically organized, should provide a clear and informative description of the problem for easy comprehension of the findings embodied in the report. It is necessary to go from the generic to the specific. It must state succinctly what was done to arrive at the recommended solution. Last, but not the least, a good technical report must be written in a simple language and assistance of any kind received from any sources should be properly acknowledged.

10. Rehearsing the Presentation
Before presentation of a researched topic there might be the necessity of rehearsing before a live audience. Rehearsals should be held before a live audience, involving them in the presentation. This helps in analyzing their reactions, and responding to them appropriately helps in preparation for the actual presentation. Scientific and technical papers are prepared by men of science for presentation before a specific audience. Hence, live audience like friends, classmates, colleagues, or comments, and suggestions on the presentation would point out weaknesses and improve presentation. Besides these, timing of the presentation can be made out to keep tune with the final presentation.

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