How to Read a Scientific Research Paper

كيفية قراءة و مراجعة مقال علمي

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ABSTRACT:

The study sheds light on the importance of reading a scientific paper that is never taught. Scientific articles are different from other texts, novels or newspaper stories; thus, they should be read differently. Reading is a common skill that learners and researchers learn. With the exponential spread of knowledge, no one has time to read everything. In fact, reading original research, though time consuming, is effective and crucial for development. Based on previous background, the reader should select papers with which he is already familiar. Rather than starting from the beginning.

This article outlines a practical and efficient method for reading research papers. It also describes how to use this method to review any kind of paper. It is always better to approach a paper by reading the conclusions in the abstract first. The methods should be next reviewed, then the results-first in the abstract, and then the full paper. For efficacy, reasons should not be read or reviewed any further in the article. Keshav' s Three Pass Approach proved to be effective in reviewing any type of papers. By adopting such an approach along with critical and creative readings, many papers will be evaluated and read, in addition, the peer-review process will be facilitated.

Keywords: Approach, article, peer review, reading, scientific paper.

الملخص:

تسلط الدراسة الضوء على أهمية مهارة قراءة ورقة علمية و التي لا يتم تدريسها أبدًا. تختلف المقالات العلمية عن النصوص الأخرى أو الروايات أو القصص الصحفية ، لذا يجب قراءتها بشكل مختلف. القراءة مهارة يمكن ان يتعلمها المتعلمون والباحثون. لكن مع الانتشار الهائل للمعرفة، لا أحد لديه الوقت لقراءة كل شيء. في الواقع ، قراءة الأبحاث الأصلية، على الرغم من أنها تستغرق وقتًا طويلاً ، تعتبر فعالة وحاسمة للتنمية. بناءً على الخلفية السابقة ، يجب على القارئ اختيار الأوراق التي يملك فكرة عنها بدلا من البدء من البداية.

توضح هذه المقالة طريقة عملية وفعالة لقراءة الأوراق البحثية حيث تصف كيفية استخدام هذه الطريقة لإجراء مسح و مراجعة للأدبيات. من الأفضل دائمًا الاقتراب من الورقة بقراءة الاستنتاجات في الملخص أولاً. يجب مراجعة الأساليب بعد ذلك، ثم النتائج المذكورة أولاً في الملخص، ثم في الورقة الكاملة. من أجل الفعالية، لا ينبغي قراءة الأسباب أو مراجعتها في المقالة. أثبت نهج Keshav's Three Pass فعاليته في مراجعة أي نوع من الأوراق. من خلال اعتماد مثل هذا النهج إلى جانب القراءات النقدية والإبداعية، سيتم تقييم العديد من الأوراق وقراءتها، بالإضافة إلى ذلك، سيتم تسهيل عملية مراجعة الأقران.

كلمات مفتاحية: منهج ، مقال ، مراجعة الأقران ، قراءة ، ورقة علمية.

1-Introduction:

The English language is considered as a very important language around the world, because it's the language of worldwide communication and publication. In fact, Researchers must read papers for several reasons: to review them for a conference or a class, to keep updated in their field, or for a literature survey writing of a new field, to advance their scientific comprehension, to review manuscripts, or to gather information for a project proposal or research application. Any researcher will likely spend many hours reading papers. Learning to effectively read a paper is a critical yet never taught ability. Usually, students and novice researchers waste much effort in the process and are frequently driven to frustration. For many years I have used a simple approach to efficiently read papers and I thought of explaining it in this paper.

2- Literature Review

Ruben (2016) has described the common difficulties and frustrations of reading a scientific paper broadly resonated among Science Careers readers. Many of them were asked on how to make sense of the scientific literature. Although it was clear for them that reading scientific papers becomes easier with experience, the stumbling blocks are real, and they argued that it is up to each scientist to identify and apply the techniques that work best for them. The responses have revealed that they read papers in a linear way starting from the title to literature cited, digesting every word along the way without any reflection or criticism.

