

MAPPING TERMS USED FOR SCIENTIFIC DISSEMINATION: A CONCEPTUAL REVIEW

MAPEO DE TÉRMINOS UTILIZADOS PARA LA DIVULGACIÓN CIENTÍFICA: UNA REVISIÓN CONCEPTUAL

MAPEAMENTO DOS TERMOS USADOS PARA DIVULGAÇÃO CIENTÍFICA: UMA REVISÃO CONCEITUAL

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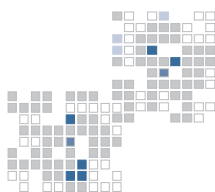
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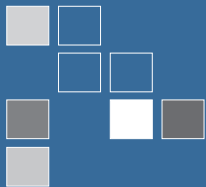
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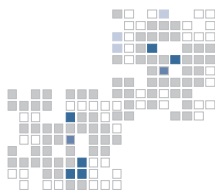
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ABSTRACT

This article reviews international literature on scientific dissemination to identify the most widely used terms and their synonyms. The study analyzed peer-reviewed articles (2016–2025) from Periódicos Capes and Dartmouth Library, in English, Portuguese, and Spanish. It found variations in terminology depending on the author's country and noted possible mistranslations. The results indicate the need to formulate a concept that clearly differentiates Scientific Dissemination from Scientific Education, Scientific Communication, and Public Perception of Science. Although conceptual distinctions already exist, these terms are often conflated in practice, leading many authors identified in this review to use them incorrectly as synonyms.

KEY WORDS: SCIENTIFIC DISSEMINATION; SCIENCE COMMUNICATION; SCIENTIFIC OUTREACH; SYSTEMATIC LITERATURE REVIEW.

RESUMEN

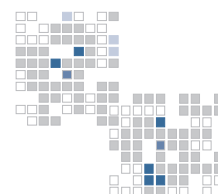
Este artículo revisa la literatura internacional sobre divulgación científica para identificar los términos más utilizados y sus sinónimos. El estudio analizó artículos revisados por pares (2016–2025) en las bibliotecas Periódicos Capes y Dartmouth Library, en inglés, portugués y español. Se encontraron variaciones en la terminología según el país de origen de los autores, además de posibles errores de traducción. Los resultados indican la necesidad de formular un concepto que diferencie claramente la Divulgación Científica de la Educación Científica, la Comunicación Científica y la Percepción Pública de la Ciencia. Aunque existen distinciones conceptuales, en la práctica estos términos suelen confundirse, lo que lleva a muchos autores identificados en esta revisión a utilizarlos incorrectamente como sinónimos.

PALABRAS CLAVE: DIVULGACIÓN CIENTÍFICA; COMUNICACIÓN CIENTÍFICA; EXTENSIÓN CIENTÍFICA; REVISIÓN SISTEMÁTICA DE LA LITERATURA.

RESUMO

Este artigo revisa a literatura internacional sobre divulgação científica para identificar os termos mais utilizados e seus sinônimos. O estudo analisou artigos revisados por pares (2016–2025) nas bibliotecas Periódicos Capes e Dartmouth Library, em inglês, português e espanhol. Foram encontradas variações na terminologia conforme o país de origem dos autores, além de possíveis erros de tradução. Os resultados indicam a necessidade de formular um conceito que diferencie claramente Divulgação Científica de Educação Científica, Comunicação Científica e Percepção Pública da Ciência. Embora existam distinções conceituais, na prática, esses termos são frequentemente confundidos, levando muitos autores identificados nesta revisão a usá-los inadequadamente como sinônimos.

PALAVRAS-CHAVE: DIVULGAÇÃO CIENTÍFICA; COMUNICAÇÃO CIENTÍFICA; EXTENSÃO CIENTÍFICA; REVISÃO SISTEMÁTICA DE LITERATURA.



Financiamento¹

1. Introduction

Literature on scientific dissemination, both in the United States (USA) and Brazil, reveals that there are numerous terms used for the activity of publicizing knowledge. Although some of these terms have different definitions, projects or programs using them eventually pursue rather similar objectives, which are even considered synonymous at times. The same occurs with scientific articles addressing it.

According to Rowe and Frewer (2005), an imprecise definition of science dissemination activities, named ‘public participation’ by these authors, has brought difficulties both to the development of good research and practical activities of effective engagement. Kassab (2019) also alerts that several terms have been used to name activities related to science dissemination, such as ‘public outreach’ (Andrews et al., 2005), ‘scientific dissemination’ (Johnson et al., 2014), ‘science communication’ (Burns; O’connor; Stocklmayer, 2003), ‘popularization’ (Myers, 2003), ‘knowledge dissemination’ (Green et al., 2009), or ‘public engagement’ (Watermeyer, 2015)². According to Kassab (2019, p.711), once a consensus cannot be reached on a correct term or terms for the activity of science dissemination, whether involving peer researchers or the population as a whole, *“there is also no common understanding on where ‘research’ ends and where ‘public outreach’ begins”*.

Regarding literature on scientific dissemination in Brazil, Bueno (2010, p.1) forewarns that “Brazilian literature on Scientific Communication and Dissemination has not contributed, over time,

to refine a few elementary concepts supporting theory and practice in these areas”. According to the author, this gap has been a barrier to a clear definition of the boundaries and scope of scientific communication and dissemination.

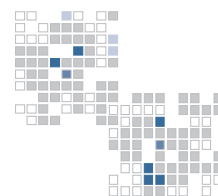
Bernal (1939), to whom the very first concept of scientific communication is attributed in a work entitled ‘The Social Function of Science’, states that scientists should be directly involved with society. At the time, this concept was harshly criticized, as most scientists believed that science should have been drawn away from the public, mostly due to political and economic affairs.

Such view has been modified over the years, without, however, being completely disregarded, since many scientists remain distant from the social role proposed by Bernal (1939). More recently, Kappel and Holmen (2019) criticized the way concepts of scientific communication were presented, since they are primarily focused on the objectives of communication and are improperly explored and articulated. Therefore, they proposed a conceptual framework to explain such objectives. Such a structure becomes interesting as it consequently involves various actions integrating it, in which scientific dissemination is encompassed.

Caribé (2015) analyzed various concepts related to scientific communication, defining it as a more generic, umbrella term under which others are subordinated. He considers scientific diffusion, scientific dissemination, and popularization of science as activities aimed at transmitting scientific information to different social groups, integrated into a set of actions targeting specific audiences. Meanwhile, terms like *public perception of science*, *public understanding of science*, *scientific education*, and *scientific literacy* are described as widely used internationally and linked to skills that the audience should develop, comprising what Caribé calls “process outcomes”—changes in the public’s capacity to

¹ This research received funding from Fapesp

² ‘public outreach’ (Andrews et al., 2005), ‘science outreach’ (Johnson et al., 2014), ‘science communication’ (Burns et al., 2003), ‘popularization’ (Myers, 2003), ‘knowledge dissemination’ (Green et al., 2009), or ‘public engagement’ (Watermeyer, 2015).



understand science. The bibliometric analysis in this conceptual review suggests that this scenario has been evolving since 2015, when Caribé's article was published.

Caribé's (2015) classification attempt was an important step toward reaching a consensus on the growing diversity of terms and concepts in science communication. This effort may even support eliminating terms like *Scientific Literacy*, often criticized for framing the public as "scientifically illiterate." Cunha (2017) points out that "literacy" was mistranslated into Portuguese and that the correct term should be "scientific literacy" (*letramento científico*), which has recently been adopted in Brazilian public policies and scientific literature.

It is obvious that the terms used under the umbrella of science communication are rather diverse. Some are presented as synonyms, other times with different concepts, which makes such classification attempt more difficult. However, in this article, we sought to contextualize international literature and verify the most typically used terms, in addition to the synonyms used less often, nonetheless they are found in some areas. This attempt aimed to capture a greater number of areas, since there are also choices for a given term depending on the area in which research is covered.

In this context, we sought to map the most widely used terms concerning scientific dissemination in the USA and Brazil. To such an end, two digital libraries were selected: Dartmouth Library and Periódicos Capes.

2. Methodology

For the searches carried out, 12 terms were used, which constituted the search strings³: Scientific

Dissemination; Scientific Literacy; Scientific Education; Citizen Science; Communication of Science; Scientific Communication; Popularization of Science; Scientific Disclosure; Dissemination of research; Science outreach; Public Understanding of Science and Public awareness of Science.

After defining the strings created based on reference articles, checking the main terms used by the authors, the following filters were used and applied in Periódicos Capes and Dartmouth Library: exact term used in the title; having been published between 2016 and July 8, 2025; having been published in English, Portuguese, or Spanish and being a peer-reviewed journal article.

We chose to search only in titles, as the Dartmouth Library does not support subject or abstract searches. To focus on articles with scientific dissemination as their main objective, title searches ensured an almost 100% scientific publication rate, excluding only duplicates or editorials. The period of 2016 to 2025 was selected so that the search could record the most recent findings and, although the 2025 search only covered the month of July, some publications have already been recorded.

Due to the large number of articles selected, it was decided to store the tables on the page of the São Paulo State University (Unesp), School of Sciences and Engineering at the link <https://bit.ly/3zt5cY3>, which allows access to the research data.

3. Results and discussions

Although the search terms were in English, Latin American authors (especially in Brazil) prefer and use fewer terms than North American authors. For example, "Scientific Dissemination" is common in Brazil but rare in North America.

If only "Scientific Dissemination" had been used, it would falsely suggest that North American authors rarely discuss the topic. In reality, at least

³ In a Systematic Literature Review (RSL), a search string is equivalent to the keyword used to find an article and the way this word is used on the database.

