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Professional paper

CHOOSING THE TITLE, ABSTRACT, AND KEYWORDS FOR A SCIENTIFIC ARTICLE IN CHEMISTRY: BENEFITS AND CHALLENGES

Arbana DURMISHI[1], Hamdije MEMEDI[1], Bujar H. DURMISHI*[1], Agim SHABANI[1]

[1] *Chemistry Study Program, Faculty of Natural Sciences and Mathematics, University of Tetova, Street Ilindeni Street, No. 1200 Tetova, Republic of North Macedonia*
**Corresponding author: bujar.durmishi@unite.edu.mk*

Abstract

Introduction to the Issue: Selecting an appropriate title, abstract, and keywords is essential when writing a scientific article in chemistry. These components greatly affect the work's visibility, precision, and acceptance in the scientific community. **Objective:** This article examines the significance of these elements in scientific papers within the field. **Methodology:** The investigation is based on a thorough review of national and international literature regarding scientific communication in chemistry. Sixty articles from indexed journals (Scopus, Web of Science, Google Scholar) were analyzed to identify best practices and common mistakes in crafting titles, abstracts, and keywords. A comparative analysis assessed the link between the quality of these components and their citation counts or views. **Results and Discussion:** The findings indicate that clear and specific titles significantly boost article visibility, while well-structured abstracts enhance reader engagement. Carefully chosen, relevant keywords improve access to the article. Failing to develop these elements can impede acceptance and dissemination. It is crucial to balance scientific accuracy with engaging descriptions, especially for early-career researchers. **Conclusions:** In conclusion, the title, abstract, and keywords are vital for success in scientific endeavors. The authors recommend using thesauri, analyzing similar works, and seeking mentorship to improve the quality and impact of manuscripts.

Keywords: Title, Abstract, Keywords, Scientific Article, Indexing, Citability

1. Introduction

The writing and publication of a scientific article represent one of the most important components of a researcher's academic career, especially in the exact sciences such as chemistry, where clarity, accuracy, and well-structured data play a crucial role. This process involves not only laboratory research and analysis but also the ability to communicate results effectively and understandably to a broader scientific audience [1]. In this context, three basic components of an article - the title, abstract, and keywords - gain particular importance, as they represent the “first page” of interaction between the researcher and the potential reader.

These elements constitute the initial contact with the scientific work, often even before the reader decides whether to read the full article. An impactful title can captivate potential readers, while a succinct and compelling abstract effectively communicates the essence of the study. Additionally, keywords enhance the article's discoverability and facilitate its indexing in databases such as Scopus, Web of Science, and Google Scholar [2]. Consequently, although these components may appear as mere formalities, they are indispensable to the efficacy of scientific communication.

In the field of chemistry, where specific terminology and naming conventions matter greatly, it is essential to select words thoughtfully and arrange information efficiently. A title that includes chemical names, formulas, or instrumental methods must be as accurate and representative as possible, while also maintaining a level of readability that facilitates searchability in databases. For example, a title such as *“Assessment of Trihalomethane Levels in Drinking Water Using*

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GC-MS" is far more effective than a general title like *"A Study on Water Pollution,"* as it immediately communicates the method, subject, and context of the study to the reader [3].

On the other hand, the abstract, although only a single paragraph, is the most read part of any article. According to several bibliometric analyses, the abstract is read over ten times more often than the rest of the article [4]. In order to fulfill its function as a summary of the work, it must clearly and concisely include: the introduction to the problem, the aim of the study, the methodology used, key results, discussion, and conclusions. Its structure should be logical and reflect both clarity and the significance of the scientific contribution. Common mistakes observed in many abstracts include the use of overly technical language, lack of a clear purpose, or excessive elaboration on results without mentioning their context or importance [1].

Moreover, keywords are often underestimated by authors, despite their direct impact on the searchability and automatic indexing of articles in search engines and scientific databases. The selection of keywords should be done strategically, using terms that represent the field, methodology, and subject of the study. In the case of an article in environmental chemistry, appropriate keywords might include: *trihalomethanes*, *drinking water*, *mass spectrometry*, *chemical pollution*, and *statistical modeling*. The use of database thesauri such as MeSH (for biologically related articles) or standardized terminologies such as those of IUPAC can assist in selecting accurate and relevant terms (National Library of Medicine, 2024 [5]; IUPAC, 2023) [6].