Therefore, Siegel (2020) suggested five steps to read a scientific paper efficiently which will help reviewers in order not to waste much time and efforts like: Screening the article in which you read the title, the personal data of the authors and try to understand the key-words. Then, getting the punch line, in which you read slowly the abstract and the introduction. After that, understanding the approach and analyzing the figures and tables. Next, the first reading, in which you skim the results and discussion, and finally, increasing understanding in which you reread the article in its entirety and consult references. He explains how these steps can guide reviewers to read and understand any article.

Also, Durbin (2009) claimed that reading research can take different forms and through practice 4- or 5-times critical reading and appraising a scientific research paper will be developed. He insisted on the organization of research papers which can facilitate the reading process. Mainly, the structure of the abstract that often helps the reader decides if the entire paper should be considered at all. Reading the abstract's conclusions section first may allow the reader to reject the paper or it may lead to an increased interest in the details of the research.

Moreover, Subramanyam et, al., (2013) in his answer to what to read in a scientific paper, he responded that not all published articles are excellent, and it is pragmatic to decide if the quality of the study "warrants reading of the manuscript". The first step for a reader is to choose a right article for reading, depending on one's individual requirement. A simple decision-making will help one to decide the type of article to select. A good paper should contain all

elements: Structured abstract, introduction, methods, results, and discussion (IMRAD). According to him readers should be aware of what to read.

Raff (2019) referred to reading a paper as reviewing process which entails to find out answers to the big question that is ""What problem is this entire field trying to solve?"" It will clarify for you the reason of this research; you will understand the topic, problem, and motivation. Then to find out answers to the specific questions ""What exactly are the authors trying to answer with their research?"" It will help you to understand the questions, hypotheses, methods and results.

3- Problematic and Objective:

Reading scientific literature is compulsory for teachers and researchers. With an overflow of scientific journals, it is crucial to develop a method to read and review the right articles. When you read a research paper, the goal is to understand the scientific contributions the authors are making. This is not an easy task, due to the fact that it may require going over the paper several times, and spend several hours to read it especially for novices. Thus, it is mandatory to outline a logical and orderly approach to reading a scientific manuscript. By breaking down the task into smaller, step-by-step components, one should be able to attain the skills to read a scientific article with ease.

4- Research Questions:

- – What is a scientific paper? And what are its main components?
- – How do you approach reading a paper?
- – What is the difference between reading a paper critically and reading it creatively?
- – To what extent is Keshav's three pass approach effective in reading and peer-reviewing a paper?

5- A Scientific Paper: Form and Components

The scientific paper is referred to either a primary research article which is a peer-reviewed report of new research on a specific question (or questions) it presents an innovation, or a review article. Review articles generally are also peer-reviewed which don't present new information, but instead summarize multiple primary research articles, to give a sense of the consensus, debates, and not answered yet questions within a field.

The researchers or authors of scientific papers always provide an interpretation of what they think their new information mean and how they contribute to our understanding of how the natural world works. By presenting the data and the analysis, other authors may evaluate these interpretations for themselves. Because our understanding is always changing, sometimes the interpretations of the data can be re-evaluated in light of new ideas and new data in other scientific papers.

Table 1. The Structure of a Primary Research Article

Section	Content
Title	The "take home" message of the entire project, according to the authors.
Author list	These people made significant scientific contributions to the project. Fields differ in the standard practice for ordering authors. For example, as a general rule for biomedical sciences, the first author led the project's implementation, and the last author was the primary supervisor to the project.
Abstract	A brief overview of the research question, approach, results, and interpretation. This is the road map or elevator pitch for an article.
Introduction	Several paragraphs (or less) to present the research question and why it is important. A newcomer to the field should get a crash course in the field from this section.
Methods	What was done? How was it done? Ideally, one should be able to recreate a project by reading the methods. In reality, the methods are often overly condensed. Sometimes greater detail is provided within a "Supplemental" section available online (see below).
Results	What was found? Paragraphs often begin with a statement like this: "To do X, we used approach Y to measure Z." The results should be objective observations.
Figures, tables, legends, and captions	The data are presented in figures and tables. Legends and captions provide necessary information like abbreviations, summaries of methods, and clarifications.
Discussion	What do the results mean and how do they relate to previous findings in the literature? This is the perspective of the author(s) on the results and their ideas on what might be appropriate next steps. Often it may describe some (often not all!) strengths and limitations of the study: Pay attention to this self-reflection of the author(s) and consider whether you agree or would add to their ideas.
Conclusion	A brief summary of the implications of the results.
References	A list of previously published papers, datasets, or databases that were essential for the implementation of this project or interpretation of data. This section may be a valuable resource listing important papers within the field that are worth reading as well.

