



ORIGINAL ARTICLE

History and Philosophy of Science in Latin America

Historia y Filosofía de la Ciencia en Latinoamérica

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ABSTRACT

Introduction: the countries of Latin America have a common history in which they share languages, roots and traditions, and this is a major milestone in their unique way of progress.

Objective: to characterise the communication patterns and impact of Latin American scientific output in the category “History and Philosophy of Science”.

Methods: a bibliometric study was conducted where the documents belonging to the category “History and Philosophy of Science” from the period between 1996 and 2016 were analysed, using as tools Scival and Scimago Country and Journal Rank.

Results: while the regional scientific output showed an annual growth, especially after 2009, this growth was less noticeable at a global level, which indicates the scientific community’s interest towards this type of studies. More than half of the documents were cited, with a citation average of 28 cites per document. More than 30 % of the communications involved international collaboration. Different studies have proven that the works which involved collaboration had a greater impact, at the expense of their visibility.

Conclusions: the analysis of the Latin-American field of History and Philosophy of Science is characterised by a sustained growth, with Brazil as its greater producer. The region has high indicators for scientific leadership and citation. They show their potential based on the recovery of the historical memory of Latin-American people in a new context related to the recognition of scientific heritage as an essential part of our people’s culture, economy, politics and society.

Keywords: History and Philosophy of Science; Latin American; Bibliometrics; SCImago Journal Rank; Scopus.

RESUMEN

Introducción: los países de América Latina presentan una historia común en la que comparten lenguas, raíces y tradiciones, y que ha marcado su singular vía de progreso.

Objetivo: caracterizar los patrones de comunicación e impacto de la producción científica Latinoamericana en la categoría Historia y Filosofía de la Ciencia.

Métodos: se realizó un estudio bibliométrico donde se analizaron los documentos pertenecientes a la categoría “History and Philosophy of Science” en el período comprendido entre 1996 y 2016, utilizando como herramientas el Scival y el portal del Scimago Country and Journal Rank.

Resultados: mientras la producción científica regional ostentó un crecimiento anual, especialmente luego de 2009, a nivel global sin embargo este crecimiento fue menos marcado, lo que denota el interés de la comunidad científica por este tipo de estudios. Más de la mitad de los documentos recibieron al menos una cita, con un promedio de 28 citas por documentos. En más del 30 % de las comunicaciones existió colaboración internacional, estudios han demostrado que los estudios donde existe colaboración poseen un impacto superior, a expensas de su visibilidad.

Conclusiones: el análisis del dominio Latinoamericano en la categoría Historia y Filosofía de la Ciencia se caracterizó por un crecimiento sostenido, sobresaliendo Brasil como mayor productor. La región ostenta elevados indicadores de liderazgo científico y citación muestran su potencialidad en función recuperar la memoria histórica de los pueblos latinoamericanos en un nuevo contexto, el del reconocimiento de un patrimonio científico, parte integral de la cultura, economía, política y sociedad de nuestros pueblos.

Palabras clave: Historia y Filosofía de la Ciencia; Latinoamérica; Bibliometría; SCImago Journal Rank; Scopus.

INTRODUCTION

The countries of Latin America have a common history in which they share languages, roots and traditions, and this is a major milestone in their unique pathway of improvement. In this progress, it must be recognised that science has played a secondary role.⁽¹⁾

According to Kreimer,⁽²⁾ the usefulness of the social studies of science in Latin America contains several questions, among them: the scope they have and the knowledge they produce, the dynamics of science and the technology in our countries, and the structures and changes of the Latin American societies themselves. Therefore, it is necessary to consider the relations of our region, understood as a peripheral context, with the most dynamic centres of science and technology.

These approaches coincide on the need to propose an interpretation of the phenomena of development and underdevelopment in terms that include science and technology as one of the main explanatory variables. Along these lines, it is necessary a bibliometric analysis on the subject matter, in order to determine the regional trends in relation to the publications on said topic, hence the objective of this article is to characterise the communication patterns and impact of the Latin American scientific production in the category "History and Philosophy of Science".

METHOD

A bibliometric study was conducted in the Scopus database (<http://www.scopus.com/home.url>), which was created in 2004 by Elsevier B.V. and it is the largest abstract and citation database of peer-reviewed literature and of high quality web sources, since it covers nearly 18,000 serial titles from more than 5 000 publishing houses; 16 500 of them are peer-reviewed journals. It also has an extensive range of conference materials, web pages on the Internet and patents.⁽³⁾ The retrospective of the processing of articles and their references (necessary for citation analysis) dates back to 1996, although there is a large number of sources of articles (without references) from earlier dates.⁽⁴⁾

Scival⁽⁵⁾ and the portal of Scimago Country and Journal Rank⁽⁶⁾ were used, and documents belonging to the category "History and Philosophy of Science" from the period between 1996 and 2016 were analysed.

