

"ON BEING SCIENTIFIC IN PREPARATION OF ARTICLES"

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1. PURPOSE OF THIS ARTICLE

The Journal of Engineering Education has for the last few years provided a forum for researchers and practitioners in the field of Engineering Education to express their ideas and views about the field.

The complexity of the problems of engineering education is increasing. Many of the readers of this journal feel that dealing with these complexities needs adoption of scientific methods of enquiry by researchers and practitioners, so that more valid and reliable knowledge is available through this journal to the readers. There is a need to upgrade the quality of this journal through upgrading the quality of articles and reports appearing in the journal and also by improving its general format.

While the latter is being attended to by the editorial board separately, this article will focus on systematic method of preparing articles. The article proposes that the quality of articles can be improved only if the contributors adopt certain methods of scientific enquiry during investigation

and preparation of the articles. All articles sent to this journal must display evidence of the use of such scientific techniques. This needs sustained efforts both by the editorial board as well as the contributors of the articles.

2. AIM OF THIS JOURNAL

The Journal of Engineering Education aims at providing a forum where researchers, consultants, managers and teachers in Engineering Education can report their results of both long term and short term research/investigation or study to their peers in the field. The journal looks at 'Engineering Education' as an applied field of education, where organized body of knowledge needs to be generated for (i) assisting researchers to extend the theoretical framework, (ii) helping practitioners to develop policies for attacking fundamental problems, (iii) describing or explaining specific on-going problem situation and (iv) providing guide-lines to teachers and administrators to take appropriate actions to improve the situation through design, developing, implementing and evaluating the inno-

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vative efforts for improving the system's performance.

But the organized body of knowledge is generated in variety of ways. The contribution to this Journal by the practitioners of the Engineering Education appear in different categories of articles.

- i) **Review articles** which survey recent developments in the field. Such review articles are either commissioned by the Editorial board or at the initiative by any individual.
- ii) **Research Articles** are research reports whose conclusions are of general interest and is an advance in understanding.
- iii) **Letters** are short reports of outstanding novel findings whose implications are general and important enough to be of interest to those outside the field.
- iv) **Commentary Articles** deal with issues, in or arising from research that are also of interest to readers outside research.
- v) **News and views articles** inform non-specialist readers about new scientific advances, some times in the form of conference report.
- vi) **Scientific Correspondence** is for discussion of total scientific matter published in any journal including JEE and for miscellaneous contribution.

This article focuses on preparation of research articles (S. No. 2 above). At present, there are no real basic researchers, nor applied researchers in the field of engineering education. There are also no action researchers of professional types.

But in view of the quantitative and qualitative improvement projects initi-

ated by MHRD Unesco, the World Bank Projects, the need for research is the greatest, now. It is necessary, at least, to understand how to report the results of the research activities. This articles attempts to do this.

What about other types of articles? The other types are also important, because these types convey opinions, views of all those practitioners regarding the quality of engineering education. This journal would like to serve as a vehicle for dissemination of this type of information. These serve to convey to the readers philosophies, trends, beliefs, assumptions of these experienced people about the existing and future shape of engineering education. Their ideas serve as a starting point for researchers for identifying the theme for their research project. What is, however, important to understand is that the policies for better educational system should, however, be based on the valid data supplied by research activities.

Following sections, therefore, describe the format for research articles.

Broad Sub-fields of Engineering Education

From the point of view of practitioners in the field, the Engineering Education can be broken into following sub-fields :

Practitioners	Sub-Field
1. Ministers and Directorate of Technical Education	National and State level Management of Engineering Education.
2. Heads of the Educational Institutions	Institutional level Management of Engineering Education

Practitioners	Sub-Field
3. Academic Heads of Institutions and Dept.	Curriculum Development
4. Teachers	Instructional Design and Development (Educational Technology)
5. Students	Students learning
6. Researchers	Educational Research

3. TYPES OF RESEARCH

Here the word 'research' is used in a very broad sense and includes both long term and short term basic research, investigations, inquiry or simply study engaged in by both professional researchers, consultants or practitioners to solve problems faced by them in the pursuit of their professional activity. Research activity can be categorized into three types :

Basic Research

In this, professional scientists are involved in generating basic concepts, principles, laws and theories and improved scientific techniques to advance the frontiers of organized body of knowledge in the field of Engineering Education. There is no conscious effort to improve practice (GRIFFITHS 1978).