Research articles typically contain each of these sections, although sometimes the "results" and "discussion" sections (or "discussion" and "conclusion" sections) are merged into one section. Additional sections may be included, based on request of the journal or the author(s). Keep in mind: If it was included, someone thought it was important for you to read.

Most journals use a conventional IMRAD structure: An abstract followed by Introduction, Methods, Results, and Discussion. Each of these sections normally contains easily recognized conventional features, and if you read with an anticipation of these features, you will read an article more quickly and comprehend more.

5-1- Features of Abstracts:

They usually contain four kinds of information:
− purpose or rationale of study (why they did it)
− methodology (how they did it)
− results (what they found)

– conclusion (what it means)

Most scientists read the abstract first. Others—especially experts in the field—skip right from the title to the visuals because the visuals, in many cases, tell the reader what kinds of experiments were done and what results were obtained. You should probably begin reading a paper by reading the abstract carefully and noting the four kinds of information outlined above. Then move first to the visuals and then to the rest of the paper.

5-2- Features of Introductions:

Introductions serve two purposes: creating readers' interest in the subject and providing them with enough information to understand the article. Generally, introductions accomplish this by leading readers from broad information (what is known about the topic) to more specific information (what is not known) to a focal point (what question the authors asked and answered). Thus, authors describe previous work that led to current understanding of the topic (the broad) and then situate their work (the specific) within the field.

5-3- Features of Methods:

The Methods section tells the reader what experiments were done to answer the question stated in the Introduction. Methods are often difficult to read, especially for graduate students, because of technical language and a level of detail sufficient for another trained scientist to repeat the experiments. However, you can more fully understand the design of the experiments and evaluate their validity by reading the Methods section carefully.

5-4- Features of Results and Discussion:

The Results section contains results—a statement of what was found, and reference to the data shown in visuals (figures and tables). Normally, authors do not include information that would need to be referenced, such as comparison to others' results. Instead, that material is placed in the Discussion—placing the work in context of the broader field. The Discussion also functions to provide a clear answer to the question posed in the Introduction.

6- Keshav's Way of Reading a Paper: The Three-Pass Approach

According to Keshav (2007) while reading any academic paper there is must to avoid the fear of missing out (FOMO). No need to read and check every single part with a strong desire to read all data. Thus, he suggested a better way on how to approach this problem called the three-pass approach which involves the following:
– The first pass: The bird's-eye view
– The second pass: Grasp the content
– The third pass: Virtually re-implement the paper
– Some additional extensions

Keshav (2007) explains the three-pass approach which refers to a filtering system. It is an expletive way of reading a paper. This deductive approach goes from a general view to the specific details while each step takes provides deeper insights.

6-1- The first pass:

Here you get the bird's-eye view or "the big picture" of the paper. This step usually takes 5 to 10 minutes. You skim through the structure of the paper and ignore any details. Yet, you should read the abstract, title, introduction and conclusions thoroughly. This step serves as a first glance or check if the paper is worth reading in general. By following this approach you can already discard papers which are not useful. In this stage you ought to answer the so-called "five C's" as Keshav puts it:

6-1-1- Category:

The category describes the type of the paper. Is this paper about a concept? About a new method? Is it a literature survey?

6-1-2- Context:

The context puts the paper into perspective to other papers. What other papers are related to this one? Can you connect it to something else? You could also see the context as a semantic tree where you assign specific importance to the paper. Is it an important branch or an uninteresting leaf?

6-1-3- Correctness:

Correctness is, just as the name suggests, a validity measurement. Are the assumptions valid? Most of the time the first pass won't give you enough information to answer this question with certainty but you probably have a hunch which is enough in the beginning.

6-1-4- Contributions:

Most papers have a list of their contributions right in the introduction section. Are these contributions meaningful? Are they useful? Which problems do they solve? Are these contributions novel?