A methodology similar to the studies of Zacca-González and col.⁽⁷⁾ was used by adjusting it to the context and subject matter in question.

The main bibliometric indicators used were:

- Total Documents: Output of the selected period. All types of documents are considered, including citable and non citable documents.
- Number of Citable Documents: Exclusively articles, reviews and conference papers are considered.
- Citations: Number of citations by the documents published during the source year, --i.e. citations in years X, X+1, X+2, X+3... to documents published during year X. When referred to the period 1996-2016, all published documents during this period are considered.⁽⁸⁾
- Citations per Document: Average citations per document published during the source year, -- i.e. citations in years X, X+1, X+2, X+3... to documents published during year X. When referred to the period 1996-2016, all published documents during this period are considered.
- H index: The h index is a country's number of articles (h) that have received at least h citations. It quantifies both country scientific productivity and scientific impact and it is also applicable to scientists, journals, etc.⁽⁹⁾
- Relative Specialization Index (RSI) or Relative Activity Index: this measure indicates whether a country has a relative higher or lower share in world publication in History and Philosophy of Science than its overall share in world total publication. It is calculate based on the thematic Specialization index (TSI).⁽⁷⁾
- International Collaboration: Institution's output produced in collaboration with foreign institutions. The values are computed by analyzing an institution's output whose affiliations include more than one country address.⁽¹⁰⁾
- Excellence: Excellence indicates the amount of an institution's scientific output that is included in the top 10% of the most cited papers in their respective scientific fields. It is a measure of high quality output of research institutions.⁽¹¹⁾
- Scientific leadership: Leadership indicates the amount of an institution's output as main contributor, that is, the amount of papers in which the corresponding author belongs to the institution.^(10,12)
- Excellence with Leadership: Excellence with Leadership indicates the amount of documents in Excellence in which the institution is the main contributor. ^(10,13)

RESULTS

The scientific production in History and Philosophy of Science in the Latin American countries in the period studied was of 5 844 documents and the total volume of publications in all areas was of 1 474 596, which represents 0,39 %. Figure 1 illustrates the publications by years in the aforementioned area and in the world.

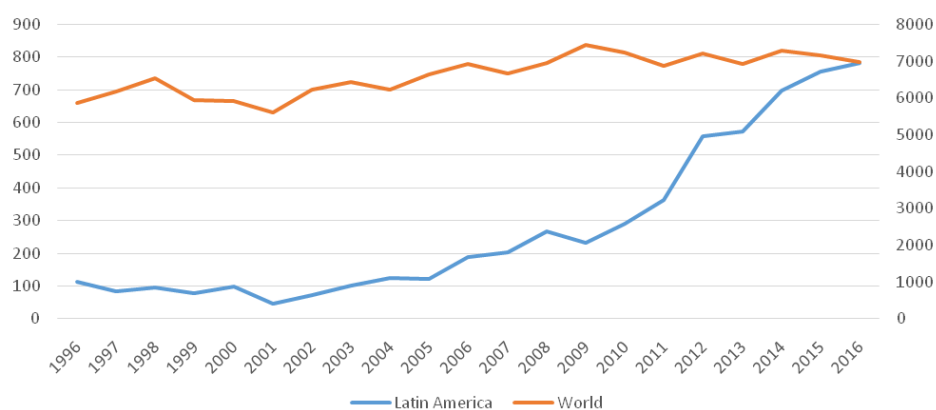


Figure 1. Scientific output by year

Table 1 shows the distribution of documents by country and Table 2 shows the main indicators of visibility and scientific collaboration.