Applied Research

Such activities are undertaken by applied researchers who draw upon the basic theoretical framework to solve problems of practice. The efforts of these researchers may result into (i) new policy framework by the practitioners (ii) new perceptions, explanations and predictions of the on-going phenomena

(iii) design of a new system for bettering performance of the engineering education (WHYTE 1984).

Action Research

Here researchers, consultants and practitioners engage in organizational efforts to improve organizational performance through joint activities of diagnosis, action planning, evaluation of action and re-planning action. The results of this research may incidentally enrich basic research, but the primary aim is to improve practice (FRENCH & BELL 1992)

4. METHOD OF ENQUIRY

Whatever may be the type of research undertaken, there are certain common features adopted by all investigators in their researches which enhance objectivity, validity and reliability of the knowledge generated. This leads to potential users of this knowledge accepting the findings with greater confidence. (BELL JUDITH 1993)

Following are the basic steps of scientific enquiry.

1. Sensing the Problem and Selecting the Topic for Investigation

Researcher's attention is directed towards the problem because of the extra-ordinary event in the surroundings or as a result of reflection.

The article must explain what are the events that attracted his attention; what efforts he has made to limit the scope of his investigation and select a topic for his detailed investigation; what he hopes to achieve at the end of his investigation: develop a new concept, explanatory theory as in basic research; or improving immediate on-going process as in action research.

This step requires researcher to prepare a short list of topics related to the problem-situation, selection of one of the topics for investigation giving reasons, establishing focus of study; deciding objective of study or formulating hypothesis; deciding upon the approaches and methods of investigation and planning a time table.

In the initial paragraph under the heading 'Outline of Research', all salient points mentioned above must be described.

2. Reviewing the Literature

Before proceeding with the investigations, the researcher must know what other experts have said about this topic earlier. For this he must review the existing literature. Such reading also gives the researcher ideas on approach and methods of investigations adopted by earlier investigators, provide you with initial framework for collecting, classifying, analysing and interpretation of data you will be collecting during investigation.

Your article must mention the ideas you have gained through review of literature in next few paragraphs under the heading 'Review of previous work'.

3. Keeping Records and Maintaining Notes

Scientific work needs systematic maintenance of records of study for (i) indexing sources of information to facilitate retracing them later whenever needed; (ii) referencing these sources in the body of the text in a standard format, e.g. Author's name, title of the source, year of publication, place of publication, publisher etc.; comments about its suitability for research topic; (iii) note taking for recording ideas,

data and evidence obtained from such information sources; (iv) categorizing and classifying the subject matter according to tentative outline of the proposed articles; (v) noting quotations verbatim in the body of the text.

Such systematic record keeping should be reflected in your article in the form of (i) bibliographical references in a standard format; (ii) cross-referencing in the body of the text; (iii) verbatim quotations; (iv) acknowledgement of use of logic and methods adopted from others. These are all mark of scholarship.

4. Collecting, Analysing Ideas, Data and Evidence

Researchers generally obtain data and evidence from any one or combination of methods of investigation mentioned below depending upon the nature of the subject-matter.

- (i) from primary and secondary documentary sources,
- (ji) by designing and administering questionnaires,
- (iii) by planning and conducting interviews,
- (iv) by maintaining diaries which are the records of researchers' professional activities,
- (v) by conducting observational studies.

In your article, you must describe the methods of collecting information and explain why you have chosen these methods under the heading 'Description of the procedure, sample and tests of measurement used.'

