ARTICLE

A Manual for Crafting and Composing an Article in Mathematics Education

Guia Prático para Estruturação e Redação de Artigos em Educação Matemática

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Abstract

This work is a guide for researchers in the area of mathematics education and aims to contribute to good writing and structuring of journal articles for publication in journals, since authors who construct a persuasive and convincing argument are more likely to influence the readers and gain acceptance within the research community. To address the research question – How to write a good article in mathematics education? –, a non-systematic literature review was conducted, analyzing texts from seven journals that are among the top ten international mathematics education journals. The results offer guidance on writing the main sections of a typical paper – title, abstract, introduction, literature review, theoretical framework, methodology, results, discussions and conclusion – as well as guidance on structuring the article as a whole.

Keywords: Mathematics Education. Publication. Good Writing. Scientific Writing. Quality of an Article.

Resumo

Este artigo tem por objetivo ser um guia para pesquisadores na área de educação matemática, colaborando para uma boa redação e estruturação de artigos para publicação em revistas especializadas, pois autores que constroem um argumento persuasivo e convincente têm maior probabilidade de influenciar o público e de obter aceitação dentro da comunidade de pesquisadores. Para abordar a questão de pesquisa – Como redigir um artigo em educação matemática? –, uma revisão não sistemática da literatura foi conduzida, analisando textos de sete revistas que estão entre as dez melhores revistas internacionais de educação matemática. Os resultados oferecem orientações sobre a redação das principais seções de um artigo típico-ideal – título, resumo, introdução, revisão da literatura, estrutura teórica, metodologia, resultados, discussão e conclusão – bem como a estruturação do artigo como um todo.

Palavras-chave: Educação Matemática. Publicação. Boa Escrita. Escrita Científica. Artigo de Qualidade.

1 Prologue

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In a world increasingly driven by science and technology, the ability to communicate complex ideas clearly and effectively is of utmost importance. Scientific writing or academic writing is an essential skill for researchers. However, even the most experienced can face challenges in this form of writing.

Scientific writing in mathematics education relies on elements such as precision, clarity, and rigor, which are essential for effectively communicating complex ideas[1]. These characteristics are what Presmeg and Kilpatrick (2019, p. 354) called "rationality and lucidity of writing," which involve the presentation of evidence reliably and logically, leading to the validity and objectivity of conclusions. These elements are achieved through structuring the text, precise language, and adherence to established conventions. Clarity allows readers to easily understand concepts, while a well-defined structure guides the logical flow of arguments. Precision in word choice minimizes ambiguities and ensures the correct transmission of meaning. Rigor is maintained through the appropriate use of evidence and citations, contextualizing new findings within scientific discourse.

This article is dedicated to scientists, students, teachers and science enthusiasts who are looking to improve their scientific writing skills. We will explore the characteristics of good scientific writing with practical tips. The ultimate goal is to contribute to the writing of a good article, establishing, from the beginning, the relevance of the topic and getting readers interested in reading it.

A good academic article is composed of several facets that involve the desires of various constituents, such as the participants, academia, society, the target audience and, of course, the researcher. In order to increase the chances of an article being accepted, an important item can be added: the quality of the writing of the scientific text.

There are several ways to disseminate the results of research carried out, such as participation in events in the area and publication in the event proceedings, the production of a book chapter (or a book), a monograph (at the end of an undergraduate, master's degree or doctorate course), among other ways[2]. The principles addressed here apply to all these forms of scientific dissemination, but we will refer to the article, given that this option can be one of

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[1] It is important to highlight that the concepts of precision, clarity and rigor can vary significantly depending on the area of research. For example, in the natural or exact sciences, methodological and experimental rigor have distinct particularities compared to the rigor requirements in research in the area of education.

[2] Other ways of disseminating scientific results are through digital media, which can include the use of social networks and the production of videos (Cosmo; Sena; Muriel-Torrado, 2021). Addressing aspects related to these forms of scientific dissemination is not the focus of this article.

the most challenging for presenting results to the public due to the rigor of peer review and the limitation of the text length (number of pages, number of words or characters).

A worrying factor in the academic context is the increase in article retractions[3]. In 2023 the Journal *Nature* reported an annual record of over 10,000 retractions (Van Noorden, 2023). One reason for such retractions is the production of fake articles[4] that contrast with the quality of a good article, which includes integrity, methodological rigor, peer review, and genuine contribution.

In 2015, the *International Journal of Science and Mathematics Education* (IJSME) rejected more than 80% of the more than 1,000 submissions made in the mathematics education area (Liljedahl, 2019). There are several reasons for a manuscript to be rejected[5], but Liljedahl (2019) highlights that one of the three main reasons is inadequate writing. Such rejections highlight the importance of in-depth reflection on the quality of the writing of the texts produced.

Hiebert *et al.* (2023) mentioned that reviewers of scientific journals demonstrate genuine concern regarding the quality of the articles received, as well as the strict logical alignment in which all parts are tied together. Failure to make clear connections may be related not only to the planning or implementation of the study but also to the writing of the research article. These same authors emphasize that "writing the research report requires making all connections explicit" (Hiebert et al., 2023, p. 103), as this contributes to reducing questions about the study's contribution to the field and the author's success in answering the research question.

Nivens and Otten (2017, p. 358) emphasize that journals that publish articles need to "educate authors" to "write high-quality texts", showing what would be appropriate for the journal. Following this direction, journal editors have offered sections at conferences[6] to assist

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[3] Retraction is the formal removal of published articles due to serious flaws or incorrect data, to preserve the integrity of the scientific literature. This process is considered a serious and last resort for dealing with misconduct, ensuring that retracted publications are properly identified and monitored to prevent the spread of invalid information. Retraction is distinct from a subsequent correction, made through an *erratum* or *corrigendum*, in which a note is attached to the original article explaining the changes and corrections needed (see Wagner, 2013 for more information on this).

