**ART OF WRITING A RESEARCH PAPER AND THESIS A. Lecture-12** What is a Research Report?

*Research reporting* is an oral or a written presentation of important and useful aspects of the research work done. Scientific writing, a thesis or a paper, is intended to present clearly the purpose and outcome of a specific research investigation. It is the last but a major part of the research study. A report helps the researcher get feedback from other researchers and experts working in the same field. It also evaluates the success and originality of the researcher’s work. *Without a report, a research study is incomplete and of no use*. A report essentially conveys the outcome of a research work to interested persons. Brilliant work and most striking findings are of little value if they are not effectively communicated to the scientific world. As pointed out by Eli Maor, *in academic matters the iron rule is publish or perish*. Some times delaying a publication of a result one would lose his claim.

1. What are Research Paper or Article and Ph.D Thesis or Dissertation?

A research paper is a report published in a journal or magazine or conference proceedings, etc. Whereas a Ph.D. dissertation is a report of the entire work done by a researcher to a university or an institution for the award of the degree of doctor of philosophy. The central element of a Ph.D. education is the doctoral thesis, that is, the Ph.D. dissertation. It is an apprenticeship in *how to do research* and forms the unique part of Ph.D. degree course. A Ph.D. dissertation is a lengthy, original and substantial document. It should contain original contributions. Essentially, the *role of a Ph.D. dissertation is to demonstrate the research person’s original thinking and contribution to the topic of research*. It should also clearly point out the research competence of the researcher in his research field. M.Phil. dissertation is designed as a practice for Ph.D. thesis. It will help the researcher learn and understand the present status of the topic and make him capable of working at the Ph.D. level. The work done for an M.Phil. dissertation need not be publishable in journals.

1. Why Should a Researcher Report his Findings?

*Every research investigation is carried out with certain objectives*. The outcome of a research work may add new information to a theory or may have technological applications. Sometimes the researcher may not be aware of the theoretical development on practical applications. His research results may be useful to another research problem. Some other researchers may be working or planning to work on the same or similar type of research work. Several researchers doing same research work is a waste of time unless the solution of the problem is needed very urgently and is of great use. Repetition of a work should be avoided by the research community as much as possible. Unless a researcher reports his work to the world, the *correctness, validity and originality* of the work is under a question mark. The outcome of a research work will become known to the scientific community only through publications. G. Madhavan writes *a piece of research not published is as good as not carried out*.

In view of the above, it is important to report a work in an appropriate journal or magazine and in scientific meetings like conferences, seminars and symposia. Identify possible publications of your research findings after making a considerable progress on a research problem. Don’t be confined with a mere Ph.D. degree.

## **D.** Characteristics of a Good Report

A good report results from slow, pain taking and accurate inductive work. To attract a reader, the reading matter of a report should be clear and interesting. It should not be obscure and dull. The write-up should be logical, clear and concise. The physicist Cyril Isenberg (University of Kent) writes: *One has to present the work like a meal in a visually attractive and palatable way. It must be easily digested and, one hopes, long remembered. A paper that is difficult to understand and is not presented in a logical way, relying heavily on results in other papers, is like a dry biscuit, with little sustaining value and even less taste. It will not be digested and will be left unread or abandoned*. The basic quality or characteristics of a good scientific report/paper and thesis are the following:

1. good presentation
2. good organization of various chapters/sections
3. accuracy
4. clarity
5. free from contradictions and confusion.

Further, a Ph.D. dissertation should be a formal and should have high level of scholarship.

### XVII. OUTLINE OF A REPORT

What are the considerations to be kept in mind while preparing a report?

1. First, an outline of a report has to be prepared.
2. A sketch of what information to be conveyed must be made.
3. Then, one can write down various topics, subtopics to be considered and what material to be presented in them.
4. The sentences which are to be expanded, reworded and verified for its validity can be marked.

The outline of the report helps us concentrate on

1. what is to be presented,
2. logical relationships between different parts of the report,
3. smooth flow of the content and
4. continuity in the presentation.

The outline can be discussed with the guide, collaborators, colleagues and experts in local area. Based on their comments the structure of the report can be modified.

A three stage preparation of a report is generally done by researchers. They are:

1. First draft – *Rough draft*.
2. Second draft – *Rewriting and polishing of the rough draft*.
3. Third draft – *Writing the final draft*.

## **A.** First Draft

In this stage a researcher can write

1. what has been done in the research study,
2. procedure, method, theory and technique applied,
3. technical difficulties faced and how they were overcame,
4. broad findings and
5. concluding remarks.

Tables and charts can be typeset using computer and kept separately in order to avoid rewriting them. Conclusion should be precise, clear and objective. Further directions may be pointed out.

Since a research paper is identified by its title it should be brief and not more than above 10-15 words. A subject index of a paper is primarily based on the words in the title. Therefore, few key words which are helpful to classify the paper can be included appropriately in the title.

How does a reader decide whether to read the content of a paper or not? Abstract serves the purpose. By reading the abstract a reader would decide whether the content of the paper is useful to him. Therefore, the abstract should have positive information about the content of the paper and summary of the work reported in it. Further, if the abstract has final results and main conclusion of the paper then a reader who has a general interest in the subject can know the outcome of the paper without reading the entire text by referring the abstract itself.