11 other terms are used in this context, such as Scientific Literacy, Scientific Education, Science Outreach, and Citizen Science, which were all included in this review.

There is no consensus on the definition of scientific communication. While Albagli (1996) and Bueno (2010) define it as communication among peers without aiming for public democratization of knowledge, Kappel and Holmen (2019) present a different perspective. For the former two authors, scientific communication would be an activity aimed at disseminating specialized information to the peers themselves, which does not aim at a democratization of knowledge, i.e. a fact that would distinguish it from Scientific Dissemination or the Popularization of Science.

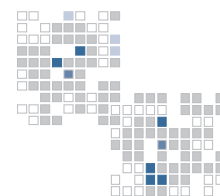
Based on this conceptual context, this study classified the 12 terms into five groups under the broader area of Science Communication:

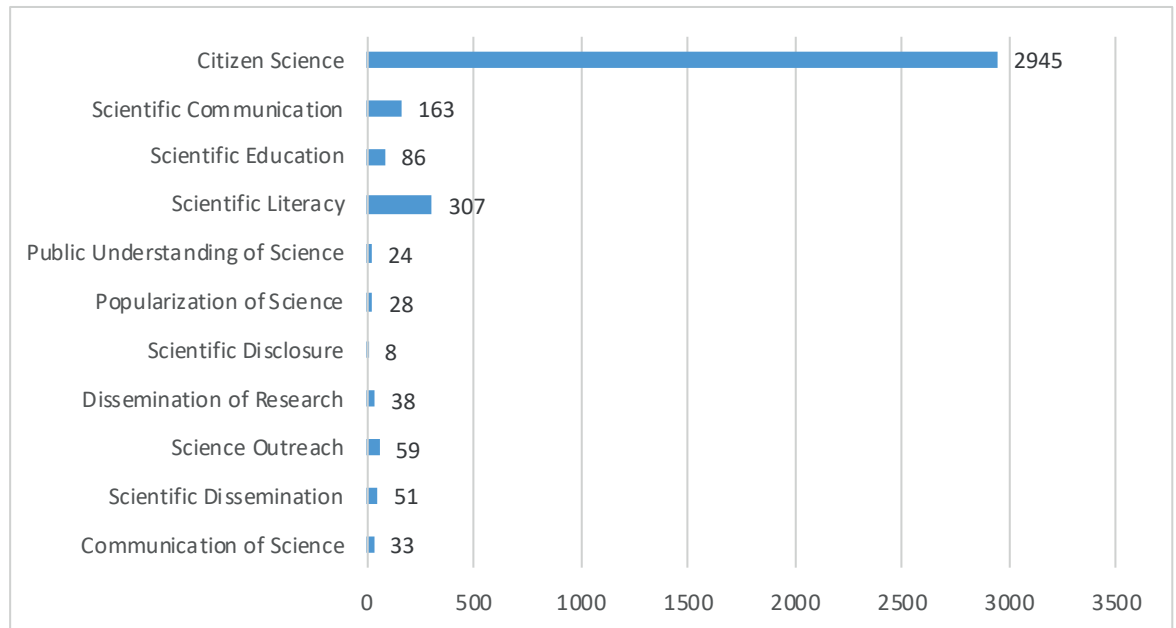
A) Scientific Dissemination, considered synonymous with Science Outreach, Dissemination of Research, and Scientific Disclosure. While “Science Outreach” is widely used in the USA in non-academic media, it appears less in scientific articles; B) Popularization of Science, Public Understanding of Science, and Public

Awareness of Science are seen as objectives or outcomes of dissemination, not synonyms; C) Scientific Education and Scientific Literacy function as tools for dissemination but also relate to scientist training; D) Scientific Communication, referring to communication exclusively among peers; E) Citizen Science, involving public participation in scientific processes beyond result dissemination.

To provide a global and contextual overview of which countries most frequently use each term, the themes addressed, and the journals publishing the most articles on each topic, graphs divided into Groups A, B, C, D, and E are presented below. It is important to note that Group A terms align with this article’s objectives; therefore, the resulting scientific publications will be analyzed in detail through tables listing the journal titles, authors, country of the main author, publication year, research objectives, and themes.

After applying exclusions and filters, 3,742 articles were selected for analysis (see Graph 1). It should be noted that “Public Awareness of Science” was excluded from the analyses, as no articles using this term were identified, although it did appear in books and other scientific documents.



Graph 1. Search strings and number of selected articles

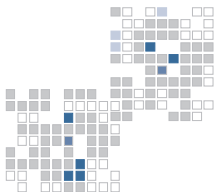
Source: the authors

A presentation of terms begins with the one that, for the present research, represents the umbrella under which all other researched terms are found: *Communication of Science*.

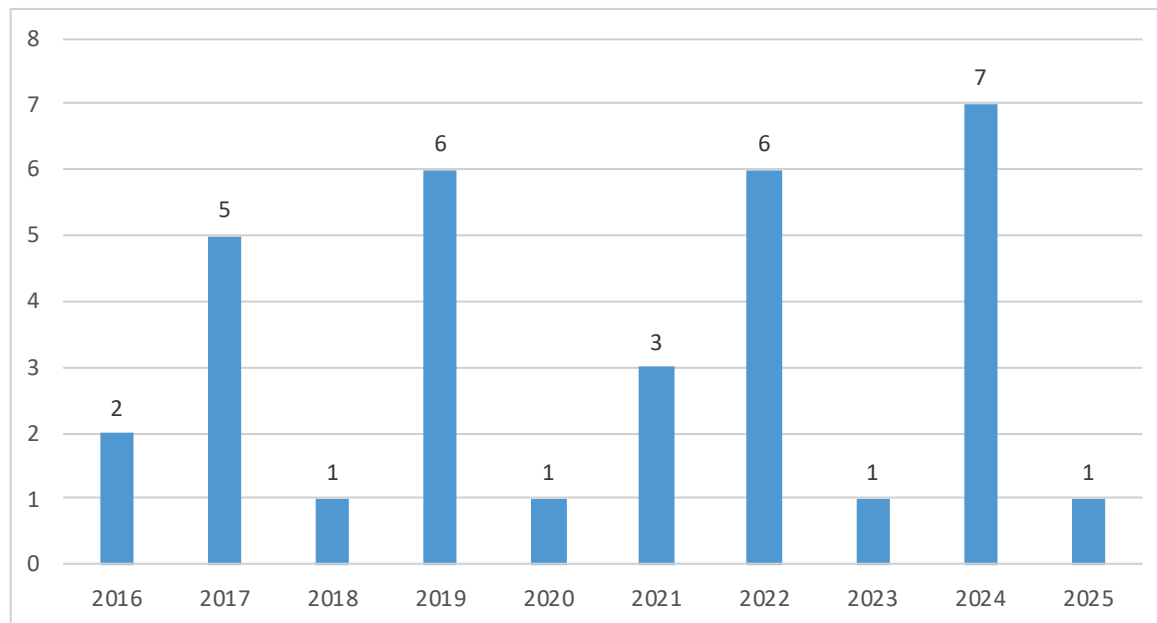
In this review, 48 articles using the term *Communication of Science* were found in both digital libraries, 11 of which were duplicates and four were editorials from scientific journals, therefore 33 articles remained for analysis.

33 selected articles having data on authors, journal year of publication, homeland of the main author, objective of publication and theme are in Table A and able to be accessed at <https://bit.ly/3zt5cY3>

Two of the authors published more than one article in the last 10 years. 2024 was the year in which the largest number of publications were found, i.e. seven publications (Graph 2).



Graph 2. Articles per year (Communication of Science)

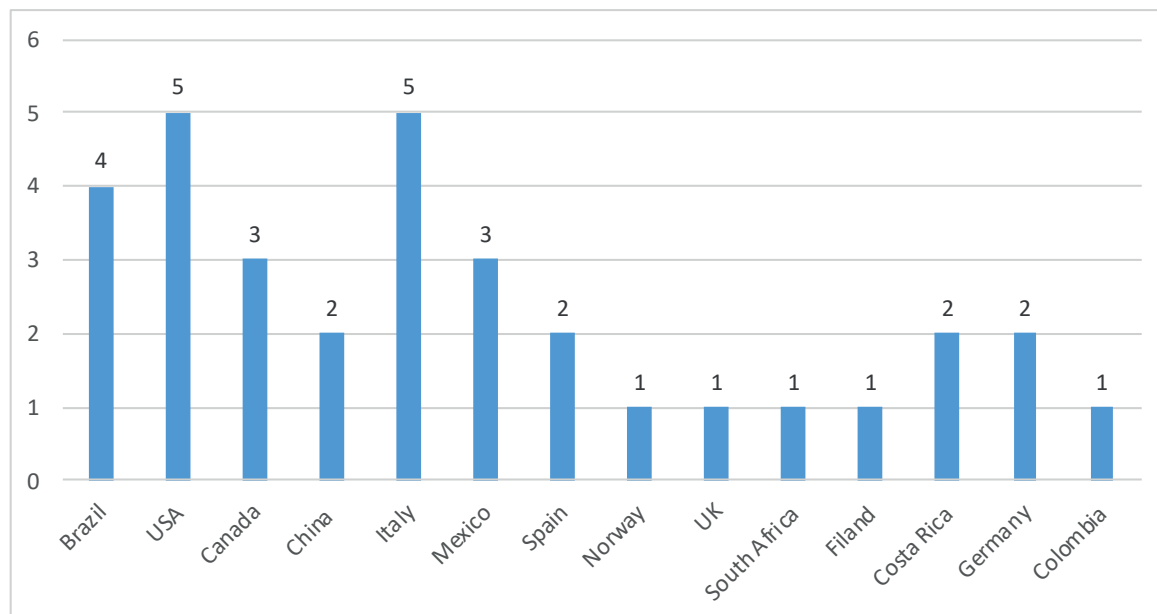


Source: the authors

33 articles classified according to the nativeland of each author is shown in Graph 3, and it should

be observed that the nativeland of the main author of each article was considered.