[4] A fake article contains misleading or fraudulent information, often generated by automatic writing software. They may be accepted by seemingly reputable journals, raising concerns about the prevalence of fake research results.

[5] A manuscript refers to a written text that has not yet been published – one that has not yet undergone the peer review process. An article refers to a text that has already been reviewed by reviewers and has already been published in a journal or as a book chapter.

[6] For example, the JRME (*Journal for Research of Mathematics Education*) has held a series of webinars, some of which have addressed the topic of scientific writing and publishing. As an example, see https://www.nctm.org/online-learning e https://www.nctm.org/webinars/jrme/ (accessed on 28 Nov. 23).

authors in preparing manuscripts, aiming to increase the quality of submitted texts and contribute to a lower rejection rate.

To contribute to this task, since good writing helps to "make one's own thinking more explicit and drive it forward" (Hiebert *et al*., 2023, p. vii), the central question addressed in this study is: how to write a good article in mathematics education? To answer this question, we will examine seven of the main scientific journals in this field and conduct a non-systematic review[7] of the literature.

Although writing a text of structural and coherent quality can be a challenge, the good news is that this can be facilitated by employing some guidelines. According to the guidelines provided by the examined journals, to produce a high-quality article, an author must follow essential sections of the article: title and abstract, introduction, literature review, theoretical framework, methodology, results, discussion, and conclusion. These sections make up what Niss (2019) called the ideal-typical article, which characterizes a quality article in prestigious journals. The ideal-typical article is usually a small-scale, qualitative, empirical case study, sometimes accompanied by quantitative research related to items, types of students, classrooms, groupings, and correlations between categories. This approach is conducted within the confines of the specific cases involved in the study. Niss (2019) argues that reviewers tend to adhere significantly to the model represented by the ideal-typical article, expressing explicit criticism of articles that deviate from this pattern.

The results presented in this study can be applied in the mathematics education area but may also contribute to other areas of the social sciences. As explained at the beginning of this section, the focus is to offer valuable guidance, mainly for authors, editors, and reviewers interested in achieving excellence in the production and review of scientific articles, aiming to contribute to the high quality of published research. Collaborating to improve the writing of a scientific article will also impact the quality of research projects and funding proposals, as well as the preparation of more concise documents, such as conference papers (Liljedahl, 2019).

1.1 Is there an ideal structure for a scientific article?

There is no ideal structure for writing a scientific article. It can be constructed in

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[7] A non-systematic review approaches and critically analyzes a topic more flexibly, without following the methodological rigor typical of systematic reviews. This format allows greater freedom in the choice of studies included and favors detailed qualitative analysis. It is especially useful when the researchers' goal is to produce a comprehensive and in-depth synthesis of the available literature (Cook, 2008).

different ways, and this flexibility allows for a wide range of approaches. While Ascher and D'Ambrosio (1994) presented mathematics through a dialogue, approaching it as something beyond simple problem-solving – which contrasted with the prevailing perception among high school students, who saw it mainly as manipulation of numbers and formulas – Thanheiser's article (2023) explores different conceptions of mathematics and its implications for education. In this article, we have three distinct perspectives to understand it: (1) as an abstract body of knowledge, (2) as a contextual and ever-present phenomenon, and (3) as an intrinsically human activity.

When discussing what a typical/ideal article looks like, Niss (2019, p. 7) identified a worrying tendency to think of only one possible way to publish a quality article in renowned journals. He concluded that it is necessary to keep "open waters" – or an open mind – and to continue discussing the nature of the mathematics education field in academic publications, without allowing rigid paradigms to limit the quality and diversity of these discussions. Bakker's (2019) article is an example of this, as it does not fit into the ideal-typical format.

In response to Niss's (2019) arguments, Bakker (2019) highlights the importance of reflecting and discussing what is considered acceptable and valuable for publication. Demonstrating an open stance, he expresses his willingness to accept submissions that adopt non-typical formats, to foster a broad discussion in the field of mathematics education and keep it "alive" (p. 44).

Although the ideal/typical research article is not the only one found in journals, according to Niss (2019), it gives the impression that mathematics education research is much more monolithic in its requirements than it really is. This trend is worrying for two main reasons: more and more institutions and agencies only consider publications in journals, which forces researchers to follow rigid standards; and second, research that deviates from these standards runs the risk of disappearing, threatening the field's ability to develop and renew itself (Niss, 2019).

Although choosing to write an article in the ideal-typical format offers a certain level of security, as it is a traditional model widely accepted by academic journals, it is essential that authors, when communicating the results of their research, consider the existence of other writing and structure possibilities that also allow for effective and creative communication of the findings, while maintaining the quality of the work presented.

2 Contextualizing: The Theorists that Support this Guide

The acceptability of a manuscript cannot be reduced to a checklist since the text includes the researcher's intrinsic peculiarities, both in his/her way of conducting the research and in expressing it in words. Thus, the results of the study presented here aim to present the essential elements of a manuscript and suggest how they can be elaborated.

To answer the guiding question of this study, *how to write a good article in mathematics education*?, it is assumed that quality research has already been done. It is worth noting that although the focus of the answer to the research question is the production of empirical articles[8], articles, the production of a theoretical article[9] can benefit, given that both sections are similar.