For early-career researchers, the lack of experience in preparing these components may result in articles with low formal quality, which, although scientifically valuable, fail to communicate this value effectively. This negatively affects their chances of being accepted for publication, cited by other researchers, and ultimately, the overall impact of their work [7]. High-impact journals often impose strict standards on how these components are prepared, and many place great emphasis on the visual presentation and language used in the title and abstract.

Furthermore, in an era dominated by digital technologies, where articles are retrieved through algorithms based on keywords and publication metadata, achieving higher rankings in bibliographic search results is only possible through the intelligent and strategic use of the title, abstract, and keywords. This reality has led not only researchers but also publishers and academic journals to issue increasingly detailed guidelines for the preparation of these components [8].

An additional challenge in this regard is the translation of these elements into English for international publication. Often, inaccurate translation or the use of non-standard terminology hinders both access to and understanding of the article by a broader global audience. This necessitates close collaboration between researchers and scientific translators, or the use of supporting tools such as Grammarly, DeepL, or TermSciences [9].

This article will explore in detail the specific features of formulating titles, abstracts, and keywords for scientific articles in the field of chemistry. The approach will be both theoretical and practical, including concrete examples, comparative analysis of successful and less successful cases, as well as recommendations based on international standards and editorial experience. The goal is to assist every researcher - especially early-career scientists - in significantly improving the quality and impact of their scientific publications.

2. The Role of the Title in Scientific Articles in Chemistry

The title represents the first point of contact between the article and its audience. It is the gateway to the content of a scientific article and directly influences the interest that readers, reviewers, and editors may have in opening and reading the article further. This is especially important in the exact sciences, such as chemistry, where the number of publications is steadily increasing and the competition for attention is high [7].

In this context, the title is not merely a label for the article but a concise summary of its essence. The title must effectively articulate the study's objective, subject matter, and primary methodologies. Titles that are imprecise, excessively broad, or overly technical may result in the article being overlooked due to ambiguous messaging or poor alignment with the search terms utilized by other researchers. For instance, a title such as “A Study on Pollutants” lacks the requisite specificity and fails to convey pertinent information regarding the field, methodology, or findings. In contrast, a more precise and informative title, such as “Determination of Trihalomethanes in Drinking Water Using Gas Chromatography”, provides essential context, content, and scientific relevance [2].

A robust title in scientific chemistry publications must adhere to several critical criteria: it should be unequivocal and free from ambiguous terminology, accurately reflecting the essence of the study, and should be succinct—typically confined to 10 to 15 words. Furthermore, it ought to integrate pivotal terms to enhance indexing and facilitate online discoverability. Titles that are disproportionately lengthy or brief may engender confusion and undermine the article's overall impact [1].

High-impact journals typically favor declarative titles that convey a clear conclusion of the research rather than simply descriptive or question-based titles. For instance, a title such as "Effect of pH on the Synthesis of Silicon-Based Nanomaterials" is preferred over "Does pH Affect the Synthesis of Nanomaterials?" because it provides the reader with a more immediate understanding of the content and findings [9].

It is imperative that the title refrains from employing obscure technical abbreviations, unclarified symbols, or intricate formulas that may elude comprehension by a broader audience. Although the realm of chemistry encompasses a rich technical lexicon, the title must strike a harmonious balance between scientific accuracy and effective communication.

A meticulously crafted title significantly augments the readability, citability, and overall impact of a scientific article. It serves as a crucial strategy for advancing a researcher’s work and necessitates deliberate and systematic contemplation.

2.1. Types of Article Titles: In the realm of scientific publishing, particularly within experimental chemistry, the title functions not merely as a reflection of the content but also as a pivotal communication instrument that profoundly influences the article's visibility and its propensity to be cited. Authors must acknowledge the diverse categories of titles available and the critical elements that inform the selection of an effective one. Numerous prevalent title types exist, each presenting distinct advantages for articulating the subject matter and research methodologies:

1. **Declarative Titles**: These represent one of the most straightforward forms of scientific titles. A declarative title offers a clear and direct statement that conveys a specific outcome of the research. It is commonly found in articles that seek to emphasize a strong conclusion and effectively communicate the main message to the reader. This title format is particularly suitable when the results are clear and definitive. Examples include “Use of UV-Vis Spectroscopy for the Determination of Phenols in Polluted River Water” or “THMs are Degraded by UV Light.” Such titles are concise, clear, and accurately reflect the findings of the study, allowing readers to quickly grasp the subject matter [10].
2. **Descriptive Titles**: These titles typically provide detailed information about the study's objectives and methods. They effectively outline the topic and approach without disclosing results or conclusions. This style is often seen in articles related to laboratory experiments, procedural studies, or systematic reviews. Examples include "Analysis of Heavy Metals in Agricultural Soils of Region X Using Atomic Absorption Spectroscopy" or "Investigation of UV-Induced Degradation of Trihalomethanes in Drinking Water."

Descriptive titles are essential for accurately identifying studies in scientific databases when comprehensive information is required [7].

3. **Interrogative Titles**: These are utilized when the author intends to present a research question that remains unanswered or seeks to spark the reader's curiosity. While they can engage interest, interrogative titles should be used carefully in the natural sciences, where they may be perceived as less rigorous. Example: *"Does Nitrate Concentration Affect Cadmium Bioaccumulation in Aquatic Plants?"* or *"Can UV Light Degrade THMs in Water?"*. According to previous studies, question-based titles are often successful in engaging readers and encouraging them to seek the answer [2].
4. **Compound Titles (with Colon or Dash)**: This format combines a short phrase with a subtitle that provides more detailed information about the study topic. The title consists of two parts, separated by a colon or another punctuation mark - the first part gives the context, and the second clarifies the method or outcome. Example: *"Detection of THMs in Drinking Water: Application of GC-MS in Routine Monitoring"* or *"Degradation of THMs: A UV-Based Analytical Study"*. Compound titles are effective in delivering structured, informative messages and help readers better understand the focus and scope of the research [11].

2.2. Criteria for Selecting an Article Title: Beyond the choice of format, it is essential to adhere to key criteria when selecting a title, which include:

- **Accuracy**: The title should faithfully reflect the actual content of the study.
- **Clarity**: It should be understandable even to readers who are not narrow specialists in the field.
- **Inclusion of Keywords**: Keywords assist with indexing in databases such as Scopus, Web of Science, and Google Scholar.
- **Conciseness**: An optimal title usually contains 10–15 words. Titles exceeding 20 words are often considered less effective.
- **Originality and Specificity**: Clichés should be avoided, and the unique aspect of the study should be highlighted.

A well-chosen title not only supports the clear presentation of the article but also contributes to increasing its impact within the scientific community. Therefore, crafting a strong title requires as much attention and critical thinking as any other part of the article [1], [2].

2.3. Characteristics of an Effective Title: The title is one of the most important elements of a scientific article. It is the first component that the reader encounters and plays a key role in forming the initial impression of the article. To be effective, the title must fulfill several key characteristics that make it clear, accurate, and easy to find through scientific searches. Below are some of the main features of an effective title:

2.3.1. Informative: An effective title should be **informative**, meaning it should clearly and accurately reflect the content of the study. The title must indicate the main topic of the article and clearly communicate what the study is about. In this way, readers can immediately determine whether the article is relevant to their scientific interests. For example, a title like *"Synthesis of Silicon-Based Nanomaterials for Environmental Protection Applications"* is far more informative than simply *"Synthesis of Nanomaterials"*, as it provides more detail about the type of materials and their intended use [7], [2].

2.3.2. Concise: An effective title should be concise and clear. While it is essential for a title to convey information, it should avoid unnecessary words that can make it seem cluttered. Typically, a title should be limited to 10–15 words. A lengthy title can diminish its effectiveness and become hard to read and comprehend. For instance, the long title “A detailed study on the impact of temperature variations and air pollutants on drinking water quality in urban areas of Albania” can be shortened to “Impact of Air Pollutants on Drinking Water Quality in Albania.” According to Day and Gastel [1], shorter titles are better at grabbing attention and enhancing discoverability, particularly in online databases.

2.3.3. Understandable and Contextual: A title ought to eschew the inclusion of overly technical terminology or obscure acronyms, as these can engender confusion and restrict the audience's comprehension of the article. The presence of undefined acronyms and highly specialized jargon may render a title challenging to grasp for readers who lack familiarity with the specific lexicon. Titles should be unambiguous and precise, avoiding terms that may introduce uncertainty or ambiguity. For instance, if an acronym such as "GC-MS" (Gas Chromatography–Mass Spectrometry) is utilized, it is advisable to elucidate it within the body of the article rather than incorporate it into the title, whenever feasible [1]. Employing clear language enhances accessibility and broadens the potential reach of the publication.