Graph 3. Articles published by author/nativeland (Communication of Science)

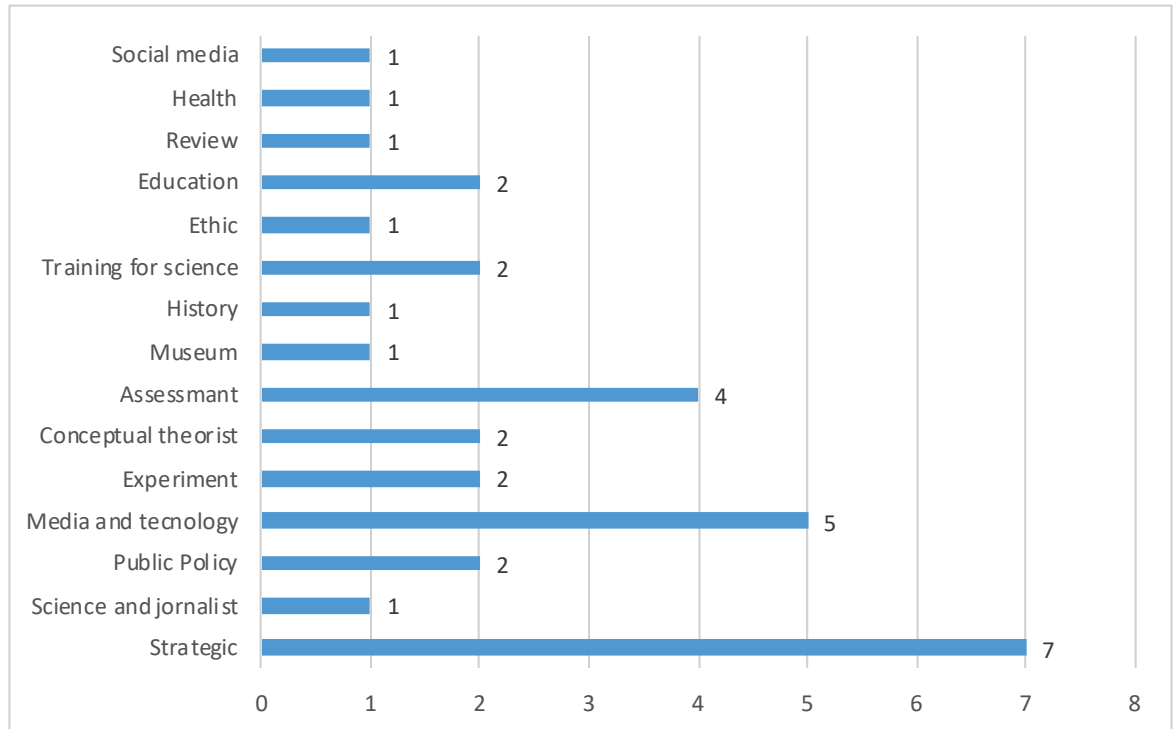


Source: the authors



It is observed that regarding the theme dissemination instruments and experiments ‘Strategies’”, cases are included on scientific carried out (Graph 4).

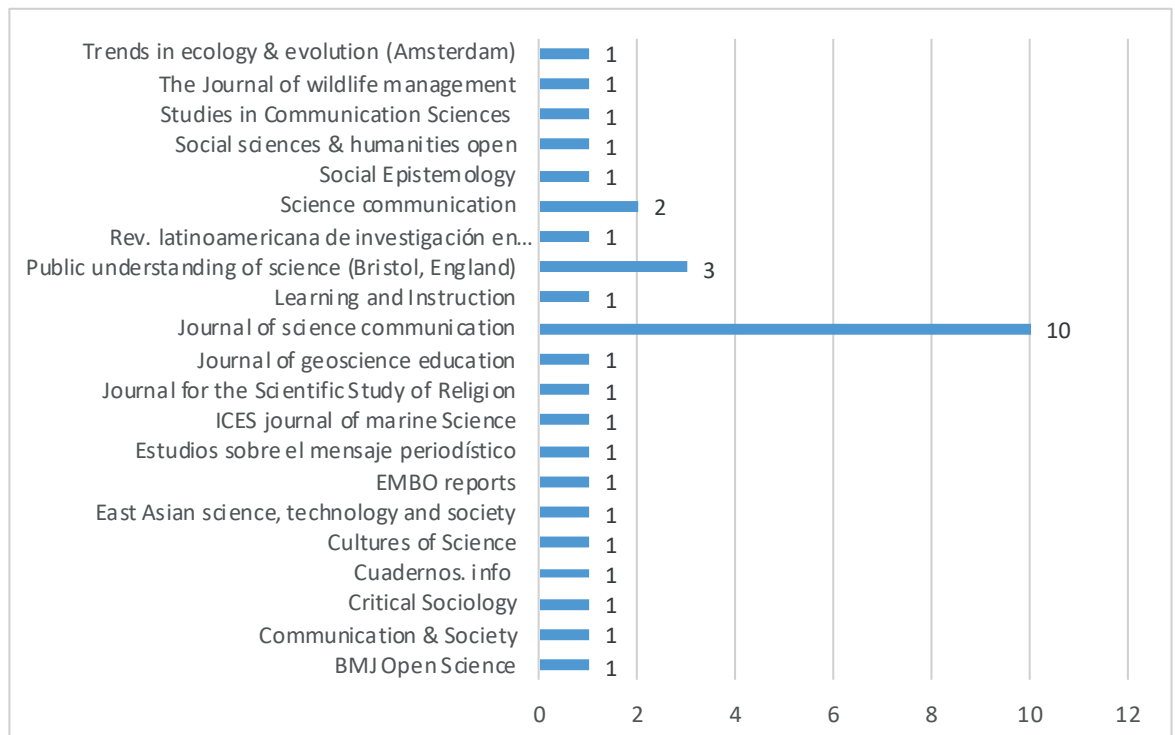
Graph 4. Articles by topic (Communication of Science)



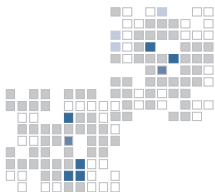
Source: the author

The 21 scientific journals in which the 33 articles under analysis were published are shown in graph 5.

Graph 5. Articles by journal.



Source: the authors



It is observed that the Italian Journal of Science Communication published the largest number of articles (10 publications), followed by the English Public Understanding of Science (3 publications) and the North American Science Communication (2 publications). All others had only one publication using the string *Communication of Science* in the title.

We now proceed to classifications by Groups, according to the objectives of grouped terms, with emphasis on **Group A** in which the terms synonymous with *Scientific Dissemination* are found:

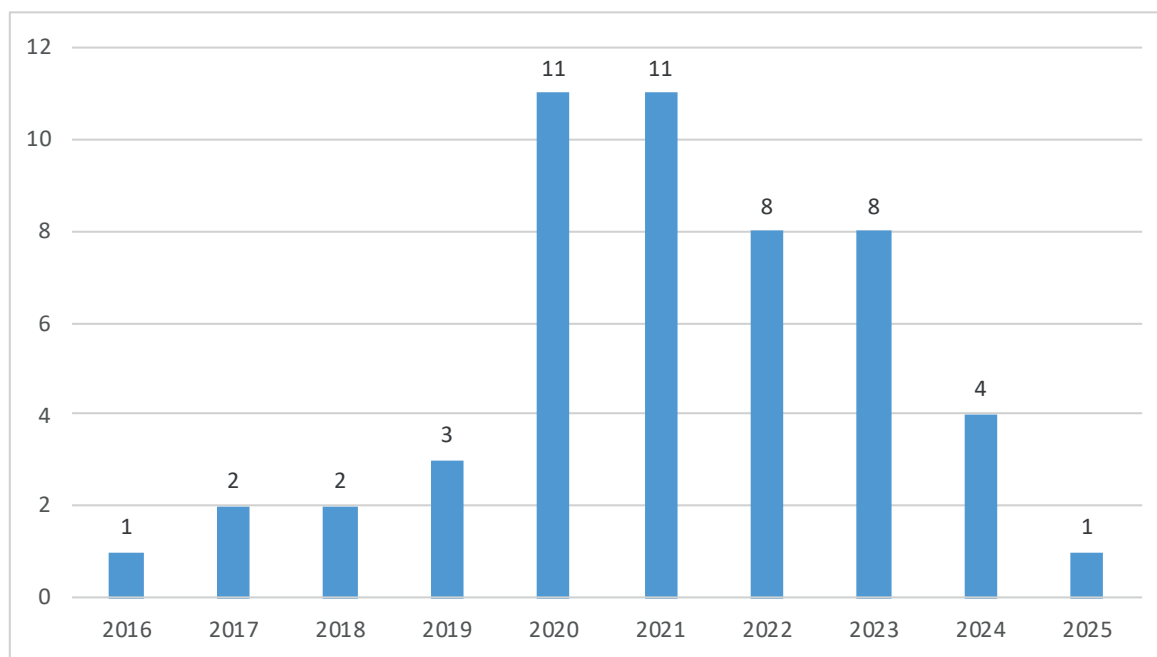
A.1 Scientific Dissemination — to verify the behavior of this term, the articles found in both virtual libraries were classified by year of publication, country, theme and journals. Out of the 76 articles using the term *Scientific Dissemination* in their title found in both libraries, 24 were disregarded on account of being duplicates, and only one was rejected since

it was realized while reading it that it was, in fact, an editorial from a journal, not an article. A total of 51 articles remained for analysis.