A study was conducted on the classification of journals in mathematics education, as shown in Table 1 below:

Authors	Classification method
(TÖRNER; ARZARELLO, 2012)	They invited experts to grade the quality of journals in the field, covering four dimensions: recognition and quality standards, peer review process, editors, editorial board, and citations.
(WILLIAMS; LEATHAM, 2017)	They interviewed some researchers who addressed points they considered relevant to the quality of a journal. In addition, they conducted a study based on citations.
(NIVENS; OTTEN, 2017)	Impact metrics that evaluate the performance of journals in different aspects were described, and 34 mathematics education journals were compared using these metrics.

Table 1 – Studies on the classification of the main journals in mathematics education
Source: prepared by the author (2024)

It is important to highlight that the study by Nivens and Otten (2017) did not produce a final classification of journals, limiting itself to a comparison based on impact metrics. On the other hand, the work of Williams and Leatham (2017), as it is the most recent classification and makes reference to the other two studies cited in Table 1, was adopted as the basis for the results presented. Yet, in both previous studies, the ten journals listed below are among the top 12. The top ten journals in such rankings were: *Journal for Research in Mathematics Education (JRME); Educational Studies in Mathematics (EMS); Central Bulletin for Mathematics Education – ZDM Mathematics Education (ZDM); The Journal of Mathematical Behavior (JMB); For the Learning of Mathematics (FLM); International Journal of Science and Mathematics Education (IJSME); Journal of Mathematics Teacher Education (JMTE);*

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[8] Empirical articles are the result of field research and require practical proof, whether through experiments or observation of a specific context to collect data in the field. Empirical research serves to anchor what is presented conceptually in the realm of experience. In other words, empirical observation and experimentation provide data to prove or even challenge the theory.

[9] Theoretical articles in mathematics education are academic documents that discuss and validate theories without relying on empirical data. They explore concepts, ideas and contemporary issues in mathematics teaching, using logical and theoretical arguments instead of empirically collected evidence. These articles address topics such as teaching at different levels, the use of digital technologies, teacher training and methodological strategies, contributing to the theoretical development of the subject.

Research in Mathematics Education (RME); Mathematical Thinking and Learning (MTL); Journal of Mathematics Education Research (MERJ).

It is worth noting that Williams and Leatham (2017) regret that some of these classifications take geographical aspects into account. It is pertinent to mention that these classifications do not include Ibero-American magazines. Only in the article by Nivens and Otten (2017), the journal BOLEMA (Bulletin of Mathematical Education) – the only Latin American journal in the field of mathematics education that is among the ten most prolific in the world (Julius *et al.,* 2021) – appears in two different rankings, as does the journal RELIME (Latin American Journal of Educational Mathematics), while the journal REVEMAT (Electronic Journal of Mathematical Education) appears in only one ranking. Therefore, Andrade-Molina, Montecino, and Aguillar (2020) sensibly challenged how classifications like these are structured.

Despite this important discussion, about how the rankings are structured and which journals appear or not in these rankings, this will not result in any detriment to the study presented here. The focus will be on the texts produced by the ten best magazines according to the classification already mentioned.

After selecting the ten best journals in mathematics education for the production of a well-written text, a survey was conducted on the websites of these journals. Descriptors such as *scientific writing, quality writing, scientific writing,* and *quality articles* were used. A total of 22 texts were used to answer the question of how to write a good article in the area of mathematics education. Texts produced by the journals JRME, IJSME, FLM, ESM, ZDM, JMTE, and MTL[10], MTL were used, as shown in Table 2, in which we summarize the main works developed for the production of a good text.

Journal	Aspect in focus	Title	Authors/References
JRME	Research question; theoretical framework and literature review (brief); methodology; quality (logical sequence)	Journal for Research in Mathematics Education: Practical Guides for Promoting and Disseminating Significant Research in Mathematics Education	(Cai; Hwang; Robison, 2019)
JRME	Brief aspects of the research question; results, discussion, and data interpretation	So What? Justifying Conclusions and Interpretations of Data	(Cai *et al.*, 2019a)
JRME	Research methodology	Choosing and justifying robust methods for educational research	(Cai *et al.*, 2019b)
JRME	Research question	Posing significant research questions	(Cai *et al.*, 2019c)

[10] It is important to highlight that, among the ten best journals in the area, seven appeared naturally in the data analysis. This is because the other three did not present productions or texts related to the aspect of preparing a quality scientific text in the area of mathematics education.

	Formulation		
JRME	Theoretical aspects	Theoretical framing as justifying	(Cai *et al.*, 2019d)
JRME	Brief explanation of the theoretical framework	How Manuscripts Can Contribute to Research on Mathematics Education: An Expansive Look at Basic Research in Our Field	(Herbst *et al.*, 2022)
IJSME	Title and abstract; Introduction; Research question; Literature review; Methodology; Results; Discussion and conclusion	The International Journal of Science and Mathematics Education: A Beginner's Guide to Writing for Publication	(Liljedahl, 2019)
IJSME	Research question; Theoretical Framework	Communicating the Significance of Research Questions: Insights from Peer Review at a Flagship Journal	(Cai *et al.*, 2020)
IJSME	Research question; Theoretical Framework; quality (coherence); results (brief)	Posing Researchable Questions in Mathematics and Science Education: Purposefully Questioning the Questions for Investigation	(Cai; Mamlok-Naaman, 2020)
IJSME	Research question	Posing Fundable Questions in Mathematics and Science Education	(King *et al.*, 2020)
IJSME	Research question	On Meaningful, Researchable, and Generative Questions	(Schoenfeld, 2020)
IJSME	Research question	Posing New Researchable Questions as a Dynamic Process in Educational Research	(Stylianides; Stylianides, 2020)
FLM	Brief explanation of introduction; Research question; Literature review; Methodology; Results; discussion and Conclusion	The very multi-faceted nature of mathematics education research	(Niss, 2019)
FLM	Quality (writing)	What is worth publishing? A response to Niss	(Bakker, 2019)
FLM	Theoretical framework; methodology (brief); quality (coherence)	Constructing and employing theoretical frameworks in (mathematics) education research	(Cai; Hwang, 2019)
FLM	Introduction (brief); quality (genres of scientific writing)	For the Learning of Mathematics: An Introduction to the Journal and the Writing Within It	(Barwell; Reid, 2019)
ESM	Introduction (brief); quality (genres of scientific writing)	Supporting English non-dominant language authors' efforts to publish: perspectives from the editors-in-chief of highly recognized journals in Mathematics Education	(Geiger; Delzoppo; Straesser, 2022)
ESM	Quality (originality)	Why to publish on mathematics education to be useful? Educational Studies in Mathematics and its founder Hans Freudenthal	(Beckers, 2019)
ESM	Briefly about: introduction, aspects of the research question, literature review, methodology, discussion and quality (adequate writing)	Educational Studies in Mathematics: Shaping the Field	(Goos, 2019)