6-1-5- Clarity:

Based on the sections you just read, do you think that the paper is well written? Did you spot any grammar mistakes? Any typos?

6-2- The Second Pass:

This step can take up to 1 hour. You can still ignore details like try to make some notes at the margins and write down key points. Try to rephrase the key points in your own words. Keep in mind that research groups often spent several months or even years to conduct their

research. And now they had to compress their results and knowledge into a paper which may be had to meet certain requirements.

6-3- The Third pass:

You have to be very certain that this paper is worth your time before continuing with this step because it can take up to 5 hours as a beginner. More experienced readers may be able to finish this step in 1 hour. Now is the time to read the complete paper with all its details. Try to virtually re-implement the paper or use any tools you like to recreate the results. If you are a reviewer then you probably have to take this step to give detailed feedback. At the end of this pass you should be an expert and know the paper's strong and weak points. You can make claims about missing citations and potential issues.

7-Some Optional Extensions

In addition to the three passes, there are some other steps which might add some benefits to the three-pass approach and to facilitate the reviewing process to the reader as well .

7-1-Little boxes

When you take a look at the paper, you start surrounding symbols, figures and tables with boxes. It is very useful with the first pass while skimming through the paper. It is also beneficial to separate the text into big boxes and small boxes.

7-2- Highlighters

Highlighters are a great tool to mark sections in the paper and give them distinctive meanings. You can even try to come up with your own highlighting system, or to give every colour a distinctive meaning and stick to it. For instance, yellow for interesting and important sentences. Green is for citations and blue for definitions and catchphrases.

7-3-Mind Maps

If you are more visual and want to get a better overview of the paper, mind maps may be a suitable fit. There are no strict rules in creating mind maps and I just started with the title of the paper in the center. Big arrows are pointing to the main section titles and these are the big branches. Then, subsections will be highlighted with colours if you want. Feel free to come up with your own map. This step usually adds 25 minutes to the first-pass and it may help you to get the broad picture more visually. This may also be a faster way to refresh your memory about a paper after some time has passed.

7-4- Pomodoro Technique

The Pomodoro technique of Girillo (2018) is a great tool if you are lacking motivation. Sometimes it's not the case that you do not know how to read a paper but more that you feel intimidated by it and lack the motivation to even get started.

Get a timer and set it to 25 minutes. Do not expect any results. Just set it to 25 minutes and start. Eliminate any entertainment and stick to the three-pass approach until the 25 minutes are up. You may not finish the whole three-pass approach but at the end of the 25 minutes you will likely be surprised what you achieved. You now know what the paper is about and you probably feel less apprehensive. You probably feel like you could set the timer again for another 25 minutes. By using this time boxing approach, you gain momentum and can follow the three-pass approach more easily. The impressive thing is: you can apply the Pomodoro technique to any task.

8- Conclusion:

This paper demonstrated how the process of acquiring new information and creating knowledge is complicated as it depends on reading scientific articles. Developing a reading method aimed at efficiently deciding to read a paper in a very interesting approach . The rigid and predictable structure of scientific writing helps with this task. In fact, and at first glance, a journal paper might appear intimidating for some or confusing for others with its tables and graphs. Reading a research article can be a frustrating experience, especially for the one who has not mastered the skills of reading scientific literature. One can also learn to read research articles by following a systematic approach developed by Keshav, and that was named The Three-Pass Approach. This approach contains three effective methods or passes, which facilitate the reading skills of a paper. Each step has a specific target. Moreover; all the three passes can easily increase the readers' efficiency of reviewing.

 Reading a research paper must be a critical operation. Reading a paper critically is easy, in that it is always easier to tear something down than to build it up. In fact, it is so due to that critical reading involves asking a set of definite questions: If the authors attempt to solve a problem, are they solving the right problem? What are the limitations of the study, as illustrations? Meanwhile, reading creatively involves harder, more positive thinking. What are the good ideas in this paper? Do these ideas have other applications or extensions that the authors might not have thought of? Can they be generalized further? Both forms of reading along with Keshav's Approach are recommended to review and effectively read any academic paper.

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