The 51 selected articles having data on authors, journal, year of publication, nativeland of the main author, theme and objective are in Table B available at <https://bit.ly/3zt5cY3>

In terms of yearly publications, 2020 and 2023 had the most publications, with 11 articles published during each year. However, 2021 and 2022 are also worth highlighting. It is observed that the post-pandemic period has aroused greater concern among scientists about disseminating science, especially on account of some criticisms faced by scientists, which may have also led to a greater number of scientific articles published from 2020 to 2023 (pandemic and post-pandemic years), and 74.5% of which were published along ten years using Scientific Dissemination in the title.

Graph 6. Articles per year (Scientific Dissemination)



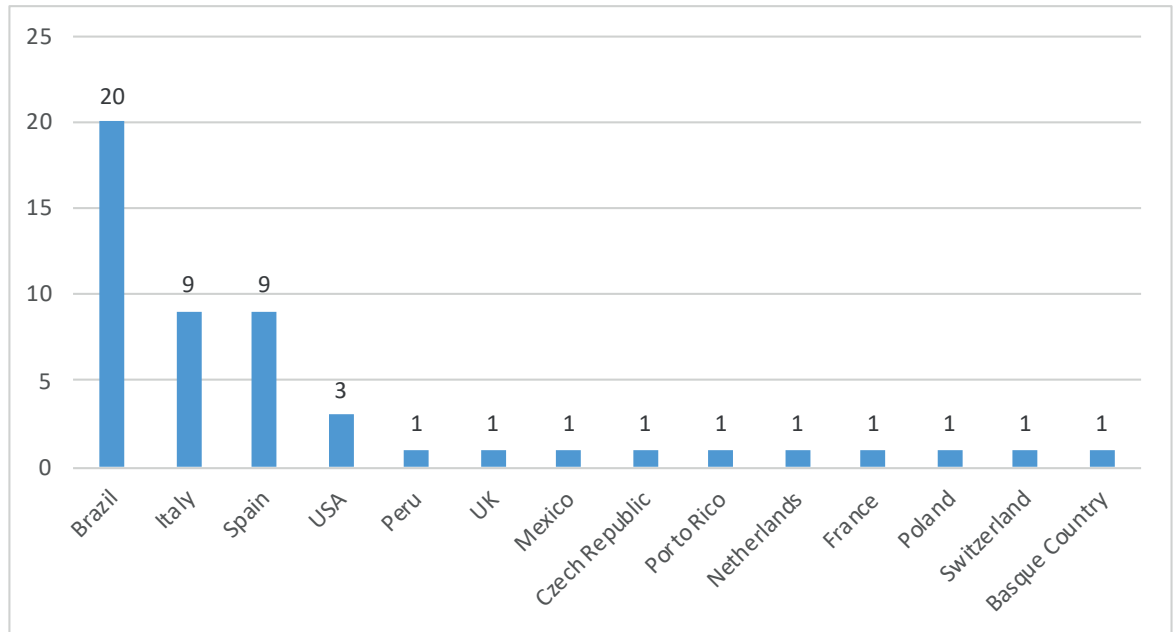
Source: prepared by the authors



It is observed that Brazil is the country using the term Scientific Dissemination the most as a translation of scientific dissemination into the English. It is also noted that Italy and Spain occupy

second and third place, and both countries speak Neo-Latin languages, as well as Portuguese. Such usage may be a choice of linguistic preference (Graph 7).

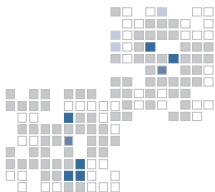
Graph 7. Articles by author/nativeland (Scientific Dissemination)



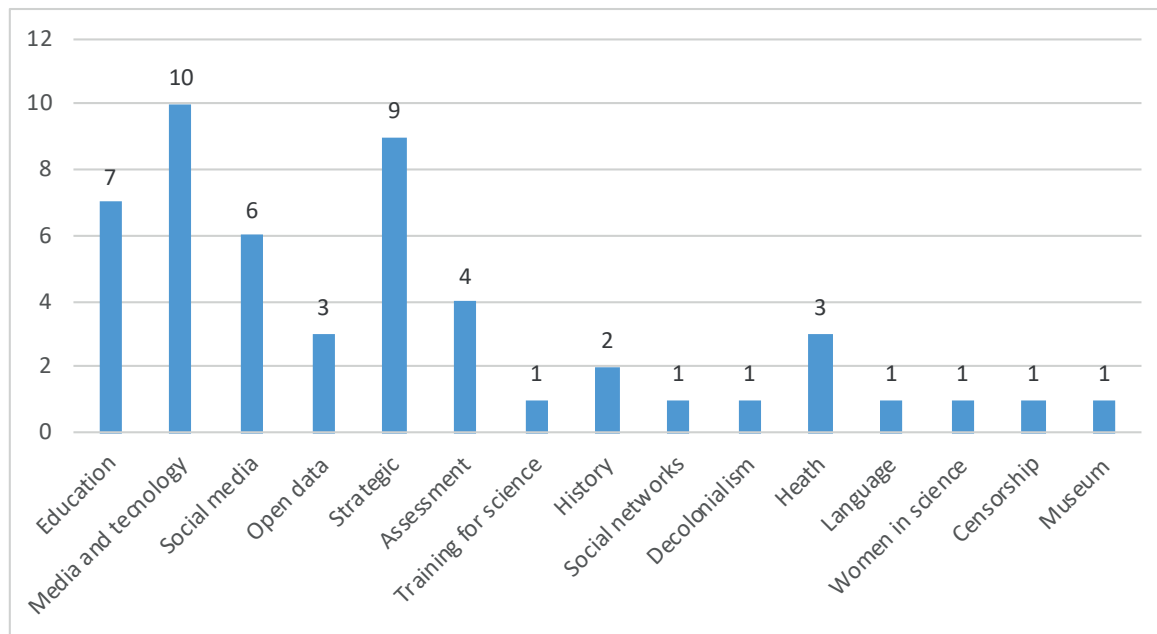
Source: the authors

It is observed that, when it comes to reading the articles and classifying their themes, the issue of formal scientific education is present, even though the articles use the term Scientific Dissemination in their titles. This implies the difficulty faced by

the authors themselves regarding what scientific dissemination truly means. Regarding formal scientific education, it refers to teaching in a school environment (graph 8).



Graph 8. Articles by topic (Scientific Dissemination)



Source: the authors

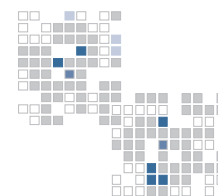
Open data is another relevant topic, as these articles emphasize the importance of making data publicly available, particularly in scientific journals, to facilitate access by other researchers. In this context, scientists themselves can also be considered a target audience for scientific dissemination, given the fragmentation of science into various fields and the potential for interdisciplinary exchange.

Notably, two of the three articles identified — Fuller et al. (2020) and Novaes and Guilhem (2020) — highlight ethical and responsibility issues, especially in relation to COVID-19, as key arguments for data publication. The third article, by Mercier, Magloire, and Karnani (2020), discusses the Peer Community In (PCI) initiative as a mechanism to ensure scientific validation through processes such as peer review.

The item Advisory/Education of Scientists contains articles providing tips to scientists on scientific dissemination procedures. These range from articles showing steps towards good scientific dissemination through courses and education of scientists.

Most strategies constitute cases about forms of scientific dissemination. It is noteworthy that some articles addressed strategies used for scientific dissemination about COVID-19, as is the case of an article published by Fawcett et al. (2021) and Caetano (2021).

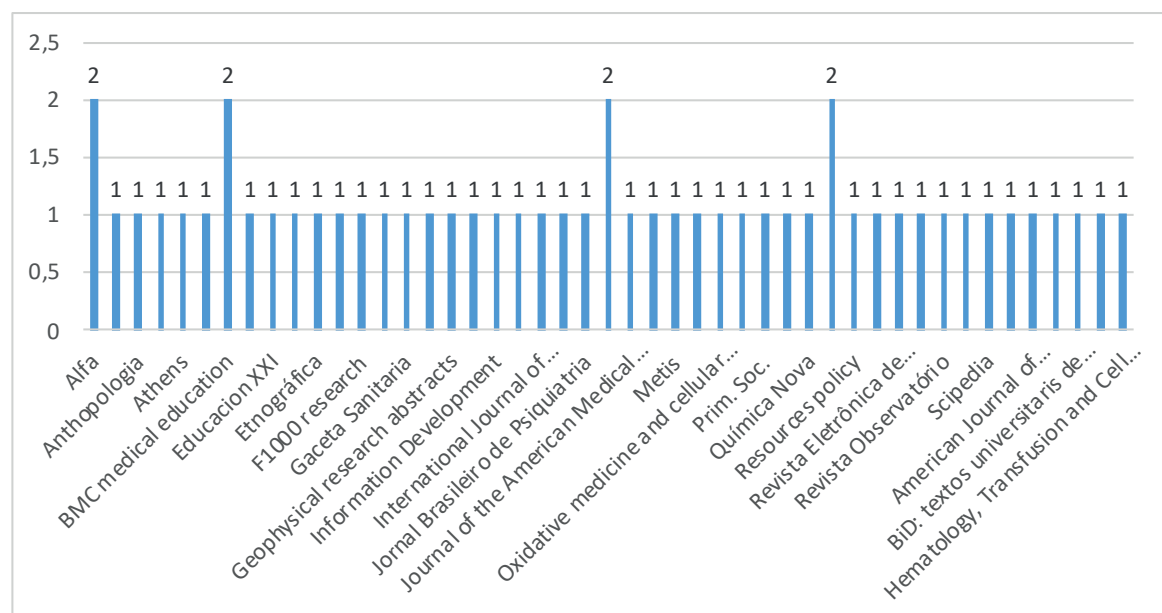
Articles were also classified into those focused on social networks and those on media and technologies for scientific dissemination. Studies on social networks analyze their use by researchers to share their own work or content of interest, highlighting the exponential growth of these platforms as tools for dissemination and their increasing attention in academic research. Regarding media and technologies, the articles examine the use of television, magazines, newspapers, and radio as channels for communicating science, focusing on messages conveyed and audiences reached. Articles on history explore the evolution and memory of scientific dissemination, including programs and projects, while evaluation articles analyze the implementation of dissemination activities and offer feedback on best practices.