ZDM	Literature review; theoretical framework; methodology; introduction (brief), research question and results	ZDM Mathematics Education—Its Development and Characteristics	(Kaiser, 2019)
MTE	Theoretical framework; results and brief aspects of the research question	Publishing in the Journal of Mathematics Teacher Education	(Potari, 2019)
MTL	Title and abstract; literature review; methodology; discussion and aspects of the research question (brief)	Towards Article Acceptance: Avoiding Common Pitfalls in Submissions to Mathematical Thinking and Learning	(English, 2019)

Table 2 – List of texts chosen for review
Source: prepared by the authors (2024)

Among the texts analyzed, seven were chapters of the book "Compendium for Early Career Researchers in Mathematics Education", whose editors are Gabriele Kaiser and Norma Presmeg, and belongs to the series "ICME-13 Monographs", published in 2019 by Springer.

3 Guide to Structuring and Writing an Article

3.1 The First Section: Introduction

Niss (2019) explains that the introductory section does not necessarily need to be called *Introduction*. For this author, this initial section should contain the theme, justification, and background of the study, as well as a brief review of the basic literature to situate what will be done in the current research scenario.

Thus, we can say that the introduction is commonly reserved for presenting the original contribution of the research. To do this, it is essential to follow some steps: start with an engaging introduction that highlights the relevance of the topic, provide context on existing research, call attention to the originality of the approach, specify the research problem, and give an overview of the structure of the article. An effective introduction not only contextualizes the research but also *sells* it to the editor, reviewer, and reader, incorporating known and unknown elements, hypotheses, and/or research questions and methods used in the study.

The author needs to outline what was investigated and the purpose of the research, and highlight the uniqueness and relevance of the study, situating it in the context of the existing literature. To capture the reader's attention, the author(s) must present the phenomenon of

interest and explain why this phenomenon is interesting and important to the reader (Liljedahl, 2019). To expose the phenomenon, the author can point to it in recent literature based on data or an experience – whether personal or shared. In short, it is suggested that the author present the theme in the introduction in a more general and accessible way and then present the research question.

When reducing the phenomenon to be studied to a research question, Liljedahl (2019) suggests using less technical language. According to guidelines from Barwell and Reid (2019) and Niss (2019), from the FLM journal, and Kaiser (2019), from the ZDM, the research objective or research question should appear in the introduction as a guide to the ideas that will be presented.

According to Liljedahl (2019), many manuscripts are rejected by IJSME reviewers and editors because they present an uninteresting or redundant topic and do not contribute considerably to the improvement of knowledge in the area. However, although a topic of interest is important, this alone does not guarantee the acceptance of a manuscript.

3.2 The Second Section: Literature Review and Theoretical Framework

In the literature review and theoretical framework, authors should clarify and present the positioning of their study within existing research in that field of research to highlight the relevance of the work being developed. This section may include both the review of theoretical concepts and previous empirical studies, both of which are fundamental to the study presented (Cai; Hwang; Robison, 2019). To provide a solid foundation for the study presented in the manuscript, Cai, Hwang, and Robison (2019 from JRME emphasize that it is essential to include relevant works that support and support the investigation, both in mathematics education and in research that supports the study, even if outside the field of mathematics education.

3.2.1 Literature Review

For Liljedahl (2019), from IJSME, the most appropriate approach would be to consider the literature review as the space to delimit the phenomenon of interest until reaching the research question. In this sense, the literature review is not a random exploration of the literature – or a listing of existing studies (Cai; Hwang; Robison, 2019) – but rather a structured orientation that directs the reader's attention and interest to the research question.

Liljedahl (2019) proposes an analogy between a literature review and a city tour: the first type of city tour is a simple observation of the main landmarks, while the second is a careful selection that highlights the historical and cultural relevance of the points chosen to highlight what makes the city unique. Many literature reviews resemble the first type of tour, being uninteresting and uninformative, especially for a visitor who already knows the city well and has visited these landmarks countless times. In many cases, readers of the articles are already familiar with much of the cited research and do not need to be introduced to it again. According to English (2019), it is crucial to observe how this literature is being positioned to reveal gaps or unexplored areas that current research seeks to address, clarify, or that require further attention.

Other relevant aspects should be considered when conducting a literature review. One of them, reported by ESM (Geiger; Delzoppo; Straesser, 2022), is to pay attention to a broader international scope when conducting the literature review. This aspect refers especially to authors whose English is not their first language. In addition, English (2019), from MTL, highlights that article submission is expected to be self-contained, not depending on readers to seek information from other author's publications.