2.3.4. Search Engine-Oriented: An effective title should be carefully optimized for search engines. Including key terms related to the research topic significantly increases the chances of the article being found in major scientific databases like Scopus, PubMed, Web of Science, and Google Scholar. These databases use algorithms to identify and rank scientific articles based on specific searches, and incorporating relevant keywords enhances the visibility to other researchers [7], [8]. For example, a title that includes phrases like "molecular specification," "synonyms in organic synthesis," and "analytical methods" is much more likely to appear in keyword-based searches compared to one that lacks these important terms. In summary, crafting an effective title requires a thoughtful balance of clarity, precision, and search engine optimization. It should be informative, concise, and clear while also containing the right keywords to aid online visibility. The title is a vital component of the scientific publishing process and greatly affects the reach and impact of scholarly work.

2.4. Common Mistakes in Title Formulation: When crafting a compelling scientific title, authors frequently confront various pitfalls that can undermine reader engagement and misrepresent the article's content. Among the most common missteps are:

1. **The use of ambiguous phrases**: A prevalent error is the employment of unclear and overly broad expressions such as “An observation on…” or “A possible study of…”. Such terminology lacks precision and clarity, potentially obfuscating the study's purpose and essence for the reader. Research suggests that a title ought to be as informative and direct as possible to accurately convey the study's objectives and methodologies [2].
2. **The inclusion of generic terms devoid of scientific significance**: Another recurrent issue is the incorporation of commonplace words that lack specific scientific relevance. Terms such as “problems,” “aspects,” or “causes” can render a title vague and insufficiently connected to a particular research domain. According to Hartley [2], a scientific title should employ precise and field-specific language that accurately encapsulates the principal focus of the study.
3. **Exclusion of the essential chemical or methodological component**: A further oversight lies in the absence of a precisely articulated chemical or methodological element, which is indispensable for comprehending the fundamental nature of the research. In the discipline of chemistry, it is imperative that the title reflects the specific substance or

technique employed; failure to do so may undermine both the significance and clarity of the study. This represents a frequent error when the title does not clearly delineate the focus of the inquiry, as emphasized by [12].

4. **Excessive length**: Overly long titles can become tedious and lose the reader's focus. Including too many words often dilutes the core message and makes it harder for readers to quickly grasp the article's content. As Fiszman et al. [13] point out, shorter and clearer titles are more likely to attract readers and be retrieved by search engines and databases.

3. The Purpose of a Scientific Abstract

The abstract is a brief summary that provides a quick and clear overview of the full scientific article. It should contain key information that helps the reader immediately understand what was studied, what methodology was used, and what results were obtained. The abstract functions, in essence, as a kind of "advertisement" for the article, as it is often the first part that readers encounter when deciding whether to engage further with the full text. According to Day and Gastel [1], the abstract plays a crucial role in attracting readers and is often the first section viewed by indexers and information seekers in scientific databases such as Scopus and PubMed. In this context, the abstract should be clear, concise, and comprehensive, presenting the objectives of the study, the methodology applied, the main results, and the conclusions. As Taylor [14] notes, a well-crafted abstract is designed to capture attention and provide enough information to form a complete picture of the scientific work without requiring the reader to consult the entire article to grasp its essence.

3.1. Structuring a High-Quality Abstract: A high-quality abstract should be clearly structured and well-organized in order to provide a complete and accurate overview of the scientific article. According to Johnson et al. [15], a typical abstract includes four key components that help create an effective and understandable summary of the scientific work:

1. **Brief Introduction (Study Context)**: This section should present the background and significance of the study, offering enough information to explain why the research is important. As Williams [16] emphasizes, this part should be concise and focused on the topic being studied, avoiding excessive detail.
2. **Clear Objective**: The objective must be stated directly and simply to explain the purpose of the study. Brown et al. [17] highlight the importance of clearly expressing the research aim, as this helps the reader understand what was investigated and what the study intended to achieve.
3. **Methods Used**: This segment should describe the techniques and methodology applied in the study, providing the reader with a general idea of the experimental or analytical approach used.
4. **Key Results and Conclusions**: This part is essential, as it summarizes the main findings and outcomes of the research. According to Green [18], presenting the significant results and conclusions helps produce a clear and concise abstract that can capture the reader's interest and motivate them to read the full article.

