

Questions to ask in order to understand a scientific article

As a scientist student, scientist researcher, academic scientist... reading research papers is a significant part of their learning, of their work... It is necessary to stay up to date in the field, enhance scientific understanding, review manuscripts, and gather information for project proposals or grant applications. Scientific articles differ from other types of texts like novels or newspaper stories. Therefore, they should be read differently.

Research papers have a well-known format called **IMRD**, which stands for Abstract, Introduction, Methods, Results, and Discussion. They also include the Title and Authors at the beginning, Conclusion and References at the end, and sometimes Acknowledgements. These articles may have multiple cross-references, tables, and supplementary materials, such as data sets, lab protocols, and gene sequences. These characteristics can make them dense and complex, and the ability to understand them effectively requires practice.

1-Abstract:

The Abstract of a research paper is a short summary of the article. It should include the focus, results, and ultimate conclusions of the study. Although it does not explain in full detail, it is an essential tool to determine whether further investigation is necessary. Therefore, it is recommended to read the Abstract first,

The abstract is always available: it does mean that when searching for an article, you always find the abstract with the title, authors affiliation and key words, even when an organization (like your university, or firm) does not have a subscription to a journal. ***The Abstract is the best thing to read FIRST.***

Question to ask:

- **Does this interest me?**
- **Is this related to my area of research?**

2- Introduction:

The Introduction of a research paper explains the idea investigated. It should include a "Literature Review," which is a summary of research already performed by others on the same topic. The Literature Review should indicate ***why the particular study is unique*** or ***how it adds to the discussion***. This section can help answer questions like what other people have done in regards to this topic, how the research is unique, and whether it will tell anything new.

Questions to ask:

- **What have other people done in regards to this topic?**
- **How is this research unique?**
- **Will this tell me anything new?**

3- Materials and Methods:

The Materials and Methods section of a research paper describes how the study was performed. It should include the specifics of the experiment or study, so that it can be replicated if necessary. It is important to note that some studies do not include enough information to be repeated, and that is considered a poor Materials and Methods section, or sometimes, you have to read previous studies done by the authors: the explanation is that as the authors specialize in solving a scientific problem, they aren't going to repeat every time the details of their experimental part, that why if you are interested, you have to look for further details by looking to their previous publications.

Questions to ask:

- Could I repeat their work?
- Is all the information present in order to repeat it?

4- Results:

The Results section of a research paper provides unbiased findings. The data should be presented here. Sometimes, the Results and Discussion sections will be combined. It is essential to ask questions like whether the results presented in a factual and unbiased way, if all the data is present, and what conclusions can be formulated from this data.

Questions to ask:

- Are the results presented in a factual and unbiased way?
- Is all the data present?
- What conclusions do you formulate from this data?

5-Discussion/Conclusion:

The Discussion section of a research paper analyzes the data and explains what the researchers felt was **significant** about the results. (Statistically significant $p < 0.05$, meaning 95 from 100 experiments follow the rules, and that only 5 from 100 do not follow, so the difference is significant and it's accepted)

This is where they interpret the data and point to facts and figures. The Conclusion of a research paper provides the final thoughts from the researchers. It may reiterate what was noted in the Discussion or may even be combined with it. Many times, the Conclusion recommends areas for future research.

It is essential to ask questions

- like whether their analysis agrees with the data present,
- what the weaknesses in their argument are,

- whether the conclusion is valid,
- and what other research should be explored next.

6-References:

The References section of a research paper gives credit to other scientists and researchers. It shows what works the article referred to when planning their research and writing their paper. It is important to check this section and read other articles or research by respected authors in the field.

Questions to ask:

- What other articles should I read?
- What other authors are respected in this field?

In conclusion, reading a research paper is an essential skill for scientists. The IMRD format is a helpful guide to understand the different parts of the article. By asking relevant questions during each section, students, academicians, scientists, researchers... can gain a deeper understanding of the research paper and apply it to their work.

References of this text: 1-how to read a scientific paper, Illinois university

2-reading scientific paper, Elsevier