3.2.2 Theoretical Framework

The definition of theoretical structure – or theoretical framework – is not a consensus among different authors, so we decided to adopt Niss's (2019) definition that a theoretical framework is an organized structure of concepts (such as ideas, notions, distinctions, terms, etc.) and statements about a specific class of domains, situations, or phenomena. Theoretical structures, as described by Niss (2019), appear to serve at least six distinct, although not necessarily opposing, purposes: to explain observed phenomena, to anticipate the occurrence of events, to guide actions or behaviors, to offer an organized view to examine the world, to protect against unscientific approaches, and to serve as a defense against criticism from skeptical colleagues in other areas.

Theoretical frameworks are essential for synthesizing, reorganizing, and providing insights from large research bodies (Cai; Hwang, 2019) and can come together with/after the literature review or even within the methodology section (Herbst *et al.,* 2022). According to Cai et al. (2019d), a strong theoretical framework is an indispensable part of a scientific manuscript and needs to be developed as an essential part of the design and execution of the research.

It is in the theoretical framework that the author will direct the main arguments to

support the expected answers to the research questions (or hypotheses), focusing on the most recent version of these arguments and integrating the findings of the literature review. In addition, in this section, the author needs to present to the reader the technical vocabulary and terminology that will be used in the research and the manuscript (Cai; Hwang, 2019; Liljedahl, 2019; King *et al.,* 2020).

It is worth noting that Kaiser (2019), from ZDM, emphasizes that the theoretical framework does not need to be a structure developed by the study authors. Nowadays, it is common to refer to major theories of mathematics education developed by other authors. These theories are used to support the study or as tools to evaluate the results obtained in the research in progress.

The theoretical basis is essential to demonstrate the relevance of the study carried out in the national and international context since a solid theoretical framework enables readers to apply the study results within their own context (Goos, 2019). It is essential to develop all theoretical constructs carefully and incorporate them into the overall framework.

To a certain extent, it is important to focus the literature review on the research question and avoid an overly broad view of the field only vaguely linked to the research questions and the objectives of the article. The balance between breadth and focus is important (Kaiser, 2019).

In the journals JRME and FLM, Cai, Hwang, and Robison (2019), and Cai and Hwang (2019), respectively, advise authors to make it clear to the reader how the theoretical framework influenced decisions about the design and conduct of the study. In this sense, Cai and Hwang (2019), from FLM, Cai, Hwang and Robison (2019), from JRME, Liljedahl (2019), from IJSME, and English (2019), from MTL, emphasize that, in manuscripts that present empirical results, it is vital that the literature review also introduces the theoretical framework that will be used in the study design, conduction, data collection, data analysis and interpretation of results, allowing the research questions to be answered by the data obtained. Cai *et al*. (2019, p. 218), from JRME, made an opportune comparison when positioning the theoretical framework as "a connecting thread that ties together all of the parts of a research report into a coherent whole".

Rethinking your theoretical framework as a contribution to the field involves considering it a central component of scientific research, not just a mandatory step before the next phase (Cai *et al*., 2019d). This implies, for these same authors, developing their structure gradually as they progress. This process is a fundamental element of ongoing research work and will likely result in several drafts of your written document.

According to English (2019), theory directs the discussion of results and may reveal

modifications or extensions in the theoretical structure itself. In addition, Cai and Hwang (2019) see the theoretical framework as an intentional construction that dialogues with the study, being shaped and shaping it. These authors also emphasize that theoretical frameworks are not fixed; They maintain a dynamic relationship with the conduct and communication of research, evolving as the investigation and its results unfold. This view implies that researchers can adjust or expand their theoretical frameworks during the study and data analysis. This is because creating a revised framework, enriched by new discoveries and more solid hypotheses, is not something to be avoided in mathematics education studies reported in research journals, but rather something to be valued, as this adds a valuable contribution to the field (Cai; Hwang, 2019).

3.2.3 The Research Question

In the literature review, it is important to identify the main works and their contributions to the field. Then, as highlighted by English (2019), it is crucial to identify the existing gaps in the area under study and demonstrate how the research addresses these gaps to contribute to the field advancement. To do this, it is necessary to carry out a critical analysis of the literature to identify areas that are little explored and that require more attention, showing the need to address the gap presented.

For Liljedahl (2019), a well-designed research question should clearly indicate how the results will contribute to filling the gaps or clarifying aspects that are less explored in the research literature. This can be done in several ways, from applying existing theories in new contexts to analyzing a phenomenon from a new perspective. It is worth noting that if there is more than one research question, there should be several predictions and several foundations (Hiebert et al., 2023; King *et al*., 2020).

Some authors from IJSME (Cai *et al*., 2020; Cai; Mamlok-Naaman, 2020; Schoenfeld, 2020; Stylianides; Stylianides, 2020) and JRME (Cai *et al*., 2019a; Cai et al., 2019c) highlight the importance of building a study on researchable and meaningful questions, present some sources of good questions, and emphasize the necessary alignment of research questions with theory and methodology, in addition to guiding the argumentation in the results.

When writing a manuscript, a relevant question is: where in the text should the question that guides the research be placed? It is worth noting that the location of the question that guides the article is not unanimous among theorists. Kaiser (2019) recommends that a research question should be established at the beginning of the article and also be presented in the

abstract. Presenting the research question in the introduction guides the reader on the focus of the article, contextualizes the relevance of the topic, and facilitates the organization of the text (English, 2019). In this way, the reader is guided from the beginning on the development of the article, arousing their interest in understanding the proposed objective(s).

For Liljedahl (2019), the most appropriate place to introduce the research question is at the end of the literature review since the research question at the end of the review not only concludes the exploration by offering the last step to focus on the phenomenon of interest but also creates a natural transition to the methodology section. In contrast to including the research question in the introduction, if placed at the end of the review, the reader, at this point, already has the technical vocabulary and detailed understanding of the field to understand the formulation of the research question in all its complexity and subtlety. However, regardless of the location of the research question(s) (or hypotheses), they must be explicitly stated and supported by the theoretical framework. The question should be designed in such a way that the reader, when faced with it, quickly identifies the relevance of that manuscript for the research area.