5. Analysing Evidence and Presenting Findings

Evidence collected must first be categorised and coded for analysis. Analysis of this data is done by using

statistical tools and logic provided by theoretical framework of the field. The results of such analysis end up into the findings of the investigations. These findings are integrated into the existing theoretical framework to develop better insight into the problem-situation; better comprehensive theory, better perception of the problem, better policy, better design or better implementation strategies.

Your article must reflect your efforts in coding information, analysing information, summarising findings of the investigation, interpreting these findings from the potential user's point of view. This appears under the heading 'Statement of results and discussion and summary and conclusion'.

5. STRUCTURING REPORT/ARTICLE

Most researchers agree that the report, article or dissertation should include following major sections :

1. Outline of Research
2. Review of previous work
3. Precise statement of the scope and aim of investigation
4. Description of the procedure, sample and test of measurements used
5. Statement of results
6. Discussion of findings
7. Summary and conclusions
8. References
9. Abstract
10. Annexures/Appendices.

Your article must include all the above elements when it is ready for submission to the Journal.

6. MECHANICS OF PRESENTING A REPORT

Every report or article of scientific nature possesses external features designed to promote better understanding by the readers. They are as follows.

- **Length** : Restrict your article to maximum prescribed words.
- **Title** : The title should accurately reflect the nature of your study.
- **Acknowledgement and Thanks** : Acknowledge the help you have received from experts and organizations at various stages of your investigation.
- **Headings** : Include section headings wherever possible to help readers to follow your structure and arguments.
- **Table and Figures** : Understanding of the text improves, if supported by tables and figures. Number them sequentially and refer to them in the body of the text.
- **Quotations** : All quotations verbatim must be written in inverted commas, intended in the body of the text. Its source must be immediately acknowledged.
- **References** : Sources used must appear alphabetically at the end of the report under the heading 'References' in a standardised format. Include only those references which are referred to explicitly in the body of the text.
- **Appendices** : Any information that supplements understanding of the text, but may disrupt the flow of argument in the main text, must be included separately in appendices. Examples are formats of research instruments like questionnaires, extra comments, additional data etc.

- **Abstract** : Prepare a brief but informative statement giving the purpose of your investigation, method employed and conclusions reached. This appears at the beginning of the report.
- **Presentation** : Submit the article in a typed form in double spacing, with quotations indented and typed in single spacing. Pages should be numbered. Typing should be on one side of the page only, leaving left-hand margin of one and half inch.

All figures should be drawn on the tracing paper or bond paper in black Indian ink. If the figures are complicated, they should be drawn in size double that size in which it is intended to appear in print. All these drawings should be attached separately and their place indicated in the body of the text for the guidance of the printer.

It is stressed, once again, that writing paragraph headings and section headings are important from the readers' point of view.

Standard Formats : The Journal is in the process of standardising the format of various elements of reports : Title, referencing, quotations, figures, tables, abstracting etc. Till then, researchers are invited to as many references available in the market. Some of them are included in the references for this article.

7. ACKNOWLEDGEMENT

This note has liberally made use of the basic text : BELL JUDITH - 'How to Complete your Research Project Successfully' (A Guide to First-time Researchers) 1987 - Open University Press Publication. This is now available in

India through its Indian reprint by UBS Publisher and Distributor, New Delhi (Rs.65/-). This book is strongly recommended.

However, for further indepth understanding of scientific investigations, you will have to read books cited under 'Reference'.

8. CONCLUSION

The ability to introduce scientific technique in preparing articles comes only with practice and understanding. It is a slow process, but an essential process which should be encouraged by all key managers of the Engineering Education (Ministries and Directorate of Technical Education, Heads of Educational Institutes and Heads of Departments), so that all actors in the Management of Engineering Education, including teachers, internalise this scientific attitude in the interest of better Engineering Education.

The publication of their investigative efforts in this journal should be considered as a major academic contribution of these actors and should be considered in the reward policy of the system's manager.

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- Note** : Bureau of Indian Standards has also published standards for standardizing formats for writing scientific articles. These must also be referred to.

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Contributions

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