3.2. The Use of Verb Tense in Abstracts: The appropriate use of verb tense is a key aspect of structuring a clear and accurate scientific abstract. According to Smith [19], selecting the correct tense helps convey information effectively and enhances the readability of the abstract. To reflect the sequence of scientific activities, it is important to use verb tenses that correspond to the stage of the study being described:

1. **For the study's purpose and objectives**: The present tense is most appropriate for describing the aims of the paper, as these remain valid and relevant throughout the

research process. Jones and Taylor [20] argue that the use of the present tense emphasizes the general and ongoing relevance of the study's objectives.

2. **For methodology and results**: When describing the methods and findings of the research, the past tense is more suitable because these elements have already been completed and documented. Brown [21] notes that using the past tense clearly indicates that the research has been conducted and supports a logical flow of information.
3. **For conclusions**: The present tense or passive voice is commonly used to present the main conclusions, as they often describe generalizable knowledge that remains applicable. Smith and Johnson [22] highlight the importance of using the present tense to convey general findings that are still valid and relevant for future application.

3.3. Avoiding Unnecessary Details in the Abstract: A scientific abstract should be clear and direct, avoiding the inclusion of unnecessary information that may confuse the reader and make it longer than necessary. According to Taylor and Green [23], eliminating non-essential elements is critical to maintaining clarity and ensuring that the abstract contains only essential information. Some of the details that should be avoided include:

1. **Including references**: The abstract should serve as a summary of the study and should not contain citations of existing literature. The use of references can distract the reader and make the abstract overly complex [24].
2. **Unexplained acronyms**: Acronyms should be used cautiously. When included, they must be defined immediately after their first appearance. Without proper explanation, acronyms may create confusion and hinder comprehension [25].
3. **Excessive numerical data or detailed results**: Detailed numbers and in-depth results should be avoided, as the abstract is meant to provide a brief summary, not a comprehensive analysis. Such details should only be included if absolutely necessary to illustrate the main findings of the study [26].
4. **Tables or figures**: The use of tables and figures in abstracts is inappropriate, as they take up additional space and are not necessary to convey the main information in a concise and clear manner [27].

3.4. The Benefits of a Well-Written Abstract: A properly and professionally written abstract provides numerous benefits, both for authors and for readers and editors. According to Miller and Davis [28], a strong abstract increases the visibility of the article and improves its chances of being accepted for publication in prominent scientific journals. The main benefits of a well-crafted abstract include:

1. **Increases the likelihood of article acceptance**: The abstract is one of the first elements that editors and reviewers evaluate during the article review process. A well-written and succinct abstract can enhance the likelihood of an article being accepted by a scientific journal [29].
2. **Facilitates prompt decision-making for readers**: The abstract serves as an essential tool for readers to evaluate the relevance and utility of an article for their research endeavors. Taylor [30] emphasizes that a meticulously crafted abstract enables readers to swiftly ascertain whether to delve into the full article, thus conserving time and improving the overall efficiency of the research process.
3. **Contributes to the indexing and categorization of the article**: The abstract is equally vital for the indexing procedures within scientific databases. A well-structured abstract, complemented by appropriate keywords, can significantly enhance the article's visibility and classification on platforms such as Scopus, PubMed, and Web of Science [31].

4. The Purpose of Keywords

Keywords assume a critical role in scientific literature, serving to facilitate the identification and classification of scholarly works within academic search systems. Miller and Clark [32] assert that keywords are instrumental in augmenting the visibility and accessibility of academic research. The essential functions of keywords encompass:

1. **Automatic indexing**: Keywords are vital for the automated indexing of articles in scientific databases and search engines. They enable articles to be included in pertinent topic searches, thereby enhancing the likelihood of discovery by readers. As Taylor et al. [33] observe, meticulous keyword selection can markedly improve search outcomes.
2. **Content description**: Keywords additionally function to encapsulate the article's subject matter and content. They are indispensable for authors striving to convey relevant information to readers and researchers with specific scholarly interests [34].
3. **Enhancing visibility in databases and Google Scholar**: Keywords significantly elevate an article's visibility across academic platforms such as Scopus, PubMed, and Google Scholar. Brown and White [35] emphasize that the judicious selection of keywords can facilitate more accessible discovery and enhance an article's ranking in search results.