3.3 The Third Section: Methodology

The methodology section used to be primarily intended to detail the processes that would enable replication of the research by other scholars, an aspect that is still relevant. However, this section now has an additional, albeit implicit, but crucial purpose: to help readers understand how the research findings were achieved within that specific research context (Liljedahl, 2019).

A good methodology section should be consistent with the entire article. In addition, some points for developing a good methodology section include detailing information about the demographic context of the research and the participants, describing the type of instructional materials used and the coding structure adopted, including examples of observation or interview instruments and protocols, detailing how problems and challenges were resolved during the research, carefully translating (if applicable) transcripts into interpretive methods, providing quality indicators into quantitative methods, validating the instrument, as well as its accuracy and reliability, using appropriate statistical techniques, and identifying potential threats to the validity of the data. English (2019) highlights that, in journals with space restrictions, it is challenging to give due attention to the aspects mentioned in this section, but the details mentioned are key elements in the methodology and should be included whenever relevant.

Different journals, such as IJSME, MTL, and JRME, emphasize the importance of the methodological section to interpret the data and the need to align the theoretical framework with the analysis. They also highlight the relevance of a careful choice of frameworks, avoiding overly complex structures concerning the depth of the analysis (Liljedahl, 2019). In addition, they emphasize the importance of the connection between the data collected and the hypotheses based on the theoretical framework to guide data collection and analysis (Cai *et al*., 2019b; English, 2019). Cai *et al*. (2019b), from JRME, noted that researchers often collect unsatisfactory data that do not corroborate the research objective and question, for example by neglecting methods such as triangulation. A common reason for resubmissions to JRME, ESM, and JMTE is the lack of clarity or incomplete descriptions of research methods. English (2019) and Kaiser (2019), from MTL and ZDM point out another common flaw: advocating a specific perspective (such as constructivism) but presenting a study that is not aligned with its main ideas, leading reviewers to question this discrepancy.

Another relevant aspect that should be addressed in the methodological section of an article refers to the ethical issues involved in the research. Liljedahl (2019) emphasizes that the rejection of a study in IJSME often results from unethical or disrespectful practices toward participants. JMTE also recognizes this problem as a growing challenge in submissions to the journal (Potari, 2019). Therefore, it is essential to conduct research ethically and to detail this process, including free and informed consent, the handling of the data obtained, the measures to protect this data, and the guarantees of integrity during its analysis.

3.4 The Fourth Section: Results

The *results or findings* section aims to present the data collected and interpreted in response to the initial research questions. This section includes empirical evidence, such as interview transcripts and dialogues, to support the results. This presentation must be clear and concise, separating the data collection process from the writing process, and maintaining a logic that facilitates understanding (Liljedahl, 2019). Graphs and tables can be used to organize and summarize the results effectively.

Goos (2019) highlights that, although the data of a study were collected in a specific context, it is necessary to contextualize the research questions and results so that they are relevant and understandable to the public outside of that context. In addition, Liljedahl (2019) emphasizes that the explanation of the results and analysis should be done in a way that allows the reader to understand the author's reasoning. Finally, for this same author, providing too few

or too many details can be problematic: a lack of details leaves the reader dependent on the author's interpretation, while too much detail can serve as a distraction from the final objective and hinder the review process.

Regarding graphs and tables, elements that serve primarily to organize and summarize results, authors should consider the reason and form in which they use them in their research (Liljedahl, 2019). When used to organize, they are used at the beginning of the section to present the results clearly and concisely, but their effectiveness is compromised if they are not well labeled or if the author narrates each entry in detail – it is plausible to discuss in depth the meaning of individual parts, but tables and graphs should speak for themselves (Cai; Hwang; Robison, 2019). To summarize information, tables, and graphs condense the results discussed and should be used to direct the reader to organizational aspects, without adding substantial content.

3.5 The Fifth Section: Discussion

For Goos (2019), the discussion section is extremely important to strengthen the contribution to knowledge, as it is in this section that the author relates his/her findings to the literature reviewed previously in the text. Although there is no rigid structure for the discussion section in a report, some structures seem more effective than others. It is recommended by Cai *et al*. (2019a) and by English (2019) to begin with a summary of the main results without introducing new data, followed by a detailed interpretation of these results, answering the question: *how do the results contribute to the advancement of the field?*[11].

Authors can achieve this by describing the conditions under which the results manifested themselves and proposing hypotheses about possible variations in different scenarios. This understanding of the conditions allows for predicting similarities and differences in the results in distinct educational contexts, directing subsequent studies more specifically.

In qualitative articles, the results and discussion are more intertwined than in quantitative studies. While quantitative results can be presented before the discussion, in qualitative studies it is difficult to separate the results from the analysis, so when structuring the presentation of the results, it is important to consider this interdependence between data and discussion (Liljedahl, 2019).

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[11] This question is one of the most common and fundamental and helps to build convincing arguments to show the relevance of the work.

The foundation relevance of a study involves connecting the theoretical framework, the research questions, and the selected research methods. Thus, the discussion must connect the results to the theoretical framework of the study, supporting or challenging it (English, 2019).

The interpretation of the results is considered a dynamic process that involves comparing the theoretically based predictions with the actual results. According to Liljedahl (2019), the explicit use of the theoretical or analytical framework in the analysis of the data is crucial to ensure transparency. Furthermore, Kaiser (2019) emphasizes that the lack of connection between a broad theoretical framework and the results can be partially attributed to the lack of in-depth interpretation of the data, so establishing this connection is essential for the relevance and applicability of the study in different contexts. For Schoenfeld (2020), the triangulation practice may be the best safeguard for connecting interpretations to research questions.