In terms of journals, the ones with the most occurrences were the Brazilian ones, namely Alfa and Research, Society and Development; the

Americans Journal of Chemical Education and BMC Medical Education.

Graph 9. Articles by journal (Scientific Dissemination)



Source: the authors

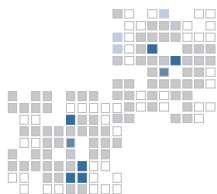
It is observed that around 40% of journals publishing articles using the term Scientific Dissemination are from the area of medicine, which indicates that the topic has aroused the attention of medical researchers.

The second term in **Group A is Science Outreach**. As aforementioned, it is a very popular term in the USA and widely used by the media and scientific popularizers, but these are not devoted to research on scientific popularization as an area of knowledge. In terms of scientific articles, the string *Science Outreach* was found in the titles of 115 articles, 52 of which were duplicates on databases and 4 were rejected after reading their abstract, as they were opinion

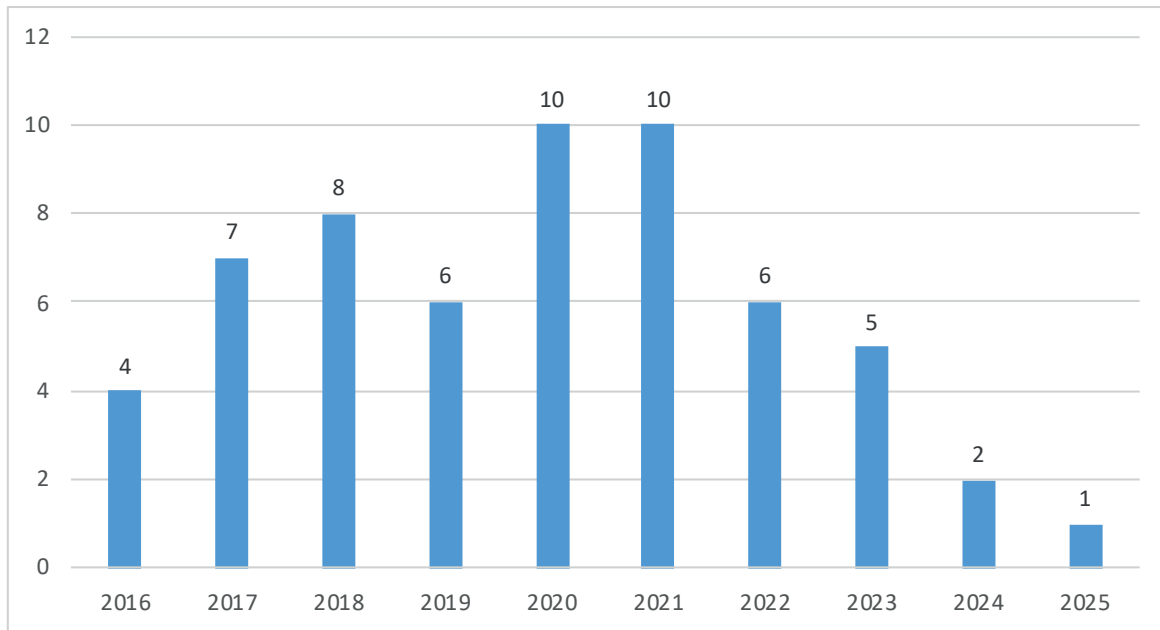
editorials, not scientific articles, thus a total of 59 articles remained for analysis.

The 59 selected articles with data on authors, journal year of publication, nativeland of the main author, theme and objective of publication are in Table C available at <https://bit.ly/3zt5cY3>

In terms of articles published yearly, 2020 and 2021 were the years during which the largest number of publications was found (Graph 10). It is observed that society was experiencing the pandemic in these years which may have led researchers to think about the importance of scientific dissemination, resulting in an increase in publications in those periods. This result represents 30% of the selected 59 articles.



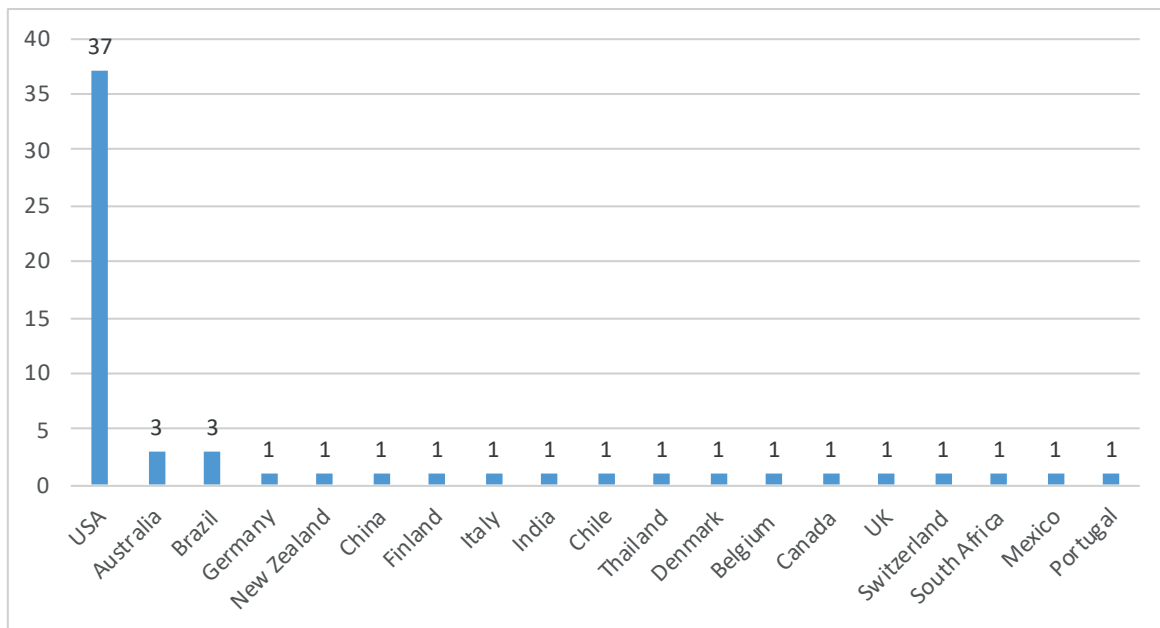
Graph 10. Articles per year (Science Outreach)



Source: the authors

Selected articles were also classified according to the country where the institution in which authors work is located, prioritizing the nativeland of the first author (Graph 11).

Graph 11. Articles by author/nativeland (Science Outreach)



Source: prepared by the authors

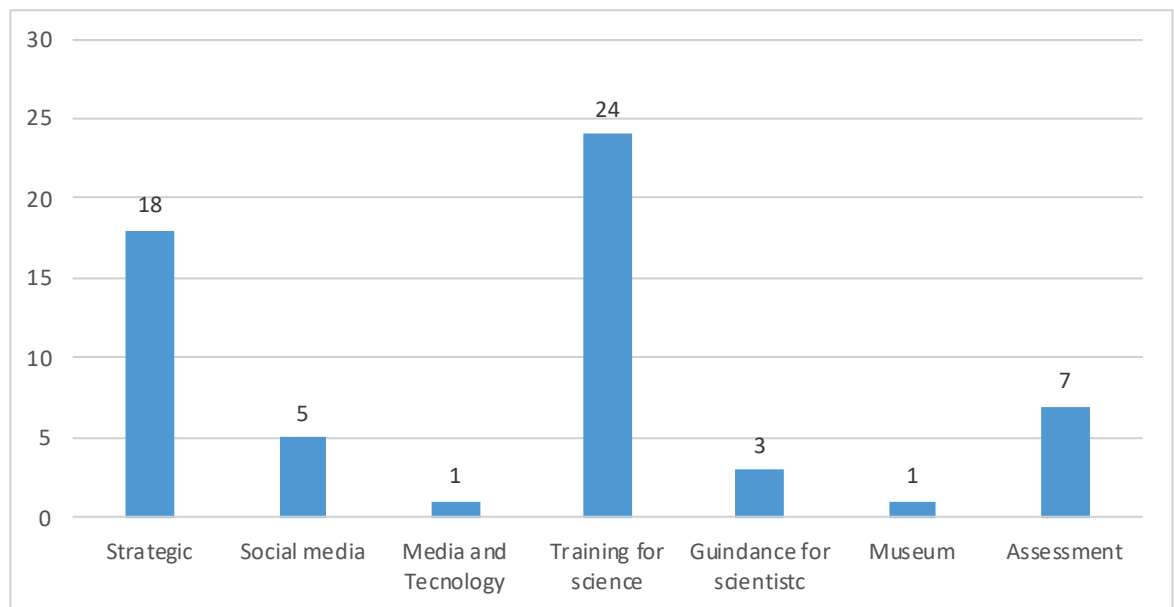


It is evident that this term, despite not being quite presently found in academia yet, given the way it is widely used by the media, the topic of scientific dissemination has been mentioned more often by North American researchers. It can be observed that the USA is accountable for a large percentage of manuscripts using Science Outreach, representing 62,7% of publications.