4.1. Selecting Appropriate Keywords: Choosing the right keywords is crucial when preparing a scientific article. Keywords greatly improve the article's visibility and enhance its discoverability in scientific databases. As noted by Harris et al. [36], careful keyword selection has a direct impact on how easily the article can be found and accessed by its intended audience. To select effective keywords:

1. **Use 4 to 7 keywords**: It is recommended to select between four and seven keywords. This number effectively captures the article's main topics without overwhelming it with irrelevant terms [37].
2. **Avoid overly broad terms**: General keywords like "chemistry" or "science" are too vague and do not specifically identify the article. Using such terms can lead to the article being lost among unrelated content [38].
3. **Include specific technical terms, chemical processes, or study subjects**: Using keywords that specify particular techniques and processes—such as "trihalomethanes," "UV-Vis spectrophotometry," and "chromatographic analysis"—is especially beneficial for making the article discoverable to researchers interested in those specific areas [39].

5. Challenges in Selecting the Title, Abstract, and Keywords

Choosing the title, abstract, and keywords for a scientific article is a vital task that requires a careful balance between clarity and technical precision. The challenges involved are considerable:

1. First, it is crucial to maintain clarity while steering clear of overly simplistic language. The key is to strike the right balance between using technical terminology and ensuring the content is understandable to a wider audience. Excessive use of specialized terms can cause confusion, whereas oversimplifying may detract from the research's depth and detail [40].
2. Second, it is important to select keywords that provide a mix of generality and specificity to improve discoverability. Keywords that are too broad, such as "chemistry," or too narrow, like "carboxyl radical reactions," can limit the article's visibility. The ideal keywords should accurately represent the subject while being searchable for researchers across various related disciplines [39].

3. Finally, it is essential to tailor the title to meet the specific requirements of the target journal. Each scientific journal has its own formatting rules, including word count limitations, preferred phrasing, and keyword requirements. Following these guidelines adds another layer of complexity that requires careful thought [33].

6. Benefits for the Author and the Reader

Choosing an appropriate title, abstract, and keywords offers significant advantages for both the author and the reader. Here are some key benefits:

1. **Improved visibility of the work**: The title and abstract are the first elements encountered by readers and reviewers. A clear and compelling title, paired with a precise abstract, can enhance the visibility of the paper and draw in a larger audience. This increased visibility is crucial for maximizing the scientific impact of the work and ensuring it connects with readers interested in the topic [36].
2. **Greater citation potential**: Articles with well-crafted titles and abstracts are more likely to be cited by other researchers. This is vital for raising the scholarly visibility of the research and facilitating its wider dissemination within the academic community. Relevant keywords also boost the likelihood of the article being discovered in searches and cited in other works [39].
3. **Strengthened academic profile for the author in research networks**: The title and abstract play a role in enhancing the author's visibility on academic platforms like ORCID, ResearchGate, and Google Scholar. A well-read and prominent article can bolster the author's academic profile and create opportunities for future collaborations and research initiatives [38].

7. Conclusions and Recommendations

Based on the preceding discussion, the following conclusions and recommendations can be articulated:

1. Meticulous attention to the title, abstract, and keywords is paramount for the success of any scientific publication. These elements transcend mere preliminary steps in the writing process; they are integral to the overall efficacy of the publication. They facilitate the article's connection with the appropriate audience and enhance its scientific impact. Consequently, authors should approach these components with due diligence.
2. It is prudent for authors to meticulously examine the submission guidelines of the target journal, as the requirements for titles, abstracts, and keywords can vary considerably among journals. Engaging with scientific thesauri and keyword databases can aid in the selection of terms that are both appropriate and widely recognized within the scientific community. Furthermore, scrutinizing models of previously published articles can provide invaluable insights for the development of these critical components.
3. By concentrating on titles, abstracts, and keywords, authors can significantly augment the impact and quality of scientific communication. This meticulous attention to detail in the publication process enables research to reach a wider audience and to contribute more effectively to the advancement of scientific disciplines [41], [42].

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