In summary, the discussion section should answer in detail the question: *how do the results contribute to the advancement of the field?,* interpret the data in depth, and examine how the research questions were addressed. The authors must contextualize the results, evaluating how they corroborate or challenge previously established theories. Furthermore, it is essential that the discussion establishes a clear connection between the results and the theoretical framework used, highlighting the study's contributions to the advancement of the field (Schoenfeld, 2020; Goos, 2019).

Finally, at the end of the discussion section, English (2019) suggests highlighting the implications of the findings for future research and applications in educational practice, including possible methodological improvements in the research area.

3.5.1 Unexpected Data: How to Deal with It

Unexpected findings are sometimes the most interesting conclusions of a study, and this is like a signal to pay more attention to the theoretical framework. This may mean deciding that the theoretical framework is still compelling and conjecturing why it was inadequate in a particular case, or deciding that the theoretical framework is flawed and revising it. In either case, the theoretical framework is not treated as an *a priori* constraint, but rather as an evolving structure (Cai; Hwang, 2019). These unexpected findings can be valuable, providing valuable insights and encouraging new questions in research (Cai; Mamlok-Naaman, 2020).

In case of encountering unexpected results, Cai *et al.* (2019a), suggest three ways to

approach them educationally for the reader: firstly, if researchers reevaluate the theoretical framework and consider it convincing, even with unexpected findings, it is instructive to summarize the initial framework, present the results and speculate why the framework was inadequate, proposing changes, as this can guide future research or a second study; a second path, if they recognize serious flaws in the theoretical framework in light of unexpected findings, is to rebuild it based on previous work, moving closer to the first path to offer a more robust framework; Finally, if researchers identify misalignments between methods and theoretical framework or research questions, they should correct these methodological problems and re-conduct the study. According to Cai *et al.* (2019a), these paths help to understand the phenomenon investigated and improve the research.

3.6 The Sixth Section: Conclusion

The interpretation and analysis of data in an article should subsequently lead to a coherent conclusion. Making a good conclusion and analysis of the data beforehand would avoid comments such as *there are many new ideas in the conclusion that are not addressed in the results or I think the article would benefit from a more coherent and specific explanation of exactly how the analysis was carried out at this stage*.

According to Liljedahl (2019), the conclusion serves four purposes: to answer the research question, to present other consequences, to review the highlighted literature and relate it to the results, and to comment on how the research contributes to understanding the phenomenon of interest, even if it does not clarify it completely.

The answer to the research question begins in the discussion of the results and is a crucial point. This is the way in which the author can demonstrate to the reader the relevance of the research. Each aspect discussed in the results should contribute to this answer or indicate other emerging results. It is essential to avoid having a single point of discussion that fully answers the research question, as this may question the adequacy of the question or the methodology.

The conclusion section, although not always present in mathematics education articles[12], is valued by English (2019) as a concise summary of the main results. The implications can be theoretical, practical, or methodological, but should be grounded in the study data (English,

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[12] Articles without a conclusion should not be accepted, as this reflects a lack of quality in the work. English (2019) points out that, in some cases, the *Conclusion* section may not exist separately, as the conclusive ideas and answers to the research questions appear in a final section, often titled *Discussion and Final Considerations* or something similar. However, it is clear that an article without a clear conclusion and that does not answer the proposed research question (or objective) is flawed (Cai *et al.*, 2019a; Liljedahl, 2019).

2019; Cai; Hwang; Robison, 2019). In the case of qualitative studies, English (2019) advises that the description of methodological limitations be made in the discussion section or the conclusion. It is recommended to offer suggestions to mitigate them, such as expanding the sample or conducting additional interviews to better understand the participants. If the authors choose to discuss the limitations of the study, they can highlight how their interpretations are directly affected by the study restrictions.

3.7 To Finish: Title and Abstract

The titles and abstracts of articles must be clear and concise and faithfully represent the content of the study, facilitating comprehension and electronic indexing. Excessively long titles can undermine interest in the article and confuse indexing mechanisms (English, 2019). Another relevant aspect is that the more detailed the title, the lower the potential interest. Examples of titles can be seen in articles from the FLM journal, where most publications present openings carefully crafted to attract the reader's interest. Both the titles and the initial paragraphs are developed meticulously to capture the public's attention.

According to Liljedahl (2019), the title played a different role before the advancement of technology with computers and the internet. Previously, a title needed to include all dimensions of the research, whereas today it can be more concise and focused on the object of study and how it was conceived. Interesting examples can be found in the article *The Elusive Slope* (Lingefjärd; Farahani, 2018) and in the article *Com a palavra, o professor de matemática e o interpretador de Libras* (Santos; Menezes, 2023).

It is important to emphasize that we cannot use any set of words to form a title. Liljedahl (2019) does not recommend, for example, that the location/country be included in the title – given that all research was carried out in a specific location –, except when the study covers an international comparison. Other aspects not recommended in a title are the age range of the participants and the instruments used for data collection.

The abstract of a work, such as a dissertation or thesis, can generally be written in a freer way than in a manuscript submitted to a scientific journal. These journals limit the number of words (or characters) allowed or establish a fixed structure the author must follow. It is worth mentioning that the JRME establishes one of the lowest limits for the word count in an abstract (120 words[13]) and also emphasizes that the abstract must "accurately capture the nature and

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[13] This stipulation can be seen on one of the magazine's online pages (available at https://www.nctm.org/writeforjrme/, accessed on December 20, 2023, in the *Preparing Manuscripts* section).

contribution of your manuscript".