## **B.** Second Draft

This is the most important and difficult part of the writing. Extreme care must be taken in writing this draft. One convenient approach is to edit the draft imagining that someone else has written it.

Unclear points, jargons, weakness of the report have to be identified and revised. Overgeneralization of outcomes should be avoided. For example, Hermitian operators have real eigenvalues. Generalizing it as eigenvalues of operators are real or concluding that to have real eigenvalues, operators should be Hermitian are incorrect. Similarly, complex analytic functions satisfy Cauchy–Riemann conditions. It does not mean that functions satisfying Cauchy–Riemann conditions should be analytic. How do you avoid over-generalization? For some details see, for example, ref.[8]. If you have introduced any graphics and tables, discuss it in the text.

Attention must be paid to the arguments made, logical flow of work presented, the quality of supporting evidences and conclusion drawn. Do these in each chapter. Don’t do the entire second stage at a single stretch. Give sufficient time between revisions of two consecutive chapters. During the break time think over the revision made in the previous chapter or section.

More importantly, grammar must be checked. A careful spell check must be made. Use simple words as far as possible. Indecisive words such as perhaps, somewhat, rather, etc. should be avoided. Usage of some particular words repeatedly, for example, ‘very’, ‘extraordinary’, ‘invariably’ should be avoided. Expressions such as ‘it seems’, ‘there may be’, ‘since’, ‘putting’, etc. should be replaced by appropriate equivalent words.

Style, presentation and grammar can be improved by asking your friends, colleagues to read and give their critical comments, suggestions and correct English grammar.

In some universities the report is first read by an English teacher. He will correct the grammar and give suggestions. After this only a researcher can submit the thesis.

Complicated and lengthy sentences have to be rewritten and broken. Similar sentences or sentences conveying same information must be eliminated. Check whether the words used clearly convey exactly the meaning intended.

S. Chandrasekhar said: *I always sought to present my findings in as elegant, even literary, a form as possible. I select some writers in order to learn. For example, I read Henry James or Virginia Woolf, and I don’t simply read the text as a novel; I see how they construct sentences, how they construct paragraphs, how one paragraph goes into another and so on.* (J. Horgan, Current Science, 67 (1994) pp.500-01).

B.S. Warrier says: *There is one clear distinction between an article and a thesis in use of vocabulary. You may find that authors of popular writing make use of synonyms to kill monotony. For example, instead of repeating the word teaching, they may use instruction, coaching, training, schooling, tutoring and education, ignoring the fine differences in the shades of meaning.*. (The Hindu, 20 November 2006 p.6 of Education Plus).

The conclusion may carry something more than a repetition of the findings indicated elsewhere. All conclusions should be directly related to the research. Perhaps the conclusion could reveal a special insight of yours, throwing up a possibility of the findings being applied to a different situation or even different discipline. Proper references of related work should be included. Trivial matters and obvious conclusion should not be included and if there are such sentences then they should be dropped.

## **C.** Third Draft

This is the last stage. In this stage, one can concentrate on *final touches and finishing*. This should be in the direction of making the report weighty, authoritative, attractive and convincing. Similar words and format should be avoided in successive sentences. Make sure that the script clearly shows the originality of the author and importance of the outcome of the study performed.

In all the three stages of report preparation one should follow a proper style of writing. Use clear and unadorned English appropriate for the readers. One has to be aware of to whom the research report is intended. *The report is not for the supervisor*. It is better to avoid the use of personal pronoun. Use of “I” and “the author” should be avoided. Some supervisors like to use “we”. For an interesting fun about the usage of “I” and “we” see p.106 of *Why are things the way they are?* by G. Venkataraman (University Press, Hyderabad,

1992).

Both active and passive voice should be used wherever necessary or appropriate. However, when using them one should check whether the meaning is strictly correct. For example, when writing *The experimental results agree with the theory* we must check whether we are strengthening the experimental result or the theory. Care must be taken in using present and past tenses. Use past tense to describe the data collection and work done by others and you. For interpretation, assessments and discussions present tense is appropriate.

Since a research article is to be read by experts in the field, avoid expressions such as “In other words” and “To put it in a simpler way.” Experts may not take kindly to such phrases, as they feel that they are competent to grasp even complex ideas stated in difficult idiom.

Between various stages it is advisable to give gap of few days so that you can leisurely think of the manuscript and record how to revise it. This will avoid unnecessary tension and half-hearted write up.

*How do you ensure that your paper will be well received by readers?* Some of the suggestions are:

* Before sending it to a journal, authors can ask their colleagues and friends working in the same field to read it and comment on it.
* The paper can be given to colleagues who are not familiar with the topic so that it can be attracted by non-specialists in the field.
* Don’t feel offended if the colleagues suggest drastic changes.
* Think back to couple of papers which have made an impression on you and are still long remembered. Note down and analyse the style, presentation and other features that have impressed you.

As pointed out by David Hilbert the presentation and understanding of the outcome of an investigation is not to be considered complete until you have made it so clear that you can explain it to the first man whom you meet on the street. This clarity and ease of comprehension is so important.