Table 1. Distribution of scientific output by countries

| Rank | Country | Documents | Citable documents | Citations | Self-citations | Citations per document | H index | RSI | Rank RSI |
|------|---------------------|-----------|-------------------|-----------|----------------|------------------------|---------|----------|----------|
| 1 | Brazil | 1 745 | 1 576 | 57 699 | 8709 | 33,07 | 120 | - 0,1792 | 34 |
| 2 | Argentina | 687 | 640 | 25 408 | 1915 | 36,98 | 70 | 0,0800 | 22 |
| 3 | Mexico | 626 | 579 | 41 146 | 2145 | 65,73 | 86 | - 0,1593 | 33 |
| 4 | Chile | 363 | 333 | 17 253 | 1208 | 47,53 | 58 | - 0,0345 | 28 |
| 5 | Colombia | 228 | 208 | 7 918 | 405 | 34,73 | 36 | - 0,0271 | 27 |
| 6 | Venezuela | 140 | 122 | 6 680 | 331 | 47,71 | 30 | 0,0783 | 23 |
| 7 | Panama | 82 | 58 | 13 283 | 660 | 161,99 | 43 | 0,6221 | 3 |
| 8 | Peru | 73 | 64 | 6 796 | 322 | 93,1 | 27 | 0,1215 | 18 |
| 9 | Puerto Rico | 72 | 65 | 5 507 | 149 | 7649 | 30 | 0,1860 | 13 |
| 10 | Cuba | 68 | 64 | 1 655 | 122 | 24,34 | 12 | - 0,2497 | 38 |
| 11 | Costa Rica | 47 | 41 | 5 020 | 106 | 106,81 | 14 | 0,1565 | 17 |
| 12 | Ecuador | 42 | 35 | 3 699 | 111 | 88,07 | 17 | 0,0899 | 20 |
| 13 | Uruguay | 40 | 34 | 2 974 | 64 | 74,35 | 15 | - 0,1267 | 31 |
| 14 | Guadeloupe | 27 | 27 | 262 | 17 | 9,7 | 9 | 0,6808 | 1 |
| 15 | Bolivia | 24 | 22 | 2 336 | 81 | 97,33 | 13 | 0,2912 | 11 |
| 16 | Trinidad and Tobago | 14 | 13 | 319 | 22 | 22,79 | 9 | - 0,1171 | 30 |

| | | | | | | | | | |
|----|-----------------------|----|----|-------|----|--------|---|-----------------|----|
| 17 | Jamaica | 14 | 12 | 630 | 17 | 45 | 9 | - 0,13 65 | 32 |
| 18 | Nicaragua | 12 | 8 | 255 | 23 | 21,25 | 5 | 0,42 43 | 9 |
| 19 | Haiti | 11 | 11 | 802 | 10 | 72,91 | 8 | 0,57 33 | 4 |
| 20 | Barbados | 10 | 10 | 173 | 12 | 17,3 | 7 | 0,23 19 | 12 |
| 21 | Guatemala | 8 | 7 | 184 | 9 | 23 | 5 | - 0,03 82 | 29 |
| 22 | El Salvador | 6 | 5 | 29 | 6 | 4,83 | 3 | 0,45 03 | 7 |
| 23 | Bermuda | 6 | 5 | 2 980 | 50 | 496,67 | 5 | 0,15 92 | 16 |
| 24 | French Guiana | 5 | 5 | 880 | 28 | 176 | 5 | 0,16 70 | 15 |
| 25 | Dominican Republic | 5 | 4 | 97 | 9 | 19,4 | 2 | 0,08 21 | 21 |
| 26 | Grenada | 4 | 4 | 146 | 1 | 36,5 | 3 | 0,53 72 | 5 |
| 27 | Belize | 4 | 4 | 151 | 3 | 37,75 | 2 | 0,04 50 | 24 |
| 28 | Paraguay | 4 | 4 | 857 | 2 | 214,25 | 3 | 0,01 96 | 25 |
| 29 | Honduras | 4 | 4 | 873 | 3 | 218,25 | 4 | - 0,18 81 | 35 |
| 30 | Suriname | 3 | 3 | 82 | 0 | 27,33 | 3 | 0,43 29 | 8 |
| 31 | Martinique | 3 | 3 | 34 | 1 | 11,33 | 3 | 0,33 78 | 10 |
| 32 | The Bahamas | 3 | 3 | 29 | 3 | 9,67 | 3 | 0,10 60 | 19 |
| 33 | Antigua and Barbuda | 2 | 2 | 13 | 0 | 6,5 | 2 | 0,63 61 | 2 |
| 34 | Montserrat | 1 | 1 | 22 | 2 | 22 | 1 | 0,48 02 | 6 |
| 35 | Saint Kitts and Nevis | 1 | 1 | 5 | 1 | 5 | 1 | 0,17 02 | 14 |
| 36 | Guyana | 1 | 1 | 5 | 0 | 5 | 1 | - 0,01 32 | 26 |
| 37 | Dominica | 1 | 1 | 2 | 0 | 2 | 1 | - 0,19 52 | 36 |

| | | | | | | | | | |
|----|--------------------|---|---|----|---|----|---|-----------------|----|
| 38 | The Dutch Antilles | 1 | 1 | 36 | 2 | 36 | 1 | - 0,20 69 | 37 |
| 39 | Virgin Islands | 1 | 0 | 4 | 0 | 4 | 1 | - 0,31 50 | 39 |

RSI: Relative Specialisation Index (its calculation can be consulted in Escalante Collazo y col.⁽¹³⁾)

Table 2. General citation and collaboration indicators

| Indicator | Value |
|-------------------------------|---------|
| Documents | 2 596 |
| Citations | 163 794 |
| Citations by documents | 28,03 |
| % Documents cited | 58,4 |
| % International Collaboration | 34,21 |
| Normalized Citation | 0,82 |
| Excellence | 542 |
| % Excellence | 9,28 |
| Scientific leadership | 4 295 |
| % Leadership | 73,5 |
| Excellence with Leadership | 54 |
| % Excellence with Leadership | 0,92 |

DISCUSSION

Overcoming the underdevelopment of Latin America will result from the simultaneous action of different policies and strategies. In any case, and whatever the chosen paths, the access to a modern society implies necessarily a decisive action in the field of scientific-technological research.⁽¹⁵⁾

While the regional scientific output showed an annual growth, especially after 2009, this growth was less noticeable at a global level, which indicates the scientific community's interest towards this type of studies.