Therefore, it emphasizes the need for a review to observe the various terms presenting themselves as synonyms, as previously warned in this article.

The theme 'strategies' not only comprises cases exploring forms of scientific outreach, but also scientific dissemination programs and projects (Graph 12).

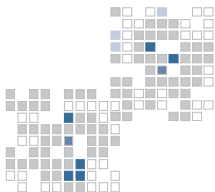
Graph 12. Articles by topic (Science Outreach)



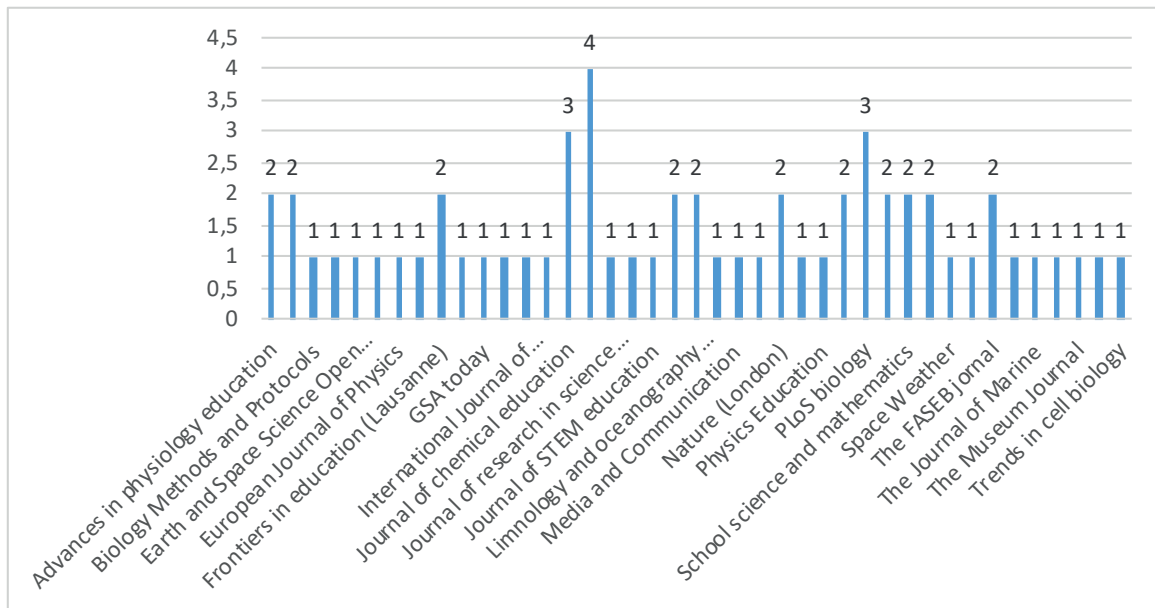
Source: the authors

Regarding journals, it is observed that the North American Journal of microbiology & biology education published the largest number

of articles, also followed by the North American Journal of chemical education and PLoS biology.



Graph 13. Articles by journal (Science Outreach)

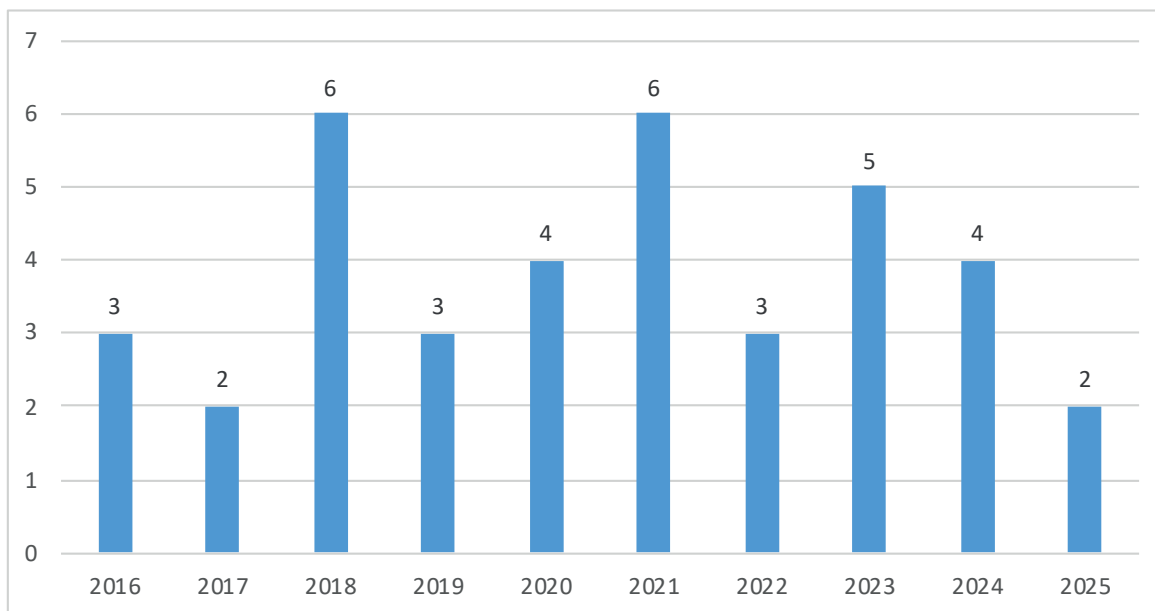


Source: the authors

The Group's third term is **A3. Dissemination of Research**. The 38 selected articles having data on authors, journal, year of publication, nativeland of the main author, theme and objective of publication are in Table D available at <https://bit.ly/3zt5cY3>

In terms of yearly publications regarding the term Dissemination of research, 2018 and 2021 were the years in which the largest number of publications were identified, although a greater number of publications can be observed using this term, including pre-pandemic years.

Graph 14. Articles per year (Dissemination of research)

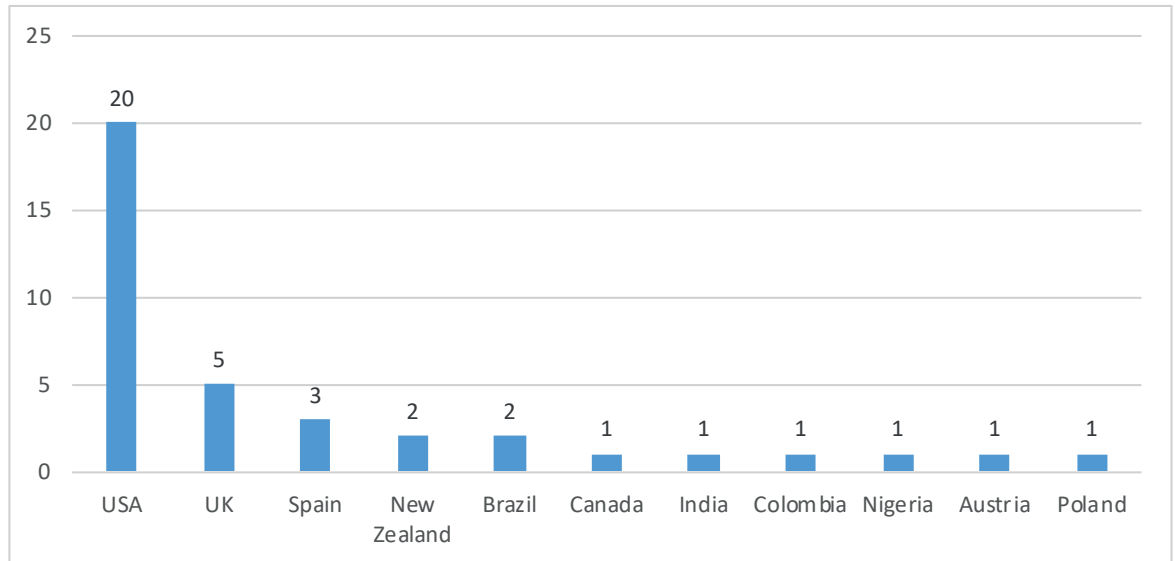


Source: the author



Next, we observe how the articles using *Dissemination of Research* are classified in terms of authors' nativeland.

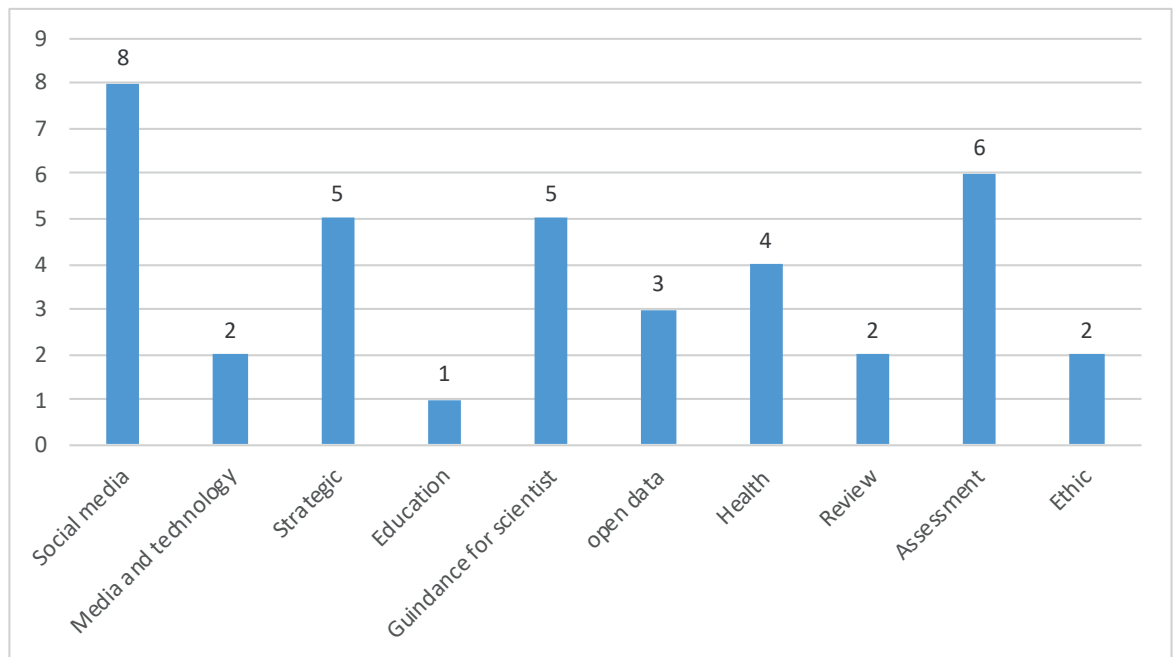
Graph 15: Articles by author/nativeland (Dissemination of research)



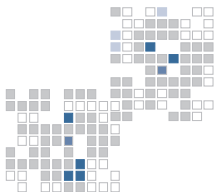
Source: the authors

Regarding the themes used, Social Media stands out, followed by Assessment (graph 16).