Writing abstracts is not a trivial task, and it can take more time than initially estimated. In general, caution should be exercised when choosing words. That is because, depending on the journal, abstracts must contain, within the 100/250 words allowed, the purpose of the study, the methodology used, its main findings, and conclusions or implications.

Quoting the words of Olivia N. Saracho English (2019, p. 496), from MTL, when she states that "an abstract should provide a 'complete but concise description of the study' as well as incorporate keywords that can be used for indexing and databases". English (2019, p. 470) also warns that "a poorly written abstract creates a poor first impression that could set a negative tone for the remainder of the manuscript. Do not lose your audience in the first few words".

The abstract is read, if applicable, before reading the main text and, sometimes, instead of it. Liljedahl (2019), from IJSME, emphasizes that the reader is not yet familiar with the technical terminology carefully elaborated within the manuscript, so the abstract should be written using simple terms and ideas that can be easily understood. He also emphasizes that an abstract should not include references, as this not only presupposes specific knowledge but also creates a space where a reference is cited without an accompanying list of references. Examples of what should be avoided can be found in each journal.

A suggestion that can serve as a basis for writing an abstract was given by English (2019, p. 470): "clearly state 1-2 key findings, 1-2 central assertions about how/why the findings happened, and 1-2 conclusions or implications about what these findings mean for scholarship and practice."

However, depending on the type of research and specific guidelines of the journal, this structure may vary, for example including the suggestion of some initial sentences to contextualize and justify, in addition to some methodological aspects of the research that will be reported.

4 Summarizing Ideas and Final Words

Based on the information previously discussed in this text and the recommendations for quality articles presented by Kaiser (2019, p. 488), Goos (2019, p. 384, 387), and the analysis of the exemplary article by Cai, Hwang and Robison (2019), the following guiding questions were created:

• Does this article represent a significant contribution to mathematics education research, being distinct from other works by the author?

• Is the approach or argument original, providing new insights into relevant issues in mathematics education research?

• Does the article perform a comprehensive review of previous studies and incorporate relevant literature in the area, avoiding unnecessary self-references?

• Is the theoretical framework appropriate, ensuring alignment between the theoretical structure and the questions or problems addressed?

• Is the methodological approach appropriate, with research methods and analyses corresponding to the problem or issue under discussion?

• Are the arguments consistent, and are the claims and conclusions justified acceptably, following a logic derived from the data or other information presented?

The quality of the presentation is assessed based on the following criteria:

• Is the title appropriate and not too long, and is the abstract distinct and adequate?

• Is the writing coherent, clear, and well-organized?

• Does the quality of the figures and tables meet appropriate standards?

Of course, several other aspects that were not discussed in this article influence the writing of a scientific text and its publication in a quality journal: English (2019) and Goos (2019) show how to choose a quality journal suitable for publishing the research; Potari (2019) and Kaiser (2019) explain how the submission process works, from review to the decision stage, which can culminate in the intended acceptance; Goos (2019) from ESM addresses how to avoid plagiarism; Cai, Hwang, and Robison (2019) explain the peer review process; Crespo and Cai (2019) talk about communication with reviewers and show how to respond to questions raised. Furthermore, to increase the quality of a manuscript, journals suggest that the text be written with a logical and persuasive argument and that it pays attention to coherence, justification, and meaning, which are essential aspects in any text (Beckers, 2019; Cai; Hwang, 2019; Cai; Hwang; Robison, 2019; Goos, 2019; Kaiser, 2019).

Standardization in research articles provides organization and ease of evaluation. The concern, however, is that form may outweigh the importance of content, and standardization conventions may hinder progress in the discipline, inhibiting innovative ideas (Niss, 2019). For Niss (2019) and Bakker (2019), the notion of an ideal-typical article is what has commonly occurred and should not be a normative notion that should always be the case for a research report so that research in this field is not monolithic in its requirements. However, these researchers emphasize that it is possible to innovate beyond a prototypical understanding of what counts as research and publish non-typical articles, even in prestigious journals – as already explained by the FLM and ESM journals (Bakker, 2019; Niss, 2019).

Therefore, guidelines for conducting and writing research with specific characteristics are welcome for mathematics education, such as: replication studies, systematic mapping and review, oral and life history, research comments and book reviews. Barwell and Reid (2019) suggest the use of other writing genres to present research that can and should be further explored – such as narration, dialogue and essay. There is no single way to do this, but providing suggestions would be useful for those who venture to present the research report in this way.

Careful reflection regarding the writing of each part of a manuscript contributes significantly to increasing its chances of acceptance since the acceptance of a manuscript in a renowned journal in the area of mathematics education depends on several factors. It is important to emphasize that the factors analyzed provide aspects that are often necessary conditions but not infallibly sufficient for acceptance since the acceptance of work transcends mere rational logic and is influenced by social, psychological, political, and economic aspects (Lin et al., 2010). Scientific research is a construction that originates from the practices of a research community, which responds to the needs and interests of a broader environment and is thus imbued with sociocultural values that exert influence.

In the case of researchers from countries with less expressiveness in global science, concern for the quality of the article may increase published texts and, consequently, an increase in the relevance of research conducted in these countries, contributing to a global debate in the various areas that make up mathematics education.

Finally, perhaps the question of *how to write a good scientific article in the field of mathematics education?* will always be on the rise, and receiving reformulated answers since the structures of articles are changeable, and what was publishable about 50 years ago may not be published in a quality journal today. However, a guide that leads to the good writing of a typical ideal article – the objective of this work – may increase the chances of acceptance of such research.

Authorship contributions

All authors contributed substantially to the conception and planning of the study; in obtaining, analyzing and interpreting data; in writing and critical review; and approved the final version to be published.

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