The number of produced documents was low, which supports Thomas' postulate, who states that, although our societies are technological and our technologies are social, paradoxically, social sciences have not studied this issue in depth. The production on the socio-technical issue, whether it be at an international, regional or national level, is relatively low and incomplete; there are not relevant either for the curricular training of scientists and scholars.

In this sense, academic production should be stimulated, based on the precept that the theory-conceptual renovation and regulations may depend, at least partially, on the possibility of political democratisation and economic and social development in the region.

More than half of the documents were cited, with a citation average of 28 cites per document. This contradicts the idea that social studies of science are barely recognised within the social sciences field: undoubtedly, their experts are seen as reliable and recognised researchers, but their works are ignored and barely cited by experts on other social science fields.⁽²⁾

Science and technique are dynamic parts of the development; they are effects but also causes; they motivate it, but also receive feedback from it. The importance of the scientific and technological activity

in the occupational flow of a state is expressed in the part of the active population represented by scientists and technologists.⁽¹⁶⁾

The dynamics of science in Latin America have been the object of several studies during the last decades. However, there are still some aspects which need to be investigated. In this particular case, the way this development is analysed is precisely one of the pillars needed to obtain experiences and feedback.

One of the countries with the greatest scientific output is Brazil, number one of the region, not only regarding productivity indicators but also concerning its scientific visibility^(17,18). It is also important to highlight that this country presents the highest number of journals about this matter in the region, which may also have an impact on the amount of publications.

The five countries with the greatest productivity are not precisely the most specialised on the issue. The reason for this might be that this group coincides with those that are traditionally the most productive ones in all the areas of the region⁽¹⁸⁾ and the amount of documents in the field, in relation to the total, is not very large. However, the fact that the relative specialisation index is below the world's average reveals low specialisation in the matter.

More than 30 % of the communications involved international collaboration. Different studies have proven that the works which involved collaboration had a greater impact, at the expense of their visibility.⁽¹⁹⁾ These indicators may have an effect on the impact and show a positive correlation between the amount of collaboration and the normalised impact.

The measurement and definition of the scientific excellence lead to different formulations and indicators according to predetermined objectives. Their evaluation may be carried out through different approaches, such as the quality of the product under investigation or the researchers' performance.

Scientific excellence is an expression which implies comparative superiority with others, in terms of quality according to the best score among a group of comparable entities.⁽²⁰⁾ This indicator represents which knowledge is the most valued and widest used to develop new knowledge by the scientific community. Low levels may have a negative effect on how the story of the scientific progress of the region is told. Bornmann and col.⁽²¹⁾ state that most of the articles which contribute to the scientific progress of a field are based on important previous articles rather than on those which did not make a big contribution.

Determining the contribution of the different actors (countries, institutions, research groups, authors) is one of the objectives of science evaluation researches. Scientific leadership allows to better recognise the most genuine scientific capacities of a country. The combination of excellence and leadership has been considered the best indicator for showing the quality of a region.⁽²⁰⁾

The region has a high scientific leadership, which represents the genuine capacities in the field, and this fact together with the presence of journals in international databases indicate that the conditions have been created in order to reach a better influence and visibility of the researches. This finding is in contrast with the fact that only 0,92 % of the excellence publications had a Latin-American author as main contributor.

The findings made support the fact that to the extent that researchers delve into deeper scientific and technological knowledge in the region and new intervention strategies are proposed, critical dimension becomes a main component, hence the importance of strengthen those scientific communication channels based on the famous quote by Kant which affirms that *"Philosophy of science without history of science is empty; history of science without philosophy of science is blind"*.

CONCLUSIONS

The analysis of the Latin-American field of History and Philosophy of Science is characterised by a sustained growth, with Brazil as its greater producer. The region has high indicators for scientific leadership and citation. They show their potential based on the recovery of the historical memory of

Latin American people in a new context related to the recognition of scientific heritage as an essential part of our people's culture, economy, politics and society; as J.D. Bernal stated: "*in science, more than in any other institution, it is essential to know the past in order to understand the present and conquer the future*".

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The authors declare that there are no competing interests

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