Graph 16. Articles by topic (Dissemination of research)



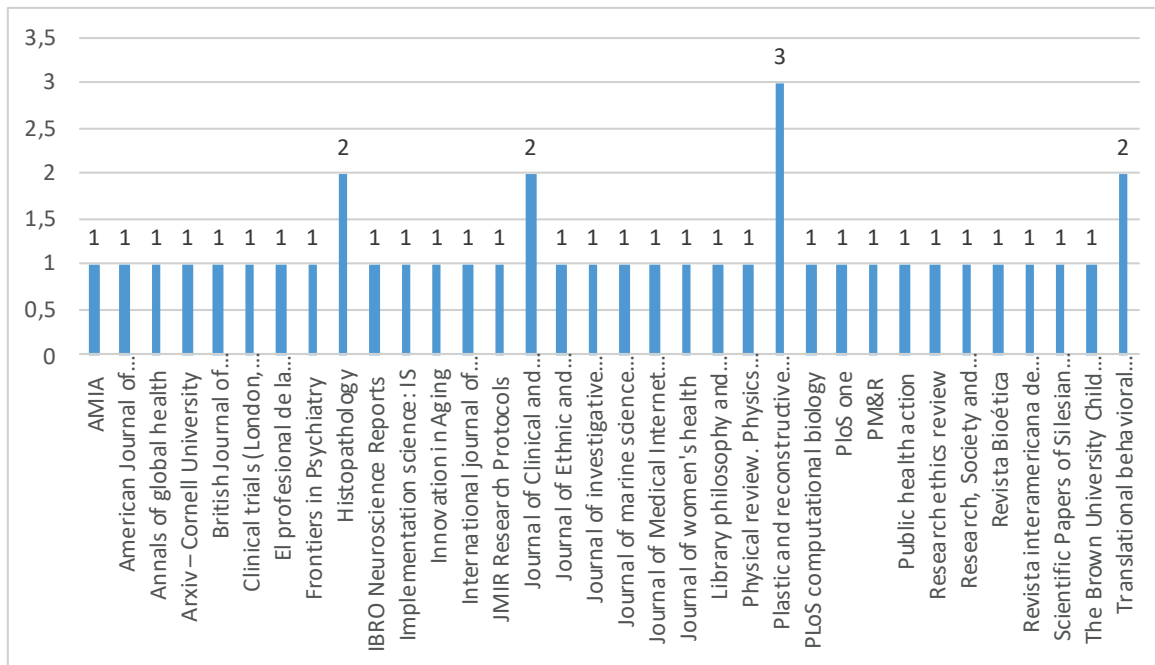
Source: the authors



Regarding the Journals (Graph 17) published articles using the term Dissemination of Research, four were published more than once, which are: the North American Plastic and Reconstructive Surgery (3 occurrences) and the

English Translational behavioral medicine (2 occurrences), Histopathology (2 occurrences) and Journal of Clinical and Translational Science, all from the menicinal area.

Graph 17. Articles by journals (Dissemination of Research)



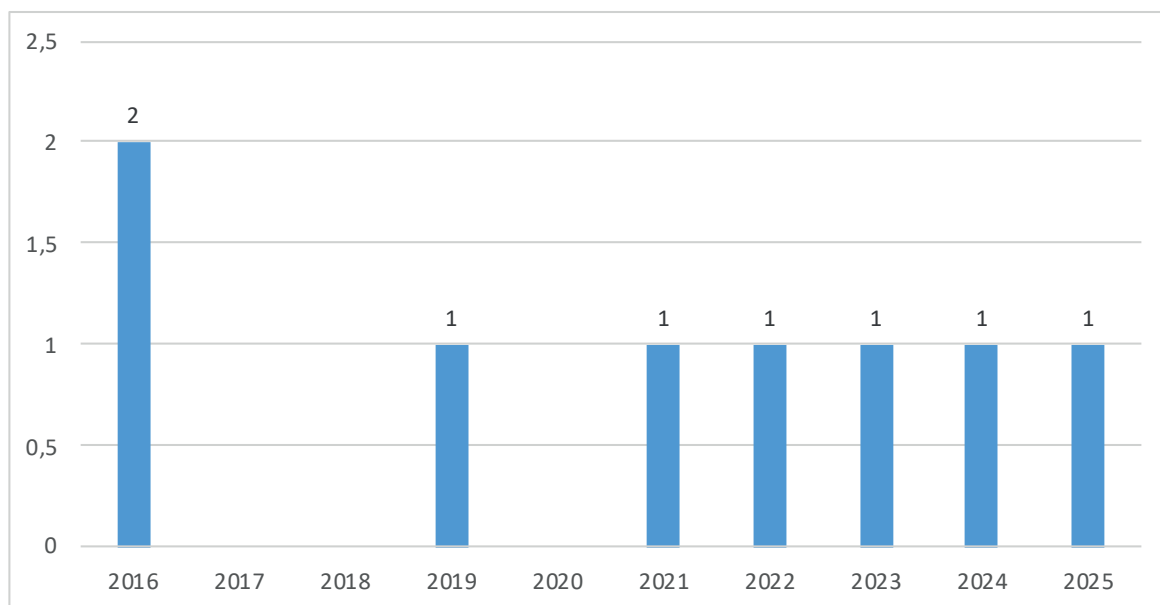
Source: the authors

A.4 - The fourth synonymous string is *Scientific Disclosure*, which is the term found in the smallest number of articles among the terms in group A. Eleven articles published in peer-

reviewed journals were selected, two of which were repeated, and one was editorial, therefore only eight articles were classified. Thorough data is available in Table E at <https://bit.ly/3zt5cY3>



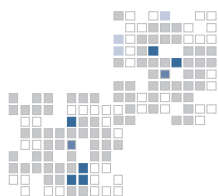
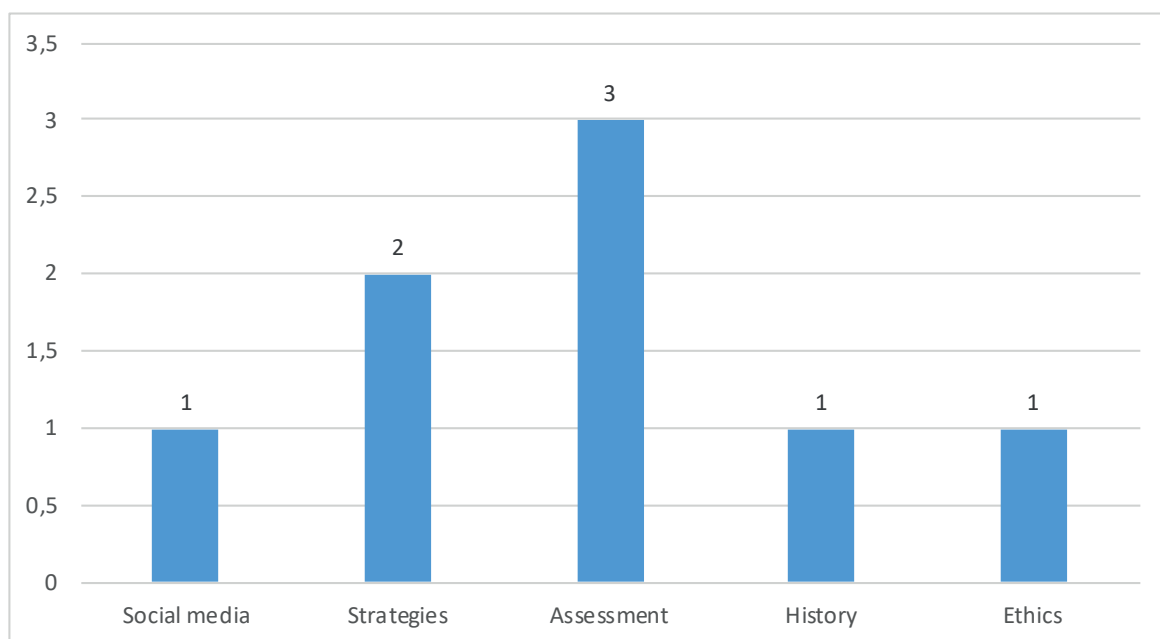
Graph 18. Articles per year (Scientific Disclosure)



Source: the authors

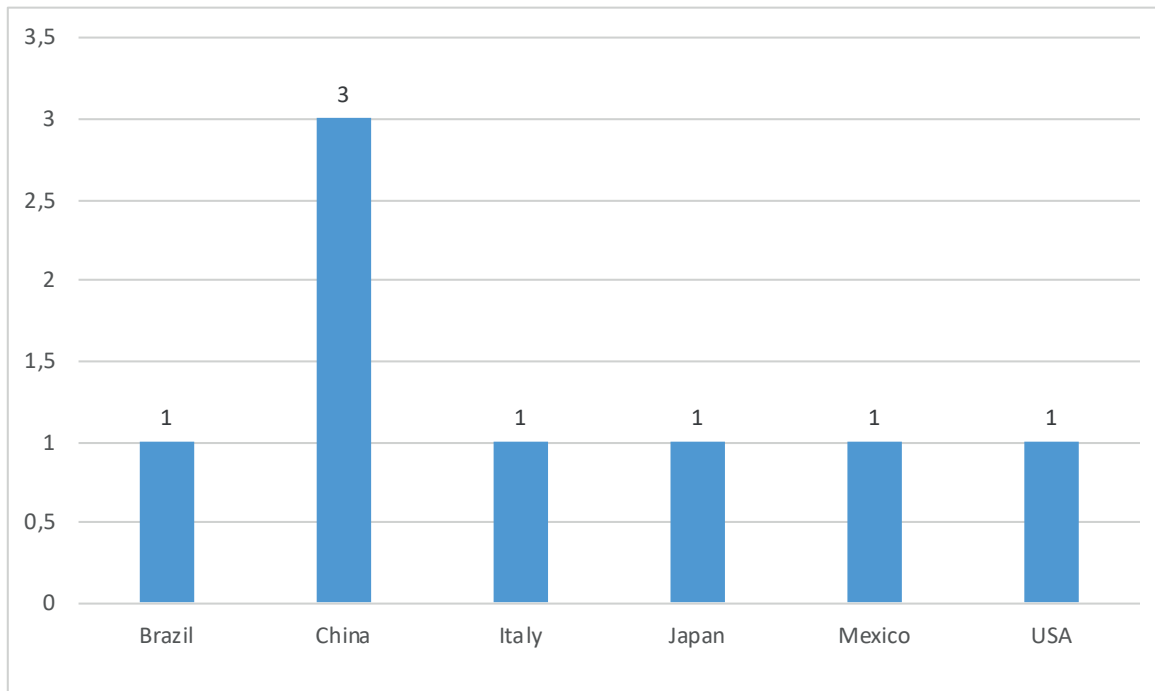
In terms of themes, assessment was the most frequent (Graph 19).

Graph 19. Articles by topic (Scientific Disclosure)



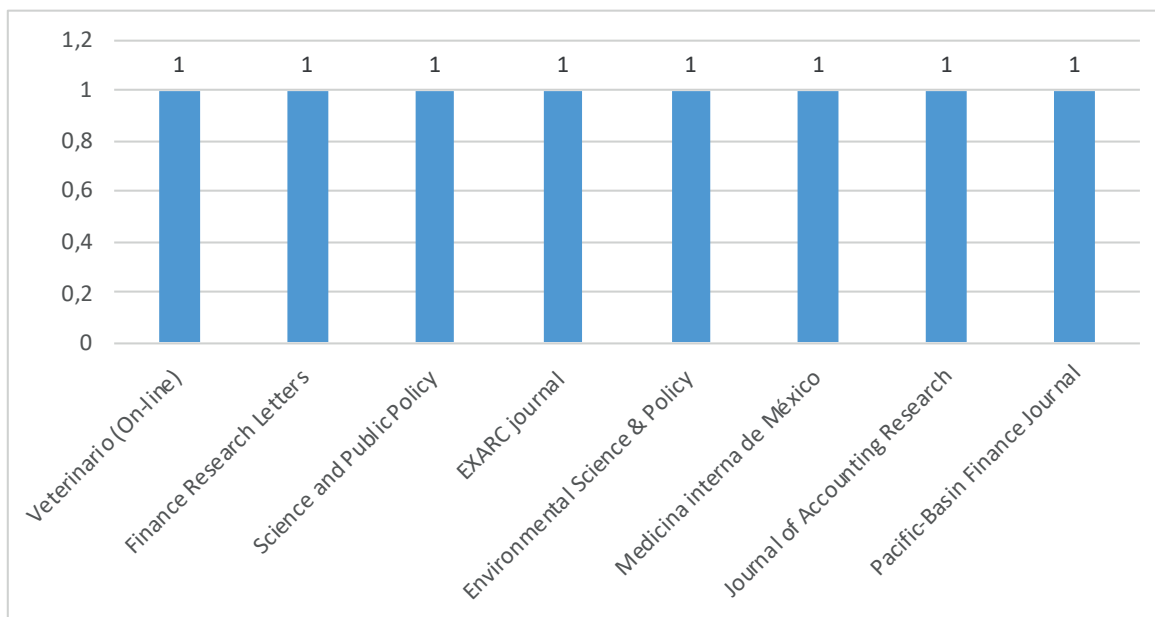
Chinese authors published the largest number of articles (Graph 20).

Graph 20. Articles by author/nativeland (Scientific Disclosure)



Regarding journals, eight articles were published in eight different ones.

Graph 21. Articles by journals (Scientific Disclosure)



The Group B consists of the terms *Popularization of Science*, *Public Understanding of Science* and *Public Awareness of Science*, all of which are regarded as objectives or results of Scientific Dissemination herein. Articles were not cataloged as in the case of those referring to Group A, since they were not considered synonyms of *Scientific Dissemination*, i.e. the cornerstone of this research, this was likewise observed in relation to the terms classified under **Group C**, composed of two terms, *Scientific Education* and *Scientific Literacy*, which are considered as instruments to understand science in this research and, consequently, scientific dissemination.

It is observed that the term was used in the sense of scientific dissemination for quite some time, which was confirmed by reading the articles, through which numerous articles were found referring to the concept of scientific dissemination.

The term Scientific Education is widely used in article titles on both platforms. According to Damazio and Peduzzi (2017) and Moreira (2004), it refers to formal teaching that enables students to interpret the world scientifically, without aiming to turn them into researchers. Rather, it seeks to stimulate interest in science and often incorporates scientific dissemination materials, such as videos and texts, in classroom practice. However, it should not be considered synonymous with scientific dissemination.

Most articles use Scientific Education within the context of formal schooling, often focusing on *Science, technology, engineering, and mathematics* – STEM teaching. Notably, a different interpretation appears in the article by Ruiz-Corbella et al. (2020), which examines the relevance and impact of disseminating scientific articles to society.

Group D includes only the term Scientific Communication, defined here following Biango-Daniels and Sarvary (2021) and

DeJesus, Umscheid, and Gelman (2021) as communication between peers — for example, scientific articles and conference presentations aimed at researchers in the same field. Similar to Groups B and C, these terms were not cataloged but merit comment.

Although most authors define Scientific Communication as peer-to-peer communication, few articles specifically address this type, with many instead discussing it in the context of dissemination or education, highlighting the lack of conceptual consensus.

Group E comprises only Citizen Science, which had the highest number of publications (2,945 articles). After exclusions, 2,945 articles remained for analysis. Because this term differs conceptually from scientific dissemination, articles in this group were only quantified, not classified.

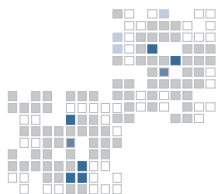
A review of these articles shows that the term Citizen Science is consistently used correctly, indicating no conceptual confusion between it and scientific dissemination.

4. Final considerations

This conceptual review highlighted the need to clearly differentiate Scientific Dissemination, Scientific Education, Scientific Communication, and Public Perception of Science, as existing conceptual distinctions are often blurred in practice, leading many authors to use these terms incorrectly as synonyms.

Reducing the number of synonyms and prioritizing the most common terms can help map developments in the field and avoid erroneous conclusions, since using multiple terms complicates literature reviews. This excess often results from poor translations.

There is also a need to clarify which activities qualify as scientific dissemination. For example: Is communication among peers considered dissemination? Some authors think so, while



others disagree and classify it as Scientific Communication instead.

It is also worth mentioning that a scientist can publish scientific articles through their peers, i.e. scientists acting in the same area, and carry out scientific dissemination for scientists working in other areas. These issues are being initially discussed a lot and is one of the actions able to lead to interdisciplinary research, providing great advances in knowledge.

What about Scientific Education? Although it is not synonymous with Scientific Dissemination, many authors treat it as such, considering it a way of promoting science and therefore an integral part of dissemination.

There is also an evolution in approaches across countries. For example, in Indonesia, the frequent use of “Scientific Literacy” suggests an initial stage focused on explaining science through formal education, a phase already surpassed in countries like the USA and Brazil.

These stages generally progress from scientific literacy and education in schools to broader community outreach (using terms like Scientific Dissemination or Science Outreach), and finally to Citizen Science, where the public actively

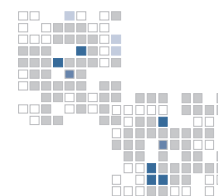
participates in research. It is important to understand each community’s stage to design appropriate actions, without implying that one stage is superior to another.

In Brazil and especially in the USA, there is a strong trend toward “Citizen Science,” which promotes greater interaction between science and society. However, Scientific Dissemination (more common in Brazil) and Science Outreach (more common in the USA) remain highly relevant, with many gaps still to be explored to strengthen this integration.

This study has limitations that suggest future research directions. Using only two databases and selecting articles by exact title terms may have excluded relevant works. Although multiple synonyms were included, some may still have been missed. Restricting to peer-reviewed articles ensured quality, but might have overlooked valuable non-peer-reviewed studies. Additionally, the focus on recent publications (2016–2022, updated to January 2024) may have excluded important earlier studies. Nevertheless, as a conceptual rather than a scoping review, these limitations are not believed to have compromised the findings.

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Artigo enviado em 15/07/2025 e aceito em 01/12/2025.

